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INTERNATIONAL FINANCE DISCUSSION PAPERS

DEVALUATION AND THE BALANCE OF TRADE UNDER FLEXIBLE WAGES

by

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Discussion Paper No. 27, April 13, 1973

Division of International Finance

Board of Governors of the Federal Reserve System

Devaluation and the Balance of Trade
Under Flexible Wages*

The current revival of interest in devaluation among policy makers makes this an appropriate time for reconsidering our conclusions about the effects of exchange rate changes. To this end this paper presents a general macroeconomic model of the open economy and analyzes the effects of devaluation on the trade balance, output, and employment. Crucial to the analysis is the endogeneity of domestic prices, for a devaluation which leads to a rise in domestic prices is really a net devaluation of smaller magnitude. In fact, if domestic prices rise by the same percentage as the devaluation, then the relative prices of imports and exports are unchanged, leaving the trade balance unimproved.

The prevailing theory of balance of payments adjustments assumes that domestic prices do not rise on devaluation as long as the economy is less than fully employed. However, when there is full employment, lowering the exchange rate causes prices to be bid up as the increased level of aggregate demand pushes against the constant aggregate supply of output. In the context of the full employment

*This paper is based on a chapter of my doctoral dissertation [6] presented to Columbia University, for which financial support was provided by the Woodrow Wilson Fellowship Foundation. I would like to express my gratitude to R. Findlay, G. Horwich, P. Kenen, D. Mathieson, and S. Salop for comments and suggestions on earlier drafts. The views expressed in this paper do not necessarily reflect those of the Board of Governors of the Federal Reserve System.

model, Meade [4] showed that domestic prices would rise by the full percentage of the devaluation if the interest rate were pegged by the monetary authorities. Since both income and the interest rate are fixed, a change in the exchange rate can result in only a change in prices, so that devaluation is unsuccessful in improving the balance. This is easily explained in terms of Alexander's [1] theory in which a reduction in domestic absorption is a necessary condition for the balance of trade of a fully employed economy to improve on devaluation. In Meade's model, constant income implies constant consumption, and constant interest rate implies constant investment. Since it does not reduce absorption, devaluation is unsuccessful in improving the balance and instead causes prices to rise to eliminate the excess demand it initiates.

In amending Meade's and Alexander's work, Tsiang [8] showed the following. If the monetary authorities were to hold constant the nominal supply of money rather than the interest rate, devaluation, even at full employment, would improve the balance. As prices begin to rise from the initial increase in demand, the real supply of money falls, thereby raising the interest rate. This causes investment to fall from its predevaluation level, allowing the difference between the two investment levels to be directed toward the foreign sector. As exports increase and imports are displaced by domestic products, the balance improves; however, for this to occur, domestic goods must become relatively cheaper. Hence prices must rise by less than the devaluation: the reduction in absorption allows the trade balance to improve at full employment.

While this analysis recognizes that prices rise on devaluation, it assumes they rise only in response to excess demand. All feedback from the labor market onto prices is ignored by assuming that the supply of labor is perfectly elastic at the current nominal wage up to the point of full employment and perfectly inelastic thereafter. Thus the nominal wage is affected only when labor is fully employed and then the change is dictated solely by demand conditions. Consequently, these models are inappropriate for analyzing devaluations in which labor, either through unions or the classical mechanism, is successful in raising money wages and domestic prices. In order to incorporate these wage-push price increases into the analysis and more fully capture the effects of devaluation on prices, this paper replaces the Keynesian supply assumption of the Meade-Tsiang model with the classical assumption that labor supply is positively related to the real wage. Moreover, we find that the conclusions about the effects of devaluation are extremely sensitive to this assumption.

In Section I we present the model and indicate that devaluation at full employment improves the trade balance, but reduces output and employment and their full employment levels. In order to explain this result and provide a graphical framework for analyzing related questions, in Section II we solve the model for the macroeconomic equilibrium using IS-LM and aggregate supply and demand analysis. Using the same tools Section III analyzes the effects of devaluation and clarifies the role of the classical labor supply assumption in determining our conclusions. Section IV examines the Meade-Tsiang model and introduces unemployment into our classical analysis. Section V presents our conclusions.

The following symbols are used in the paper:

r = interest rate

Y = output

F = exogenous price of foreign good in foreign currency

ρ = exchange rate, expressed in units of foreign currency per unit of domestic currency

D = selling price of domestically produced good in local currency

R = terms of trade; $R = \frac{D}{F/\rho}$

Y_b = exogenous foreign income

$\bar{L}$ = exogenous nominal supply of money

P = consumers' price index

$\frac{DY}{P}$ = real income

N = employment

w = money wage

N^d = quantity of labor demanded

N^s = quantity of labor supplied

B = balance of trade: exports minus imports (in domestic output terms)

X = exports

M = imports

I. A Macro Model of an Open Economy

In this section a simple macroeconomic model[1/] of an open economy is developed to analyze the effects of devaluation on income, employment, and the balance of trade. The economy consists of markets for labor services, money, and goods, which simultaneously interact in the determination of the aggregate level of income and the price level. Starting from a point of macroeconomic equilibrium in which it is assumed that the balance of trade is zero, the exchange rate is lowered and the effect of this change on the markets is analyzed.

We consider the economy at a moment of time and treat wealth and the capital stock as exogenous. Although saving and investment are occurring, these are flows which do not affect the current stocks of wealth and physical capital. For the same reason, we ignore the effect of trade surpluses and deficits on the stock of money. Since we assume there are no capital flows, a trade surplus (deficit) is reflected in an increase (decrease) in the domestic money supply. However, these changes are flows, and while they affect the future level, do not affect the current money stock which is also treated as exogenous.

It is assumed that one good is produced at home with one variable factor, labor, and that this good is both consumed domestically and exported. It is produced according to perfectly

1/ This is an extension of the conventional aggregate demand and supply analysis. For an exposition of the closed economy case see Tobin [5].

competitive conditions and its price is set to equate demand and supply. The home country is not "small" -- that is, there exists a demand curve for this good which is less than perfectly elastic. Producers determine the quantity of labor they wish to hire according to the price of the good and the nominal wage. And, in contrast to Meade and Tsiang who assume that the supply of labor is invariant to the price of consumer goods, we assume that laborers determine the quantity of labor they wish to sell according to the prices of the domestic good and the imported consumer good and the nominal wage. That labor supply is a function of three prices, while labor demand is a function of two, provides the basic asymmetry in the labor market which this paper exploits.

Unless Pigou effects are considered, the closed-economy IS schedule describes a relation between real variables and is invariant to the price level. However, in the open economy the IS relation includes the demand for imports and exports, which depend on the relative price of domestic and foreign goods. Holding foreign prices constant, changes in domestic prices affect the demand for imports and exports and thereby the IS relation. In its simplest form the IS equation of the open economy is:

$$I(r) - S\left(\frac{DY}{P}\right) = \frac{1}{R} M\left(R, \frac{DY}{P}\right) - X(R, Y_b) \tag{1}$$

such that $I_r < 0$, $S_y > 0$, $X_R < 0$, $M_R > 0$, $M_y > 0$[1/]. The explanation for this equation follows. Investment (I) is a function of the

1/ The subscript y denotes the derivative with respect to $\frac{DY}{P}$.

interest rate. Real saving (S) is a function of real income, where real income to consumers is the total value of output divided by the consumers' price index $\left(\frac{DY}{P}\right)$. Demand for imports is a function of the terms of trade $\left(R = \frac{D}{F/\rho}\right)$, which denote the price of domestic output relative to the price of the import, and of real income. To keep imports in the same units as the other components of IS, multiply the quantity of imports (M) by F/ρ, which gives the domestic value of imports, and then divide by D to bring it into real terms, or simply divide by R. Real exports (X) are a function of the terms of trade (R) and foreign income (Y_b). Both foreign income (Y_b) and foreign prices (F) are held constant throughout the analysis.

The LM relation equates the supply and demand for real balances:

$$\frac{\bar{L}}{P} = L\left(r, \frac{DY}{P}\right) \qquad \text{such that} \qquad L_r < 0, \qquad L_y > 0. \tag{2}$$

$\bar{L}$ is the exogenous nominal money supply; thus, deflating by P, we have the real stock of money $\frac{\bar{L}}{P}$. Demand for real balances is a function of the interest rate, representing the opportunity cost of holding money, and of real income, which determines the transactions demand for money. Payments imbalances, which affect the flow supply of money and next period's money stock, are omitted from equation (2), which is a relation between current stock demands and supplies.

Income earners consume two goods -- a domestic good priced at D at home or $D\rho$ abroad, and an import which sells for F/ρ in domestic markets. P, the consumers' price index, is a composite of these two prices, and it is related to D, the producers' price index, in the following way:

$$P = f(D, F/\rho) \qquad \text{where } f_1 > 0, \quad f_2 > 0^{1/}. \tag{3}$$

It is assumed that P is homogeneous of degree one in D and F/ρ; thus a doubling of both D and F/ρ leads to a doubling of P.[2/]

On the supply side it is assumed that there is an aggregate production function. Output (Y) is a function of employment (N) and the supply of capital ($\bar{K}$), which is fixed in the current period.

$$Y = \phi(N,\bar{K}) \qquad \phi_N > 0 \tag{4}$$

Demand for labor is derived from the aggregate production function, as producers set marginal revenue product equal to the money wage.

$$D\cdot\phi_N = w \tag{4a}$$

In inverse form, demand for labor (N^d) is a function of the money wage (w) divided by the producers' price index (D):

1/ As D rises, the bundle of goods originally desired can no longer be purchased because one of the prices is now higher; since the original assortment was purchased when the new mix was also feasible, the first bundle must have been preferred. Thus an increase in D with other prices held constant constitutes a lower utility level. Since a price index is an abstraction whose function is to capture changes in utility wrought by changes in the price components, a good price index increases when one of its components rises, reflecting the decline in utility, and it decreases when a price falls, reflecting the increase in potential utility. Thus we assume $f_1 > 0$, and $f_2 > 0$.

2/ One specific formulation of the index is $P = aD + (1-a)F/\rho$, where a is the proportion of expenditure directed toward the domestic good and is a function of the terms of trade, i.e., $a = a(R)$.

$$N^d = \psi\left(\frac{W}{D}\right) \qquad \psi' < 0 \tag{5}$$

The supply of labor is a function of the real wage, where the relevant price index to labor is the consumers' price index of all goods, P. Hence,

$$N^s = N\left(\frac{W}{P}\right) \qquad N' \geq 0 \, . \tag{6}$$

And in equilibrium the demand for labor equals the supply of labor.[1/]

$$N^s = N^d \equiv N \tag{7}$$

In summary, the IS relation of equation (1) assures that the supply of goods equals the demand for goods. Equation (2), the LM relation, indicates that the supply and demand for the stock of real balances are equal. Equation (7) equates the demand for and supply of labor services. Finally, since this is a system with fixed exchange rates, exports need not equal imports, and the trade balance (B) is defined in local output terms as

$$B = X(R, Y_b) - \frac{1}{R} M\left(R, \frac{DY}{P}\right). \tag{8}$$

For given values of the rate of exchange ρ, the nominal money supply $\overline{L}$, and foreign income Y_b and prices F, this economy is described by the preceding system of eight equations. The system can

1/ That is, a perfectly flexible nominal wage ensures that equation (7) holds and that there is no unemployment. In Section IV we relax the assumption of perfect wage flexibility and analyze devaluation from a point of less than full employment.

be solved for the eight endogenous variables $\{Y, r, D, P, N^s, N^d, w, B\}$ a solution exists. We may ask what the effect of a devaluation is on this solution. Totally differentiating the system, we find that $\frac{dB}{d\rho} \leq 0$.[1/] When the nominal money supply, foreign income, and foreign prices are held constant, devaluation improves the trade balance, even when domestic price increases are included. Using the same technique we find that $\frac{dY}{d\rho} \geq 0$;[2/] that is, contrary to the conclusions of the Meade-Tsiang model, devaluation leads to a fall in output and employment. In the following sections we explore the reasoning behind this result.

II. The Component Markets

In order to elucidate the structure of the model and indicate the interdependence of the individual markets, we first consider the markets separately and then solve the system using aggregate supply and demand analysis. For given levels of the rate of exchange, nominal money supply, and foreign prices (ρ, $\bar{L}$, and F),

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1/ $$\frac{dB}{d\rho} = \left\{ \left(L_r S_y + I_r L_y \right) \frac{MF}{\rho^2} \left(\frac{-X_R R^2}{M} + \frac{M_R R}{M} - 1 \right) + \frac{I_r M_y f_2 LDF}{RP\ \rho^2} \left(1 - \frac{L_y}{L} \frac{DY}{P} + \frac{1}{LP} \right) \right\} \Big/ \frac{\phi_N N' \psi' f_2 w}{DP^2} \left(L_y I_r + I_r S_y + \frac{L_r M_y}{R} \right) \leq 0.$$

2/ $$\frac{dY}{d\rho} = \left\{ I_r f_2 \frac{FL}{\rho^2} \left(\frac{L_y}{L} \frac{DY}{P} - 1 \right) - \frac{L_r PMF}{D\rho^2} \left(\frac{-X_R R^2}{M} + \frac{M_R R}{M} - 1 \right) + \frac{L_y f_2 FDY}{\rho^2 P} \left(S_y + \frac{M_y}{R} \right) \right\} \Big/ \frac{\phi_N N' \psi' f_2 w}{DP^2} \left(L_y I_r + I_r S_y + \frac{L_r M_y}{R} \right) \geq 0.$$

the aggregate demand curve indicates the locus of points $\{Y, D\}$ which clear the goods (IS) and the money (LM) markets, while the aggregate supply curve indicates the locus of points $\{Y, D\}$ which clear the labor market. These two relationships may be combined to determine the single point $\{Y^*, D^*\}$ which clears all the markets; this is the macroeconomic equilibrium. One demand curve and one supply curve can be constructed for each value of ρ; by varying ρ and examining the change in the equilibrium $\{Y^*, D^*\}$, the effect of devaluation on the equilibrium values of income, prices, the terms of trade, and the balance of trade may be determined.

II. A. <u>Derivation of the Aggregate Demand Curve (ADC)</u>

Holding F/ρ constant in equation (1), there exists one IS curve for each value of D. An increase in D shifts the IS curve down and to the left if the General Elasticity Condition (GEC) is satisfied; that is, if

$$\frac{-X_R R^2}{M} + \frac{M_R R}{M} - 1 > 0. \tag{9}$$

The GEC is a generalization of the Marshall-Lerner Condition (MLC);1/ satisfying it assures that the balance (measured in domestic currency) deteriorates as the terms of trade rise.2/ As D rises, demand for

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1/ The MLC says the following: $\frac{-X_R R}{X} + \frac{M_R R}{M} - 1 > 0$. When B = 0, $X = \frac{M}{R}$ and the GEC is equivalent to the MLC.

2/ The GEC is a sufficient condition for $\frac{\partial B}{\partial R} < 0$: $\frac{\partial B}{\partial R} = \frac{-M}{R^2}\left(\frac{-X_R R^2}{M} + \frac{M_R R}{M} - 1\right) \frac{-2M_y F/\rho^2 f_2}{RP^2\ \rho^2}$, where $f_2 > 0$ from eq. (3). The second term represents the Laursen-Metzler [3] effect which suggests that an increase in the terms of trade raises real income and worsens the trade balance.

imports rises, while demand for domestic products, both for export and domestic consumption, falls as consumers substitute foreign goods for the now more expensive domestic goods. Algebraically, the shift in the IS curve may be calculated by totally differentiating equation (1). Holding the interest rate constant we have

$$\left.\frac{dY}{dD}\right|_{IS,r=\bar{r}} = \frac{-\frac{PM}{RD}\left(\frac{-X_R R^2}{M} + \frac{M_R R}{M} - 1\right) + \left(S_y Y + \frac{M_y Y}{R}\right)\left(f_1 \frac{D}{P} - 1\right)}{\left(S_y + \frac{1}{R} M_y\right)} < 0 \qquad (10)$$

$\frac{dY}{dD}$ is negative as long as the GEC holds and $f_1 \frac{D}{P}$ is less than one. We assume the former and verify the latter by using the homogeneity property. Since a 1% rise in D and F/ρ results in a 1% rise in P, we can write the following from equation (3).

$$f_1 \frac{D}{P} + f_2 \frac{F/\rho}{P} = 1 \qquad (11)$$

It is clear that $f_1 \frac{D}{P}$ is less than one since f_2 is positive. The effect on the IS curve of a rise in D is depicted in Figure 1.

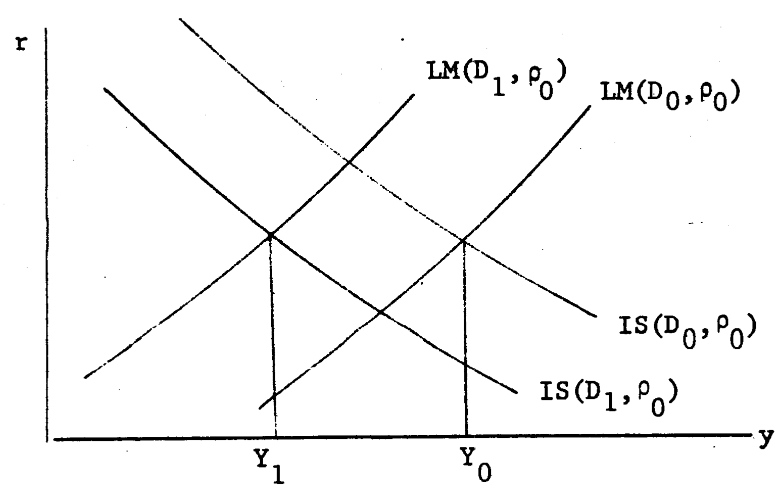

Figure 1 $\qquad D_1 > D_0$

In the same manner, holding F/ρ and $\bar{L}$ constant, one LM curve can be drawn for each value of D. A rise in D reduces the real money supply and shifts the LM curve up and to the left, as shown in Figure 1. Algebraically the shift in LM is described by differentiating equation (2) totally; holding the interest rate constant we have

$$\left.\frac{dY}{dD}\right|_{LM, r=\bar{r}} = \frac{-Lf_1 - L_y Y \left(1 - f_1 \frac{D}{P}\right)}{L_y D} < 0 . \tag{12}$$

The aggregate demand curve (ADC) can be derived graphically from Figure 1. We have two points on the ADC $\{Y_0, D_0\}$ and $\{Y_1, D_1\}$; the remaining points are determined similarly by varying D and finding the value of Y consistent with both the IS and LM relations. The ADC is shown in Figure 2. It is downward sloping because a rise in D both reduces the real money supply, which raises the interest rate reducing investment, and makes foreign goods relatively cheaper, reducing demand for domestic output. Algebraically it is derived by solving equations (1)-(3); totally differentiating this system we have

$$\left.\frac{dY}{dD}\right|_{ADC, \rho=\bar{\rho}} = \left\{ L_r \frac{MP}{DR} \left(\frac{-X_R R^2}{M} + \frac{M_R R}{M} - 1 \right) + I_r f_1 L \right.$$

$$\left. + f_2 \frac{F/\rho}{P} \left(L_r S_y Y + I_r L_y Y + \frac{L_r M_y Y}{R} \right) \right\} \Big/$$

$$\left(-I_r L_y D - S_y L_r D - L_r M_y \frac{D}{R} \right) \tag{13}$$

$\frac{dY}{dD} < 0$ because $I_r < 0$, $L_r < 0$, $L_y > 0$, $S_y > 0$, $M_y > 0$, $f_1 > 0$, $f_2 > 0$, and $\frac{-X_R R^2}{M} + \frac{M_R R}{M} - 1 > 0$.

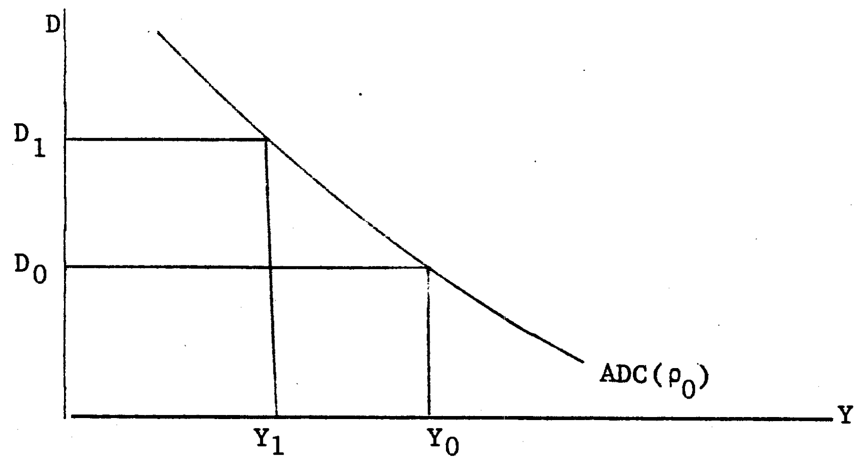

Figure 2

II. B. Derivation of the Aggregate Supply Curve (ASC)

In a similar manner we derive the ASC from equations (4)-(7). Starting from a point of equilibrium in the labor market and holding the exchange rate fixed, consider a 1% rise in D from D_0 to D_1. In order to maintain equilibrium in the labor market, w/D must fall and w/P rise, with employment rising. This can be verified by studying Figure 3. If P also were to rise by 1%, then a 1% rise in w, the nominal wage, would leave w/D, w/P, and employment unchanged. However, as shown in equation (11), a 1% rise in D leads to a less than 1% rise in P, given that F/ρ is constant. Thus there would be excess supply of labor if w were to rise by 1%, since the demand for labor is homogeneous of degree zero in w and D, while the supply of labor is homogeneous of degree zero in w and P.

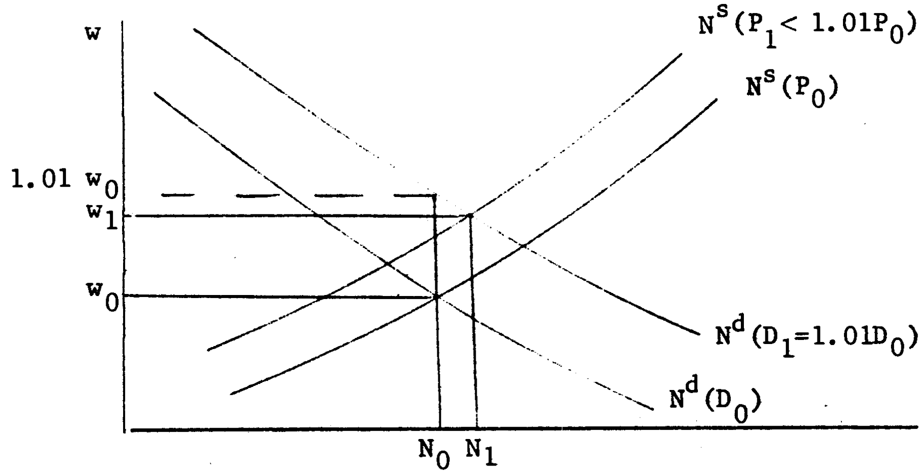

Figure 3

Some increase in w smaller than 1% again equates supply and demand for labor. But since w/D is lower than originally, employment is higher. Therefore, w must have increased by a percentage greater than the increase in P, raising w/P, in order to increase the quantity of labor supplied. Employment is now $N_1 > N_0$ corresponding to $D_1 > D_0$, and the aggregate production function eq. (4) converts this into a positive supply relationship between D and Y as illustrated in Figure 4. It should be emphasized that

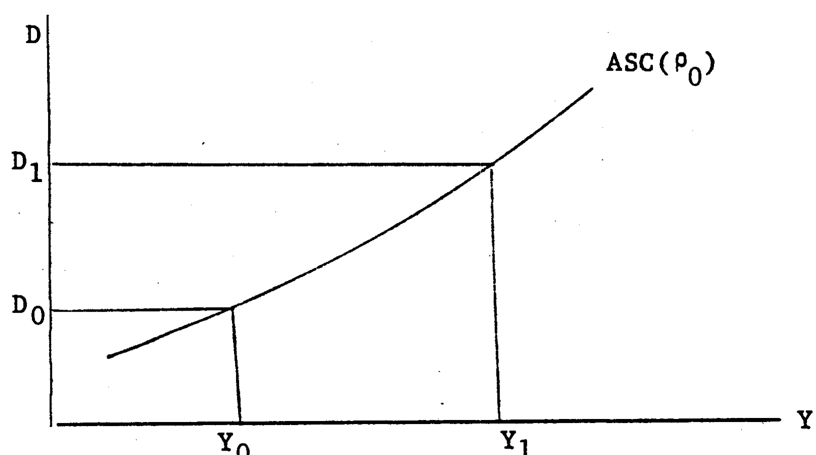

Figure 4

every point on the ASC is a point of labor market equilibrium, denoting full employment. Algebraically, differentiating equations (4)-(7) totally we have the slope of the ASC,

$$\left.\frac{dY}{dD}\right|_{ASC,\,\rho=\bar{\rho}} = \frac{\phi_N \psi' N' w \left(f_2 F/\rho\right)}{D^2 P^2 \left(\frac{N'}{P} - \frac{\psi'}{D}\right)} \tag{14}$$

$\frac{dY}{dD} > 0$ because $\phi_N > 0$, $\psi' < 0$, $N' > 0$, $f_2 > 0$.

Combining the ADC and the ASC in Figure 5, we find the equilibrium pair $\{Y^*, D^*\}$ which is determined for the given value of F/ρ. Hence the terms of trade $R^* = D^*/(F/\rho)$ are known, which along with Y^*, determine the level of the balance of trade B^*, according to equation (8).

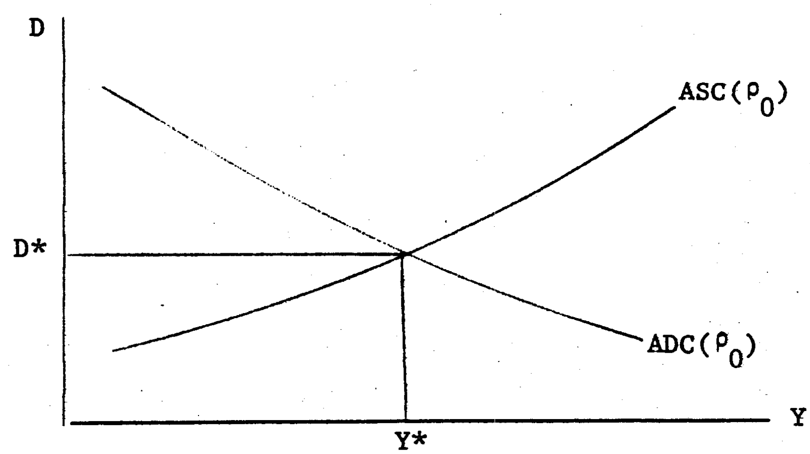

Figure 5

III. A. Devaluation

In the first instance devaluation results in a rise in the domestic price of foreign goods, which disturbs the equilibrium in each of the three markets. In the goods market devaluation raises the demand for domestic production at every price, and is equivalent to an exogenous increase in the demand for exports and a decrease in the demand for imports. Another effect of the increase in the price of imports is to increase the consumers' price index (CPI). This reduces the real wage of labor and leads to a reduction in the quantity of labor supplied at each nominal wage. In addition, the increase in the CPI, given a constant nominal money supply, reduces the supply of real balances. Whether devaluation leads to a rise or fall in the equilibrium level of real income and employment depends on the relative strength of the expansionary impact of devaluation on the market for domestic production compared to the contractionary impact on the money and labor markets.

We may now examine the effect on the equilibrium system of a change in the exchange rate. As before, the markets are treated separately in partial equilibrium and then combined to see the effects on the general equilibrium. Turning first to the labor market, we determine the effects on the aggregate supply curve of a decrease in the exchange rate.

III. B. The Effects of Devaluation on the ASC

Since demand for labor depends only on w/D, it is initially unaffected by the devaluation. On the other hand, since supply of labor depends on w/P, it is immediately decreased by the increase in the price of imports; for every nominal wage, the supply of labor declines with the fall in ρ . This is pictured in Figure 6.

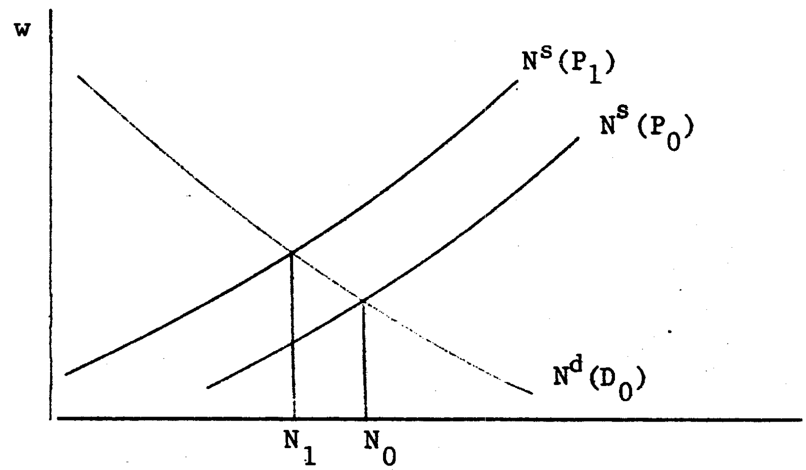

Figure 6 $\rho_0 > \rho_1$

The leftward shift in the labor supply curve causes the ASC to shift up and to the left, as depicted in Figure 7. This shift can be seen algebraically in equation (15). Totally differentiating equations

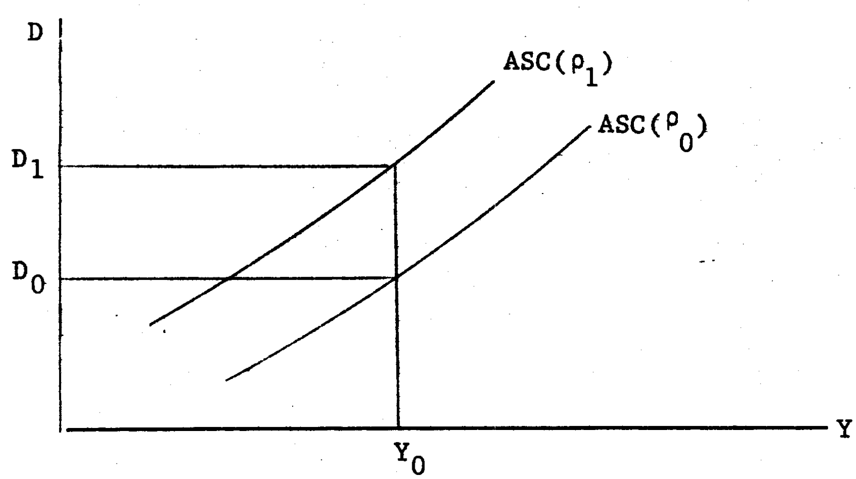

Figure 7 $\rho_0 > \rho_1$

(4)-(7), and holding D constant we have

$$\left.\frac{dY}{d\rho}\right|_{D=\bar{D}} = \frac{-\phi_N \psi' N' wF\left(f_2\right)}{\rho^2 DP^2\left(\frac{N'}{P} - \frac{\psi'}{D}\right)} > 0 \; . \tag{15}$$

We may ascertain exactly how much the ASC shifts by calculating the percentage rise in D that is needed to keep employment (and the supply of output) constant when ρ is cut by 1%. Denoting this relationship, or elasticity, by E we have

$$E \equiv -\left.\frac{\rho}{D}\frac{dD}{d\rho}\right|_{Y=\bar{Y}} \tag{16}$$

In terms of Figure 7, Ê states the percentage that D must rise when ρ is cut by 1% (from ρ_0 to ρ_1) if Y is to remain at Y_0. Calculating the value of E from the aggregate supply equations (4)-(7), it is easy to verify that E = 1.[1/] That is, a 1% devaluation entails a 1% rise in producers' prices and a 1% rise in the general price level in order to keep real output supplied constant. Intuitively, this results from the basic asymmetry in the labor market mentioned previously. In order for output to remain constant after devaluation,

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1/

$$\frac{dD}{d\rho} = -\frac{dY/d\rho}{dY/dD} = \frac{\dfrac{\phi_N \psi' N' wFf_2}{\rho^2 DP^2\left(\frac{N'}{P} - \frac{\psi'}{D}\right)}}{\dfrac{\phi_N \psi' N' wFf_2}{\rho D^2 P^2\left(\frac{N'}{P} - \frac{\psi'}{D}\right)}} = -\frac{D}{\rho}$$

or

$$E \equiv -\frac{dD}{d\rho}\frac{\rho}{D} = 1$$

employment must remain constant; this requires that w/D, the real cost of labor to producers, and w/P, the real wage to labor, must both be unchanged. When ρ falls by 1%, raising F/ρ by 1%, w, D, and P must each rise by 1% in order to leave both w/D and w/P unchanged. Therefore, for a given level of output, a 1% devaluation necessitates a 1% rise in domestic producers' prices and the general price level.

If output remains constant on devaluation, the rise in domestic prices negates the effect of the fall in ρ because macro-equilibrium requires the economy to be on its aggregate supply curve. This leaves the terms of trade, $R = \frac{D}{F/\rho}$, unchanged. That this eradicates any improvement in the trade balance which devaluation may have initiated can be substantiated by examining equation (8):

$$B = X(R,\ Y_b) - \frac{1}{R}M(R,\ \frac{DY}{P}) \tag{8}$$

Since both D and P rise by equal percentages and Y and R are unchanged, B, the real trade balance, is also unchanged. Moreover, if output rises from devaluation, the balance deteriorates. Along any ASC, D and Y rise together; likewise for R and Y and $\frac{D}{P}$ and Y. Furthermore, the balance of trade moves inversely with each of these variables *ceteris paribus*; and when all three rise simultaneously, as they are constrained to do by the aggregate supply relation, the trade balance deteriorates *a fortiori*. This analysis leads us to the following proposition:

Proposition 1: *For devaluation to improve the balance of trade, real income and output must fall.*

Moreover, if output does fall, the balance improves. Totally differentiating equation (8) with respect to R we have

$$\frac{dB}{dR} = \frac{\partial B}{\partial R} + \frac{\partial B}{\partial\left(\frac{DY}{P}\right)} \left[\frac{D}{P}\frac{dY}{dR} + \frac{F^2 Yf_2}{\rho^2 P^2} \right] < 0 \; . \tag{17}$$

This is negative for the following reasons. As demonstrated in eq. (9) the GEC is sufficient for $\frac{\partial B}{\partial R} < 0$, and we assume that imports rise with real income; thus $\frac{\partial B}{\partial\left(\frac{DY}{P}\right)} < 0$. That $\frac{dY}{dR} > 0$ depends on the positive slope of the ASC and the fact that $E = 1$. Finally $f_2 > 0$ by assumption. Because of the unique supply relation between the terms of trade and output, if devaluation leads to a fall in output then it also reduces the terms of trade, and improves the trade balance. Thus we have:

Proposition 2: <u>If the GEC holds and devaluation results in a decline in real income and output, then the balance of trade improves</u>.

Thus in conjunction with the GEC, a decline in output is a necessary and sufficient condition for devaluation to improve the trade balance. Moreover, in order to ascertain what actually happens to output and the trade balance, we must determine how devaluation affects the ADC.

III. B. The Effects of Devaluation on the ADC

The IS curve shifts up and to the right on devaluation if the GEC holds, since demand for exports increases and domestic goods replace some import demand at constant domestic prices. Algebraically, totally differentiating equation (1), we have

$$\left.\frac{dY}{d\rho}\right|_{IS,\ \substack{r=\bar{r} \\ D=\bar{D}}} = \frac{f_2 \frac{D}{P^2} Y \left(S_y + \frac{M_y}{R} \right) + \frac{FM}{D\rho^2} \left(\frac{-X_R R^2}{M} + \frac{M_R R}{M} - 1 \right)}{-\frac{D}{P} \left(S_y + \frac{M_y}{R} \right)} < 0 \quad (18)$$

The LM curve shifts up and to the left at constant domestic prices, since the stock of real money falls with the decrease in ρ. Differentiating equation (2) totally we have

$$\left.\frac{dY}{d\rho}\right|_{LM,\ \substack{r=\bar{r} \\ D=\bar{D}}} = Lf_2 \frac{\left(1 - \frac{L_y}{L} \frac{DY}{P} \right)}{DL_y} > 0 \quad (19)$$

which is positive assuming the income elasticity of the demand for money is less than one.

The ADC shifts to the left or right depending on whether the expansionary IS effect or the contractionary LM effect dominates. The former case is illustrated in Figure 8. Looking at it algebraically,

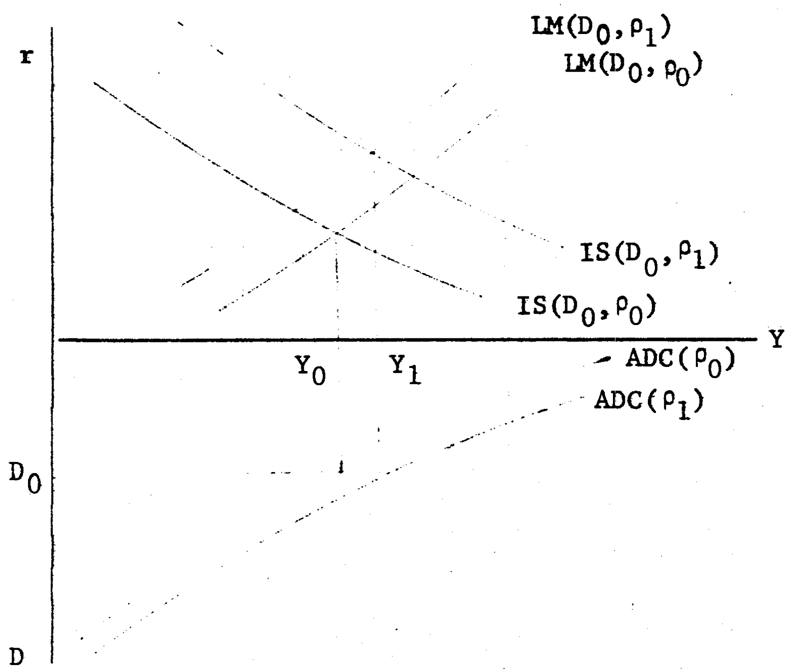

Figure 8 $\rho_0 > \rho_1$

the two forces which determine the direction of the shift in the ADC are apparent in equation (20).

$$\left.\frac{dY}{d\rho}\right|_{\substack{ADC,\\ D=\bar{D}}} = \frac{+LI_r f_2\left[1 - \frac{L_y}{L}\frac{DY}{P}\right] - L_r P\left[S_y \frac{DY}{P2} f_2 + M_y \frac{DY}{RP^2} f_2 + \frac{FM}{D\rho^2}\left(\frac{-X_R R^2}{M} + \frac{M_R R}{M} - 1\right)\right]}{DL_r \frac{M}{R}y + DL_r S_y + DL_y I_r} \tag{20}$$

$\frac{dY}{d\rho}$ is negative if the IS effect, given by the second term in the numerator, dominates; but positive if the LM effect, given by the first term in the numerator, dominates.

III. C. The Effects of Devaluation on the Complete System

If the ADC shifts to the left, then output falls, as is obvious from inspection of Figure 9. Furthermore, the trade balance improves in accordance with Proposition 2.

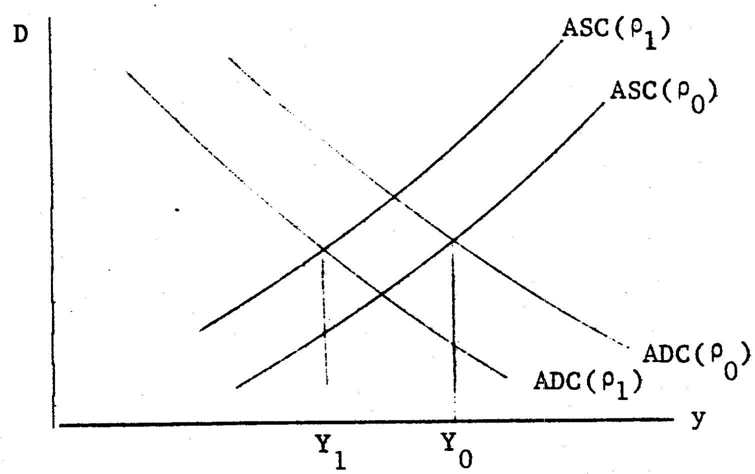

Figure 9 $\rho_0 > \rho_1$

Moreover, even if the ADC shifts to the right, output falls and the balance improves, if the monetary authorities hold the nominal money supply constant. We demonstrate this by examing equations (1) and (2) subject to the aggregate supply relation, and showing that they are consistent with a reduced exchange rate only if output is simultaneously reduced. This is illustrated in Figure 10.

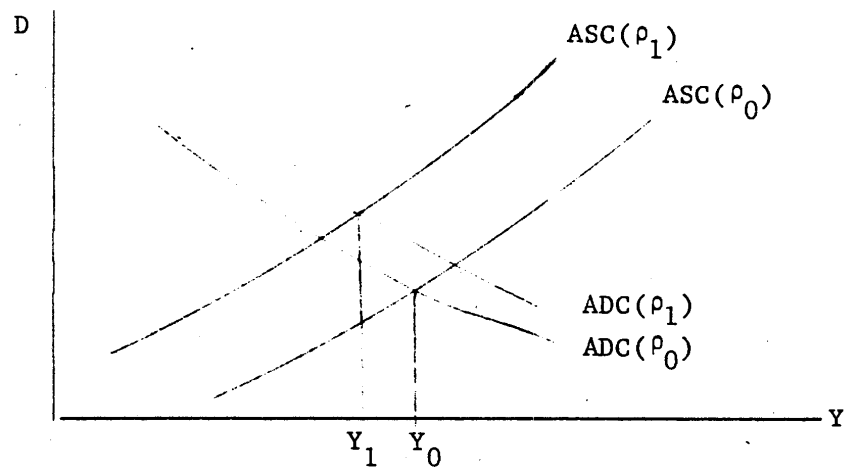

Figure 10 $\rho_0 > \rho_1$

Rewriting equations (1) and (2) we have

$$I(r) - S\left(\frac{DY}{P}\right) = \frac{1}{R}M\left(R, \frac{DY}{P}\right) - X(R, Y_b) \tag{1}$$

$$\frac{\bar{L}}{P} = L\left(r, \frac{DY}{P}\right) \tag{2}$$

Furthermore, Y and R are uniquely related by the aggregate supply relation, which we can collapse into the following single equation.

$$R = g(Y) \qquad \text{where} \qquad g' > 0 \tag{21}$$

In addition since P is homogeneous of degree 1 in D and F/ρ we can write $\frac{D}{P}$ as a function of R alone. Thus

$$\frac{D}{P} = h(R) \tag{22}$$

where

$$h' = \frac{2F^2 f_2}{P^2 \rho^2} > 0. \tag{23}$$

If output remains constant when the exchange rate is reduced, R and $\frac{D}{P}$ remain constant from eqs. (21) and (22), keeping saving, imports, and exports constant. Thus investment and its determinant the interest rate must also be constant to maintain equation (1). However, the interest rate rises according to equation (2), in order to reduce the demand for real balances concomitantly with supply which falls as P rises with D and F/ρ. This inconsistency with respect to the interest rate implies that output can not stay constant when the nominal stock of money is fixed on devaluation. Neither can output rise under these conditions, since in this case, equation (1) requires a decrease and equation (2) an increase in the interest rate. Only if output falls can equations (1) and (2) be simultaneously satisfied. Therefore we have

Proposition 3: When the nominal money supply is fixed, devaluation results in a fall in output and an improvement in the balance, assuming the GEC holds.

If, instead, the monetary authorities follow a policy of holding the interest rate constant, equations (1) and (2) can be and are satisfied with constant output. Real balances $\left(\frac{\bar{L}}{P}\right)$ are constant and prices rise by the full amount of the devaluation. This leaves the terms of trade unchanged and the balance unimproved.

III. D. Wealth Effects

Proposition 1 does not hold if consumption demand varies directly with wealth. Letting W denote wealth, which equals the sum of the real value of money $\left(\frac{\bar{L}}{P}\right)$ plus the real value of bonds $\left(\frac{\bar{Z}}{P}\right)$ plus other forms of wealth (V), we have

$$W = \frac{\bar{L}}{P} + \frac{\bar{Z}}{P} + V. \tag{24}$$

Rewriting IS to indicate that consumption and import demand rise with wealth, we have

$$I(r) - S\left(\frac{DY}{P}, W\right) = \frac{1}{R} M\left(R, \frac{DY}{P}, W\right) - X\left(R, Y_b\right) \tag{25}$$

where $S_w < 0$ and $M_w > 0$. Devaluation lowers wealth by reducing the real value of outside monetary assets, $\frac{\bar{L}}{P}$ and $\frac{\bar{Z}}{P}$, inducing wealth-holders to save more to restore their wealth to its previous level. Thus in contrast to Proposition 1, a devaluation accompanied by policies which leave the terms of trade and output unchanged, improves the trade balance, since the concomitant fall in wealth induces a fall in consumption. This decrease in absorption releases resources

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1/ See Metzler [6] for a statement of the saving-wealth relation and, in particular, for the first post-Keynesian theoretical treatment of the role of nonmonetary, as well as, monetary assets.

which can be directed to production in the foreign sector, improving the trade balance.

When wealth effects are ignored, the balance of trade is homogeneous of degree zero in D and F/ρ because of the unique supply relation between R and Y. Inclusion of wealth effects eliminates this homogeneity and makes the trade balance dependent on the actual price level. Since wealth is an argument in the demand for imports and $\frac{\partial W}{\partial \rho} < 0$, the balance of trade improves on devaluation even if all prices change by the same percentage and output remains constant.

IV. A. The Meade-Tsiang Model

In Section III we demonstrated that a successful devaluation causes a fall in employment and output. This contradicts the conclusion of Meade [4] and Tsiang [8] that devaluation improves the trade balance and increases employment. However, this discrepancy arises from the differences in the labor market postulated by these models. In our model we make the classical assumptions that the supply of labor varies directly with the real wage and that a flexible nominal wage rate clears the labor market. Thus our conclusions apply only to devaluation at full employment, for which the accompanying reduction in output is also a reduction in its full employment level. On the other hand, the Meade-Tsiang model makes the Keynesian assumptions that labor is supplied inelastically and that wages exhibit downward rigidity. Thus the labor market does not necessarily clear, and unemployment may result.

The differences between the two models are clearly seen algebraically. In the Meade-Tsiang Model equations (26) and (27) replace our equations (6) and (7). They have the supply of labor inelastic, such that

$$N^s \equiv N_{FE} \quad \text{for all } w \tag{26}$$

where N_{FE} devotes the fixed and exogenous level of full employment. While wage rigidity implies that

$$\begin{aligned} N &= N^d \leq N^s \quad \text{for } w = \bar{w} \\ N &= N^d = N^s \quad \text{for } w > \bar{w} \end{aligned} \tag{27}$$

where $\bar{w}$ is the initial (inflexible downward) wage rate. Since prices do not affect the labor supply decision in this framework, devaluation does not directly affect either the supply of or the demand for labor; hence the ASC does not shift. However, the ADC shifts to the right on devaluation because Meade holds the interest rate constant and Tsiang has money demand depending on D rather than P.1/

As a result, if output and employment are initially below their full employment levels, output and employment rise on devaluation. This is illustrated in Figure 11. Moreover, in contrast to the classical model's Proposition 1, if devaluation is accompanied by

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1/ Tsiang has $\frac{\bar{L}}{D} = L(r,Y)$.
Differentiating, we have $\left.\frac{dY}{d\rho}\right|_{LM,\ r=\bar{r},\ D=\bar{D}} = 0$.

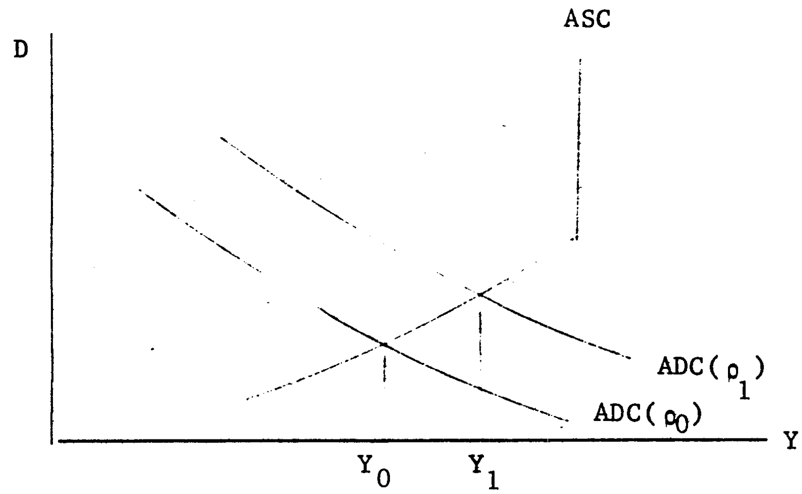

Figure 11 $\rho_1 < \rho_0$

aggregate demand policies which keep output constant, the terms of trade $\left(R = \frac{D}{F/\rho} \right)$ fall and the trade balance improves.

On the other hand, if output is initially at the full employment level, then devaluation results solely in an increase in prices, as illustrated in Figure 12. If the monetary authority holds the nominal money supply constant (Tsiang's Orthodox Neutral Monetary Policy), the price rise is insufficient to eradicate the competitive edge devaluation gains for domestic products, and the

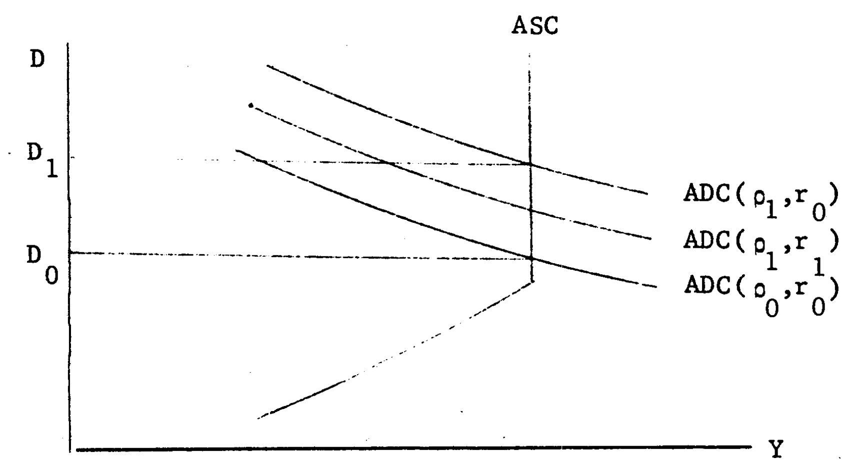

Figure 12 $\rho_1 < \rho_0, r_1 > r_0, \frac{D_1}{F/\rho_1} = \frac{D_0}{F/\rho_0}$

trade balance improves. The mechanism is as follows. The devaluation raises prices, thereby reducing the real money supply and increasing the rate of interest. This, in turn, reduces investment and allows the trade balance to improve. We also note that if the monetary authority follows Meade's constant rate of interest policy, rather than a constant nominal money supply policy, investment is not reduced and the resulting domestic price rise completely eliminates the increase in demand initiated by the devaluation. In other words, unless domestic absorption is reduced, the price rise continues until the initial terms of trade are restored. These cases are illustrated in Figure 12. The lowest ADC labeled (ρ_0, r_0) is the pre-devaluation schedule, the middle ADC labeled (ρ_1, r_1) corresponds to the constant nominal money supply policy, and the upper ADC labeled (ρ_1, r_0) represents the constant interest rate policy.

IV. B. <u>Devaluation and Unemployment</u>

In the preceeding Meade-Tsiang model the concept of full employment is obviously different from the classical notion embodied in this paper. In their model, the level of full employment is exogenous, and there is unemployment if the demand for labor falls short of this level at the minimum nominal wage $\bar{w}$. Given this initial situation devaluation increases employment (and reduces unemployment) by generating an increase in aggregate demand, making it profitable for producers to hire more workers at the fixed money wage. In our model the full employment level varies directly with the real wage. Independently of its effect on domestic demand, devaluation alters the real wage and hence the level of full employment. However, there can be no unemployment in our model since a perfectly flexible nominal wage rate ensures that both labor demand and supply are always satisfied. Thus our analysis and conclusions are relevant only to devaluations undertaken by fully employed economies. Nevertheless, by replacing the assumption of perfect wage flexibility with the Meade-Tsiang assumption that money wages are rigid downward, we can introduce unemployment into our framework and achieve a synthesis of the two models. Such a synthesis gives devaluation a direct impact on the labor market even while allowing unemployment to exist.

Therefore, rather than having the inelastic labor supply function of the Meade-Tsiang model, we have the following restatement of eq. (6), the classical labor supply function:

$$N^s = N(w/P) \qquad N' \geq 0 \tag{28}$$

Hence full employment varies directly with the real wage. Moreover, instead of assuming that the labor market always clears, we assume downward wage rigidity. Rewriting eq. (27) we have

$$\begin{aligned} N &= N^d \leq N^s && \text{for } w = \bar{w} \\ N &= N^d = N^s && \text{for } w > \bar{w} \end{aligned} \tag{29}$$

As usual, if the rigid wage constraint is binding at $\bar{w}$, then at wage levels below $\bar{w}$ employment is determined by the demand for labor, and involuntary unemployment (U) exists.

$$U = N^s - N^d \geq 0 \qquad \text{for } w = \bar{w}$$
$$= 0 \qquad \text{for } w > \bar{w} \qquad (30)$$

The synthesized model is represented by equations (1)-(5),(8),(28),(29),(30) with endogenous variables (Y,r,D,P,N^s,N^d,w,B,U). The initial wage level $\bar{w}$ is exogenous.

We derive the ASC for this model as follows. Consider first a classical labor market of the sort analyzed in Sections II and III with flexible wages and prices and initial price levels $\bar{D}$ and $\bar{P}$. The market clears at a nominal wage $\bar{w}$ resulting in employment $\bar{N}$. As D and P vary, the supply of and demand for labor curves shift, leading to an upward sloping ASC. The labor market is pictured in Figure 13 and the corresponding ASC is the curve GEB in Figure 14. However, suppose that when D and P fall to

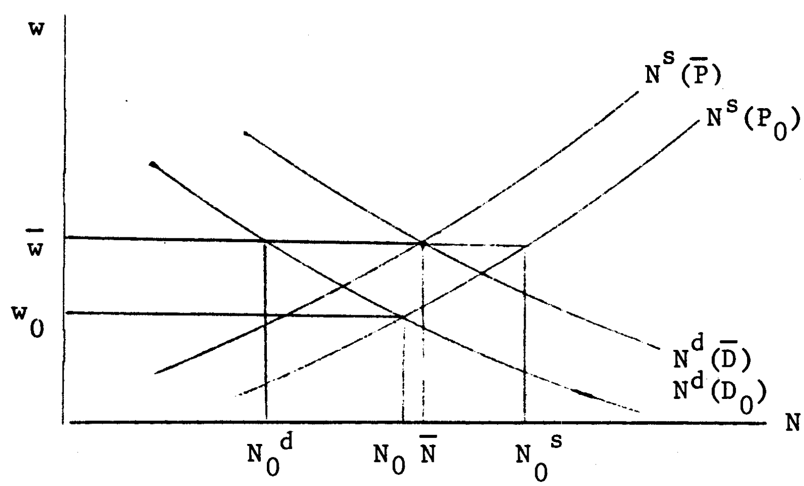

Figure 13 $\qquad \bar{D} > D_0,\ \bar{P} > P_0$

D_0 and P_0 respectively, the wage rate is unable to fall below $\bar{w}$; that is, let the rigid money wage constraint be $\bar{w}$. Hence, rather than having employment fall to N_0 and the wage to w_0, employment is determined by the demand for labor function at the rigid wage $\bar{w}$. Thus employment is given by N_0^d and unemployment by $U_0 = N_0^s - N_0^d$. In this situation GEB does not describe the constrained ASC. Instead, when D falls to D_0, output falls below Y_0 (corresponding to N_0) to Y_0^d (corresponding to N_0^d); thus the constrained ASC is given by CE. Along CE the labor market does not clear, and employment and output

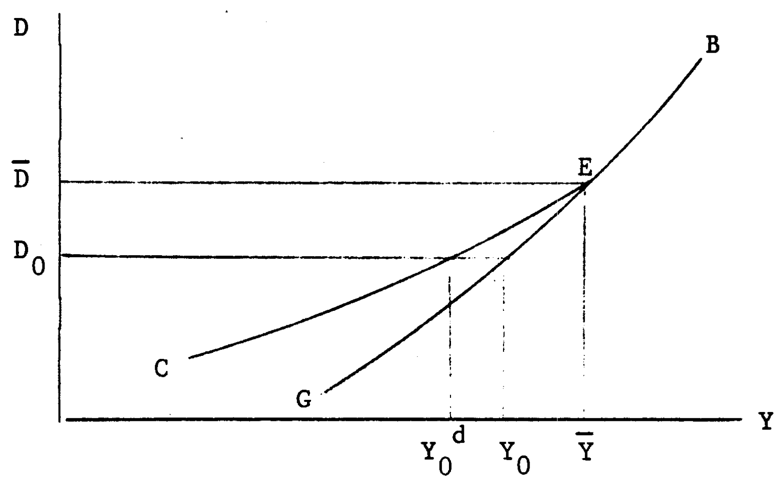

Figure 14

are determined by the demand for labor at the minimum wage $\bar{w}$. It should be noted, of course, that for increases in D and P above $\bar{D}$ and $\bar{P}$, the rigid wage constraint is not binding, and the classical ASC obtains. Hence, when the rigid wage is $\bar{w}$, the full ASC in the synthesized model is given by CEB in Figure 14.

The unconstrained ASC is identical to the classical ASC derived in Section II; therefore, it shifts on devaluation in accordance with the principles developed in Section III. Referring to Figure 15, when the exchange rate falls from ρ_0 to ρ_1 the ASC curve GEB shifts up to G'E'B'.

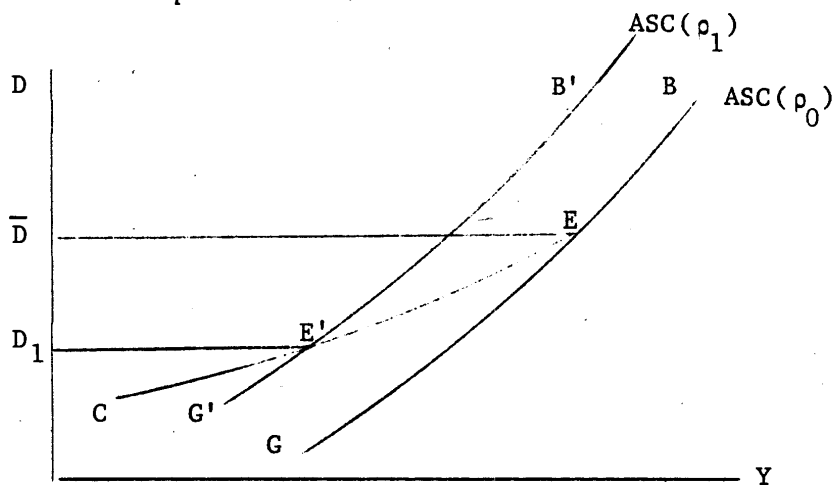

Figure 15 $\rho_1 < \rho_0$

Analagously the constrained ASC, like the ASC of the Meade-Tsiang rigid wage model, does not shift on devaluation. Thus the synthesized ASC shifts from CEB to CE'B'.

Note that the price level at which the wage constraint becomes binding falls from $\bar{D}$ to D_1. The explanation for this is straightforward. For any domestic price level and wage rate, devaluation raises import prices and hence reduces the supply of labor. The resulting excess demand for labor can be eliminated by an increase in the real wage. In particular at the rigid money wage $\bar{w}$, the excess demand for labor is eliminated by a decrease in the price of output from $\bar{D}$ to D_1. With the new exchange rate, for all $D > D_1$ the labor market clears at a wage rate above the rigid wage $\bar{w}$. Thus the money wage constraint is binding and the constrained ASC is relevant only for the region in which $D \leq D_1$.

Since the addition of the money wage constraint does not affect the ADC, we may now analyze the effects of devaluation on the economy. We first consider devaluation from a point of full employment. Suppose that the economy is initially at equilibrium at (Y_0,D_0) with the exchange rate ρ_0 as pictured in Figure 16. Lowering the exchange rate shifts the synthesized ASC from CEB to CE'B'. As demonstrated in Section III, the ADC shifts to the right if devaluation's expansionary impact on the goods market dominates its contractionary impact on the money market; on the other hand, it shifts to the left if the converse holds. The former case is illustrated in Figure 16, in which the post-devaluation equilibrium is given by (Y_1,D_1). This is identical to the classical case. The conclusions of Section III are unaffected by the addition of the constraint, since it is never binding. In

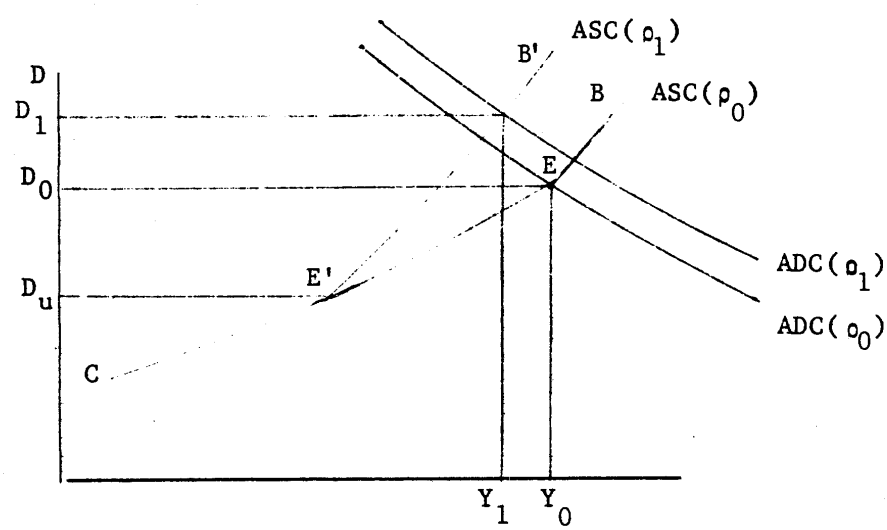

Figure 16 $\rho_1 < \rho_0$

the unlikely case in which the contractionary influence of devaluation on the real money supply is not only strong enough to shift the ADC to the left, but also powerful enough to force the price level below D_u, unemployment results. However, the monetary authority could easily remedy this result by increasing the nominal money supply in order to shift the ADC back up to the right.

We now consider the case in which the money wage constraint is binding both before and after devaluation. In this case the economy moves from one point of unemployment to another. This is illustrated in Figure 17 for an expansionary shift of the ADC. The initial equilibrium is (Y_0,D_0). While the ASC shifts from CEB to CE'B' on devaluation, the relevant region CE' is unaffected. Thus for a rightward shift of the ADC, the new equilibrium is given by (Y_1,D_1). Output and employment rise as pictured and unemployment falls. In addition the trade balance improves if the GEC holds and

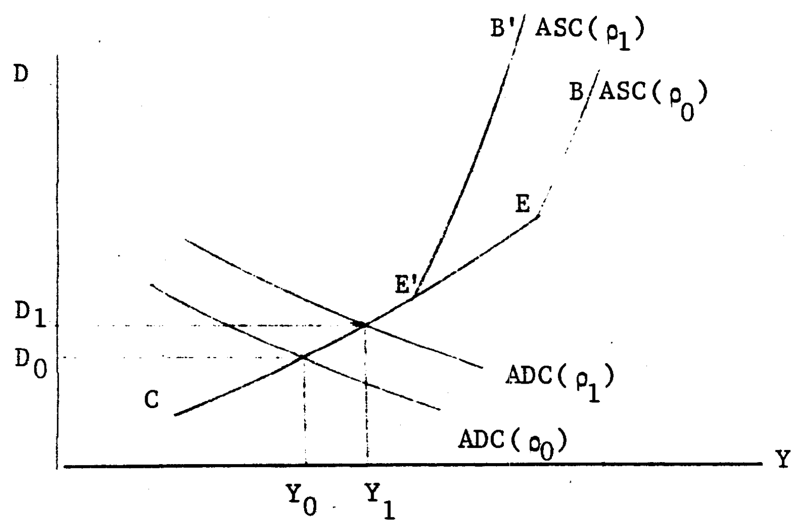

Figure 17 $\rho_1 < \rho_0$

the interest rate does not decrease. On the other hand, if the ADC were to shift to the left on devaluation, output would be reduced, unemployment increased and the trade balance improved. The demonstration of these results is left to the reader.

This case corresponds to the pure Meade-Tsiang model. Since there is excess supply of labor both before and after the devaluation, their conclusions are unaffected by the addition of the variable full employment (labor supply) function.

Finally, we consider the case in which an initial unemployment situation is eliminated by the devaluation. This analysis involves elements of both the classical and the Meade-Tsiang models. Although devaluation surely eliminates the involuntary unemployment, the level of output and employment may rise or fall depending on the strength of the aggregate demand component. We analyze the expansionary case here, leaving the contractionary case to the reader.

Referring to Figure 18, suppose that the economy is initially at the equilibrium (Y_0, D_0) characterized by some involuntary unemployment. Consider a lowering of the exchange rate from ρ_0 to ρ_1. As usual this shifts the ASC to the left. As indicated above, we assume that the expansionary impact of devaluation on the goods market dominates the contractionary effect on the real money supply, such that the ADC shifts to the right and output rises. The new equilibrium (Y_1, D_1) is on the unconstrained ASC and therefore is a point of full employment. In addition if the monetary authorities prevent the interest rate from falling, the trade balance improves. This may be compared to the pure classical model of Section III in which an increase in the interest rate is a necessary and sufficient condition for devaluation to improve the trade balance.[1/]

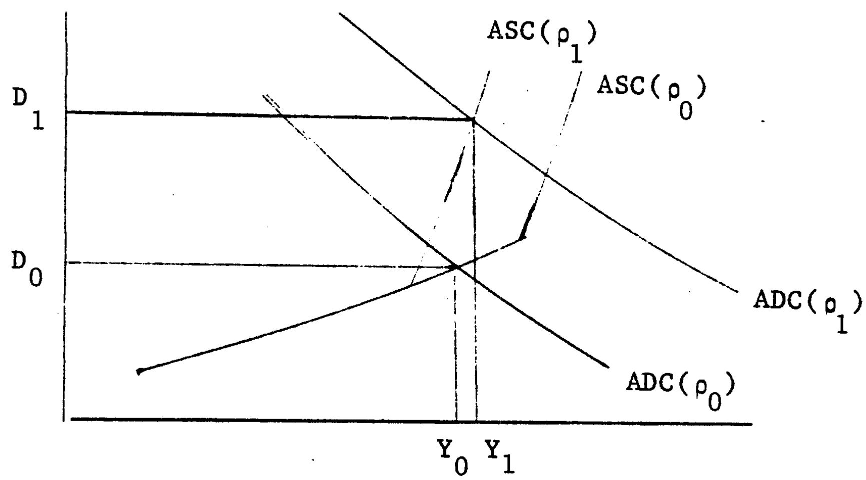

Figure 18 $\rho_1 < \rho_0$

In each of these cases an increase in the interest rate is sufficient for devaluation to improve the trade balance if the GEC holds. However, as we have seen, the qualitative impact of devaluation on the level of output depends crucially on the particular labor market assumptions made. Furthermore, the rather general synthesized model analyzed here combines the important elements of both the classical and the rigid wage models, permitting the appropriate labor market assumptions to be substituted into the general framework.

1/ See pp. 25,26.

V. Summary and Conclusions

In this paper we have analyzed the effects of devaluation on output, employment, and the balance of trade. In the process we have extended aggregate supply and demand analysis to the open economy. This general framework is useful for the study of a wide variety of questions concerning the open economy, particularly because it stresses the endogeneity of the domestic price level, a variable which is of crucial importance in determining the balance of trade.

When the supply of labor is positively related to the real wage and the labor market clears, there exists a unique relation between the terms of trade and the level of output which is invariant to the rate of exchange. This is due to the asymetric effect which foreign prices have on the demand for and supply of labor. As a result a successful devaluation reduces the terms of trade, output, and employment. It should be noted that since the labor market clears, there is no unemployment either before or after the devaluation, as there is always full employment in the economy. Furthermore, any other policy, such as a reduction in the nominal money supply, which reduces the level of output, likewise reduces the terms of trade and improves the trade balance. Unemployment does not accompany the contraction, since perfect wage and price flexibility assure that the markets always clear. Of course, this assumption and its implications run counter to the usual Keynsian model.

Devaluation is not alone in its ability to improve the balance of trade without unemployment in this classical model; however, when the possibility of rigid money wages is introduced, the exchange rate's role as a policy instrument increases. If there is initially unemployment because of rigidities in the money wage adjustment, devaluation raises prices and increases the demand for labor just as other expansionary policies do. But these other policies simultaneously increase the terms of trade and worsen the trade balance, while devaluation decreases the terms of trade and improves the trade balance. Moreover, although contractionary monetary policy improves the balance of trade, it simultaneously increases the level of unemployment (or initiates unemployment if there was previously full employment).

In conclusion we note that devaluation improves the trade balance regardless of the assumptions we make about the labor market. Nevertheless, its importance as a policy instrument rests on its unique ability to reduce the relative price of domestic goods and improve the trade balance at the same time it increases domestic prices and reduces unemployment.

Joanne Salop
Board of Governors of the
Federal Reserve System
April 13, 1973

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