CHAPTER

3

Income Determination and the Trade Balance

In this chapter we develop an initial approach to income determination and the trade balance in an open economy. Our framework of analysis will be highly simplified. We assume a country that is small in the sense that its import prices are given in world markets and independent of the level of imports. With a fixed exchange rate, domestic prices of imports are fixed as well. The second simplifying assumption is that, because of unemployment, prices of our goods are given. Output is a function of demand. The merit of making these assumptions is that we analyze income determination first, and then go on to examine how relative prices are determined.

The third assumption concerns world demand for our exports, which we

take as given. Export demand in general depends on the relative price of our goods compared to competing goods in the rest of the world and on foreign income. Here we first assume that changes in the home country, particularly in the level of our imports, are sufficiently negligible with respect to the level of foreign income so that repercussion effects can be ignored. (These repercussion effects are considered later in this chapter.) By assumption, relative prices are given. Finally, we abstract from assets market considerations and assume that our level of spending depends only on income.

In summary, our model will assume given prices, domestic output to be determined by demand, and a given level of world demand for our exports. In section I we will show the determination of equilibrium output and the associated trade balance. In section II we proceed to some comparative static exercises. The problem of repercussion effects is addressed in section II. The chapter concludes with a discussion of interdependence.

I. EQUILIBRIUM OUTPUT AND THE TRADE BALANCE

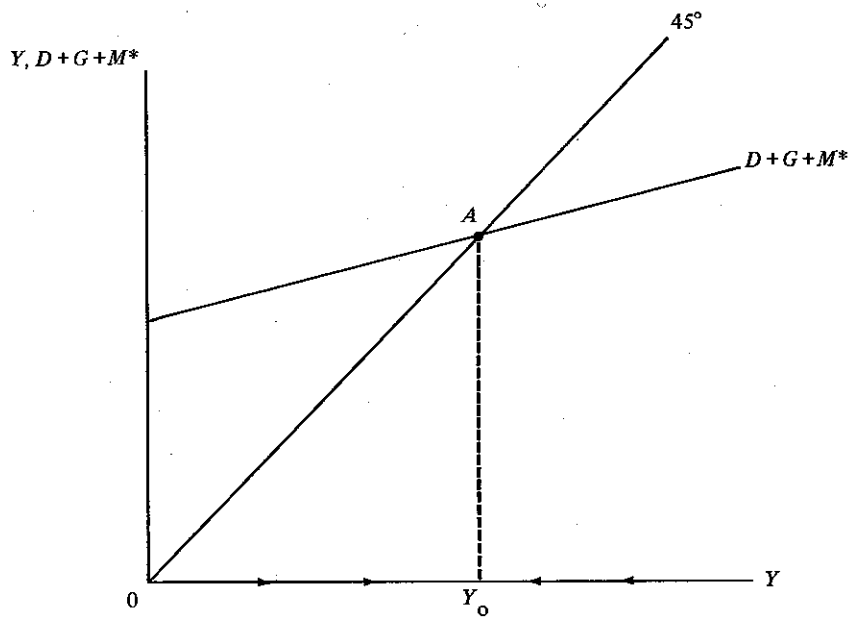
Output in our small open economy is demand determined. The demand for our output arises from domestic private spending on domestic goods D, government spending G, and world imports or our exports M^*. (We use the letter M to denote imports and an asterisk to denote a foreign variable. Thus M^* denotes foreign imports or our exports.) In equilibrium, output supplied Y is equal to demand. Thus,

$$Y = D(Y,p) + G + M^*(Y^*,p) \qquad (1)$$

Equation (1) differs, of course, from the identities developed in chapter 2. It differs because here we have behavioral functions on the right-hand side. Specifically, domestic demand D is assumed to depend on income and the given relative price of our goods p. Exports are dependent both on foreign income Y^*, which we take as given and on the relative price.

To determine the equilibrium level of income we use the standard 45° diagram of Keynesian income determination in Figure 3-1. The components of demand for domestic output are added (vertically) at each level of income to give us the demand schedule $D+G+M^*$. Demand is an increasing function of the level of domestic output, as higher output and income increase the level

FIGURE 3-1



of spending, part of which falls on domestic goods. The slope of the demand schedule is $d \equiv \delta D/\delta Y$, which is positive and less than unity.

The equilibrium level of income is shown by point A, where income equals the amount of spending on domestic goods. At a higher level of output, output will exceed demand and there will be involuntary inventory accumulation. Conversely, at a lower level of output there is excess demand and inventories are run down. With output adjusting to excess demand the economy will converge to point A.

An alternative derivation of the equilibrium level of income emphasizes not the *components* of demand for domestic output, but rather the *level* of spending by domestic residents and net exports or the trade balance. We already defined aggregate spending by domestic residents in chapter 2 as

$$E \equiv C+I+G \equiv D+G+M \qquad (2)$$

In (2) we write the definition of total spending by domestic residents alternatively as the sum of the components of total spending $(C+I+G)$ by sectors, or as the sum of spending on domestic goods $(D+G)$ and imports M. Adding and subtracting imports in (1) allows us to write

$$Y = D(Y,p) + M(Y,p) + G + M^*(Y^*,p) - M(Y,p) \qquad (3)$$
$$= E(Y,p,G) + T(Y,Y^*,p)$$

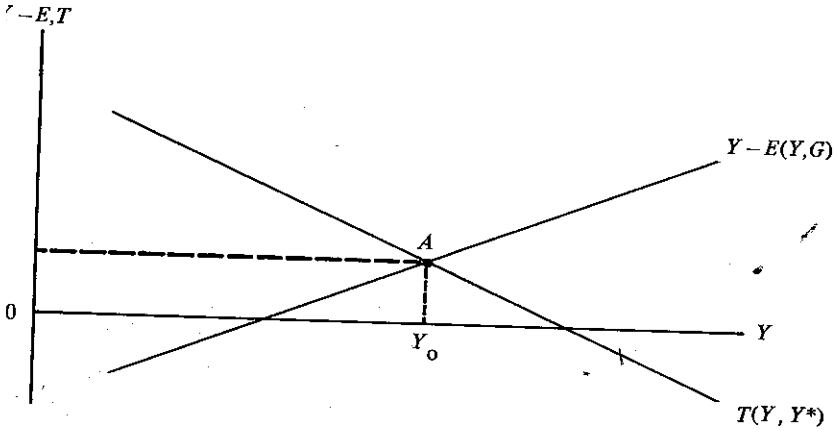
where

$$T = M^* - M = T(Y,Y^*,p) \qquad (4)$$

denotes our trade surplus or net exports.* Equation (3) states that in goods, market equilibrium output is equal to total planned spending by domestic residents plus net exports. Spending by domestic residents E is also referred to as *absorption.*

We can return now to Figure 3-1 to reinterpret the demand schedule for domestic output as total spending adjusted for net exports. An alternative

FIGURE 3-2



epiction is offered in Figure 3-2. The upward-sloping schedule shows income r output less absorption $Y-E(Y,G)$. With a marginal propensity to spend $-s \equiv \delta E/\delta Y$, that is positive and less than unity, an increase in income leads

*In later chapters we will introduce flexibility of relative prices, but we should now pay tention to units of measurment. With imports M measured in terms of physical units foreign output and M^* measured in units of domestic output we would be adding ples and blankets. So either M must be interpreted as expenditure on imports, easured in terms of domestic output, or we would have to write

$$T \equiv M^* - pM \qquad (4a)$$

ere p is the relative price of imports in terms of domestic goods. For the present ese points remain innocuous, but they are of substance in later chapters. Here we ume that $p = 1$ by convention and choice of units.

to increased net saving (or net foreign investment, as it is sometimes called). The slope of this schedule thus reflects the marginal propensity to save s.

The negatively sloped schedule in Figure 3-2 shows the trade balance as a function of the level of income. It is drawn for a given level of exports. Increasing income raises imports and worsens the trade balance. The slope of the schedule is given by the negative of the marginal propensity to import: $\delta T/\delta Y \equiv -m$.

Equilibrium income is determined at point A, where the excess of income over spending is equal to the trade surplus. Alternatively, using national income accounting terminology, at point A net foreign investment $Y-E$ is equal to net exports M^*-M. The advantage of the latter perspective, as we shall amply see below, is to separate out the total *level* of spending from the *composition* of spending between domestic and foreign goods. Such a separation is helpful when we consider the anatomy and cure of trade and employment problems.

II. COMPARATIVE STATICS

Here we shall draw on the model of income determination to study how various disturbances affect the level of equilibrium output and the balance of trade. In particular we will consider changes in world demand, shifts in domestic expenditure patterns, and changes in domestic saving.

1. An Increase in World Demand

Suppose world demand for our goods increased either because of a shift in foreign expenditure patterns or because of an increase in foreign income. What is the effect on our income and our net exports? In Figure 3-3 we show the increase in exports as an upward shift of the trade balance schedule. At each level of income net exports rise by the increase in world demand. Thus at the initial equilibrium level of income Y_0 we now have an excess demand for goods. Accordingly output expands until we reach point A', where we again have balance between income and spending.

In the new equilibrium at point A' we have an increase in equilibrium income and an improvement in the external balance. Because the vertical

shift of the trade balance schedule is equal to the increase in exports ΔM^*, it is apparent that the change in the trade balance at A' is less than the increase in exports. This is so because the induced income expansion raises import spending thereby offsetting, to some extent, the trade balance improvement. The important point, however, is that there is an increase in equilibrium net exports or a trade balance improvement.

Equations (3) and (4) provide us with the system to derive algebraically the relation between export disturbances and the resulting changes in equilibrium income and the trade balance. Differentiating (3) totally and using the definitions of the marginal propensities to save s and import m we have

$$dY/dM^* = 1/(m + s) \tag{5}$$

Equation (5) shows the effect of increased exports on the equilibrium level of income. This is the simple open-economy multiplier. Increased exports will raise equilibrium income more, the larger is the induced spending on domestic goods $d = 1 - s - m$ or the smaller is the marginal propensities to save and import. With high induced spending it takes a larger change in output to generate the excess supply with which to meet increased export demand.

To determine the effect of increased exports on the trade balance we differentiate (4) to obtain

$$dT = dM^* - mdY \tag{6}$$

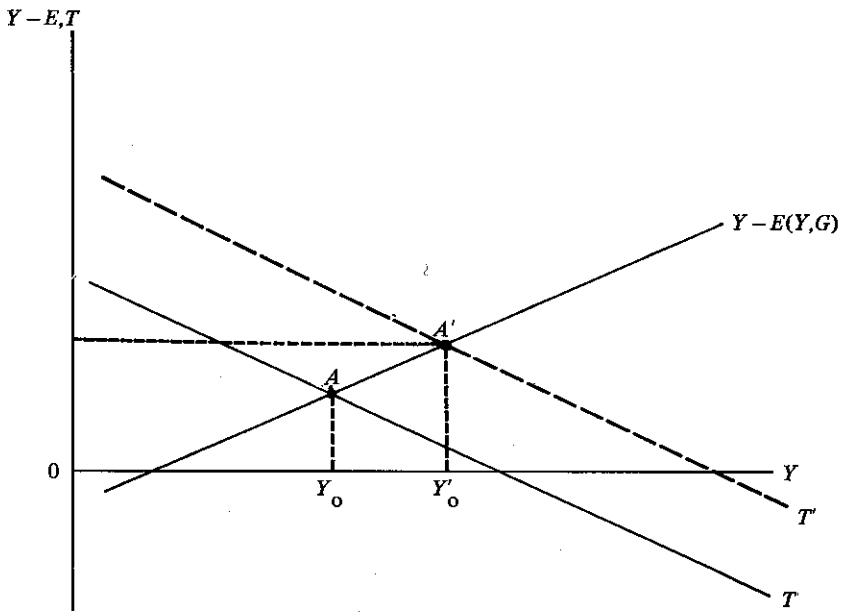
or, using (5)

$$dT/dM^* = 1 - m/(m+s) = s/(s+m) \tag{6a}$$

Increased exports thus improve the trade balance as we saw in Figure 3-3. The extent of the improvement depends on the propensities to save and import. A larger propensity to save—in terms of Figure 3-3 a steeper $Y-E$ schedule—will imply a larger trade balance improvement. A larger propensity to import, on the contrary, implies higher induced import spending, hence a lower trade surplus. This would be shown in Figure 3-3 by a steeper T schedule.

Why does the trade balance improve at all? Is it not possible that the income expansion is sufficiently large to raise import spending beyond the increase in exports leaving us with a net deficit? This is impossible because income will rise only when there is an increase in demand for domestic goods.

FIGURE 3-3



Aggregate spending by domestic residents rises only in response to induced increases in income. Therefore we *must* have an improvement in net exports if we are to sustain the higher level of income.

This gives us our first, firm result. Increased world demand raises equilibrium income and improves the balance of trade. The result is intuitive and simple and remains one of the central facts of open economy macroeconomics, the simplicity of our model notwithstanding.

2. Shifts in Expenditure Patterns

The next disturbance we consider is a shift in demand from imports to domestic goods. We assume that demand shifts so that at each income level import spending will be lower and that the demand, as well as the excess demand, for domestic goods will be correspondingly higher. This case is, of course, also represented by Figure 3-3, in which we now have to interpret the upward shift of the T schedule as arising from reduced import demand. Clearly, just as in the case of increased exports, we have an increase in equilibrium income and an improvement in the external balance. It is important to recognize that a shift in the pattern of spending or in the *composition* of

spending between domestic goods and imports has no impact on the *level* of spending. It is for this reason that the $Y-E$ schedule is unaffected.

To determine algebraically the effect of demand shifts on equilibrium income we differentiate the equilibrium condition in (3), noting that we now have an exogenous change in imports $d\bar{M}$ plus induced import changes, depending on changes in income:

$$dY = (1-s)dY - d\bar{M} - mdY \tag{7}$$

or

$$dY/d\bar{M} = -1/(s+m) \tag{7a}$$

Equation (7a) confirms that an autonomous increase in imports, with an offsetting reduction in demand for domestic goods, reduces equilibrium income. The effect on the trade balance is derived in (8):

$$dT/d\bar{M} = -1 - m\,dY/d\bar{M} = -s/(s+m) \tag{8}$$

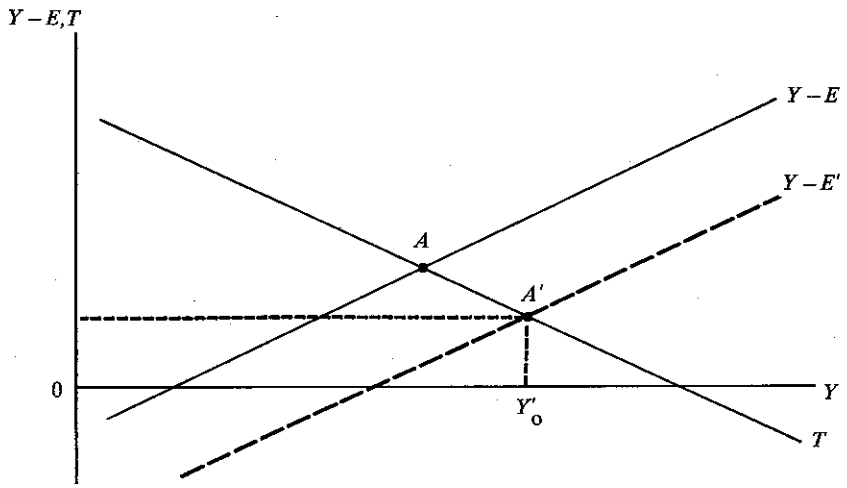
The trade-balance adjustment is again dampened by induced changes in income and imports. A shift in demand toward domestic goods improves the trade balance, but by less than the reduction in autonomous imports. Conversely, increased import spending, because it leads to a contraction in domestic income as demand shifts away from our goods, leads to a worsening in the trade balance that falls short of the initial shift.

3. A Reduction in Saving

The third disturbance to be considered is a reduction in saving or increase in aggregate spending. At each level of income absorption now increases. This is shown in Figure 3-4 as a downward shift of the $Y-E$ schedule. But we also have to ask whether this increase in aggregate spending falls on domestic goods or imports, or both.

In Figure 3-4 we show the case where all the spending increase falls on domestic goods. (There is no autonomous change in imports and accordingly no shift of the T schedule.) We see that increased spending raises the equilibrium level of income. Furthermore, as income rises in response to increased spending, this induces more import spending and accordingly worsens the trade balance.

FIGURE 3-4



Algebraically we derive the effect on income and the trade balance of an increase in autonomous spending by differentiating (3), where $d\bar{M}/d\bar{E}$ denotes the share of increased autonomous spending that falls on imports

$$dY/d\bar{E} = [1 - d\bar{M}/d\bar{E}]/(s+m) \tag{9}$$

and

$$dT/d\bar{E} = -[s/(s+m)]\,d\bar{M}/d\bar{E} - m/(s+m) \tag{10}$$

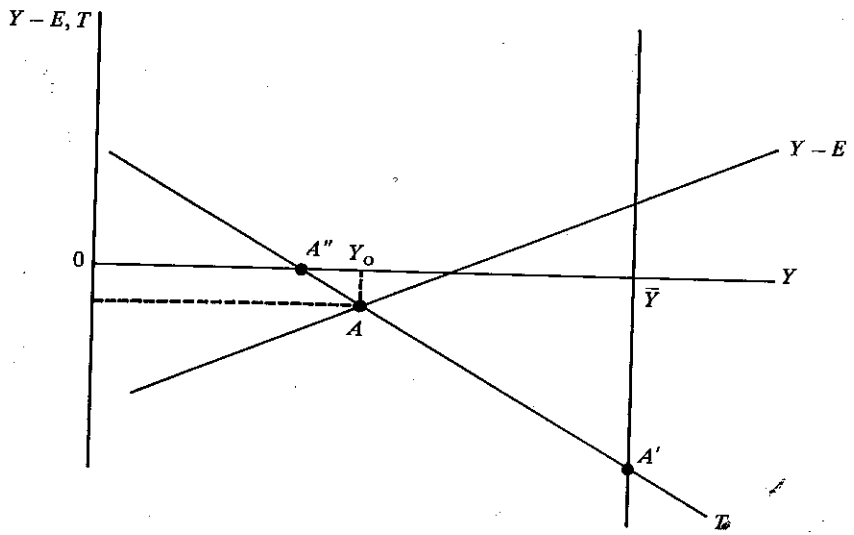
It is apparent from (9) that income will be unaffected if all increased spending falls on imports ($d\bar{M}/d\bar{E} = 1$) and that in this case the trade balance worsens by the full increase in spending. At the other extreme, if all spending falls on domestic goods, output rises by the normal multiplier and the worsening in the trade balance is only a fraction, $m/(s+m)$, of the increased spending. This is the case shown in Figure 3-4.

4. Internal and External Balance

We briefly introduce in this section the policy issue of internal and external balance that will occupy much of our later analysis. Suppose there is an income level $\bar{Y}$ at which we have full employment, or *internal balance*.

In Figure 3-5 the income level is shown as a vertical line. We also pinpoint an initial situation of underemployment equilibrium A, where the goods market clears and the trade balance is in deficit, giving us an external trade imbalance. The policy issue is how to achieve both internal and external balance simultaneously.

FIGURE 3-5



It is apparent that a situation such as the one represented by point A constitutes a dilemma. Suppose we expand the *level* of aggregate demand through an increase in government spending or a cut in taxes, shifting the $Y-E$ schedule down to point A'. Such a policy would clearly move us toward internal balance, because the demand expansion raises income and employment. At the same time, however, the expansion in income will raise imports and worsen the external balance. Conversely, a contraction in demand to point A'' will achieve external balance because income and import spending are reduced, but of course we are also moving further away from full employment.

The situation depicted in Figure 3-5 requires two instruments—one to achieve internal balance by raising demand for domestic goods, and another to prevent the external balance from getting worse. In chapter 4 we will discuss devaluation and tariffs as possible instruments for these purposes.

The issue of a *policy dilemma* does not necessarily arise. We have four possible constellations of internal and external balance problems. Of these

four only the cases of deficit/unemployment and the surplus/overemployment present conflicts. The remaining two situations can be handled by general expansion or contraction of demand.

The idea of this section is that external balance considerations place an important constraint on macroeconomic stabilization. Certainly the case of a deficit and unemployment is a common situation where an inadequacy of reserves or financing forces a country to maintain slack in the economy until a gain in competitiveness through deflation has restored external balance. An alternative would be to *finance* the deficit arising from an expansion if, for example, only a transitory decline in exports prevailed.

Dilemmas such as those we have discussed have had an important place in international policy discussions. Deficit countries that find themselves in unemployment situations have urged an expansion on the part of surplus countries so as to have the benefit of increased exports to remedy both the internal and external balance problems. These are the issues we will address in the following sections.

III. REPERCUSSION EFFECTS

In the previous analysis we have dealt with a country that is "small" in the sense that repercussion effects associated with income and import expansion or contraction in that country can be neglected. We expand our framework of analysis now to incorporate these repercussion effects and to look at the simultaneous determination of income in a two-country setting. We will maintain throughout the assumption that relative prices are given and that expenditure levels depend only on income.

1. Determining Equilibrium Incomes

Our model must be expanded now to encompass equilibrium conditions in both countries' goods markets. Equation (3) is repeated here for convenience as the condition of equilibrium in the domestic goods market. Equation (11) is the equilibrium condition in the foreign goods market:

$$Y = E(Y,G) + T(Y,Y^*) \tag{3}$$

$$Y^* = E^*(Y^*,G^*) - T(Y,Y^*) \tag{11}$$

where it is to be remembered that T represents the home country's trade surplus, so that $-T$ in equation (11) is the foreign surplus.

An illustration of our model for determining equilibrium incomes is given in Figure 3-6. The schedule YY shows equilibrium in the domestic goods market and the schedule Y^*Y^* shows equilibrium in the foreign goods market. It is readily verified that the YY schedule is flatter than the Y^*Y^* schedule, because

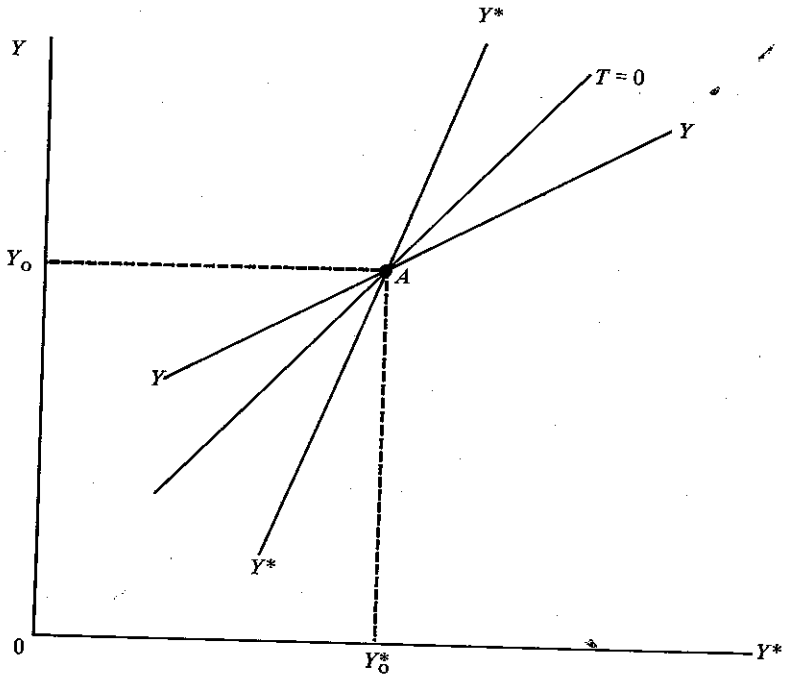
$$\left.\frac{dY}{dY^*}\right|_{YY} = \frac{m^*}{s+m} < \frac{s^*+m^*}{m} = \left.\frac{dY}{dY^*}\right|_{Y^*Y^*} \tag{12}$$

where the slopes are derived from (3) and (11), respectively. We next look at the trade balance also shown in Figure 3-6.

Repeating the trade balance shown in equation (4):

$$T = M^*(Y^*) - M(Y) \tag{4}$$

FIGURE 3-6



the slope of the trade balance equilibrium schedule is given by

$$\left.\frac{dY}{dY^*}\right|_{T=0} = m^*/m \tag{13}$$

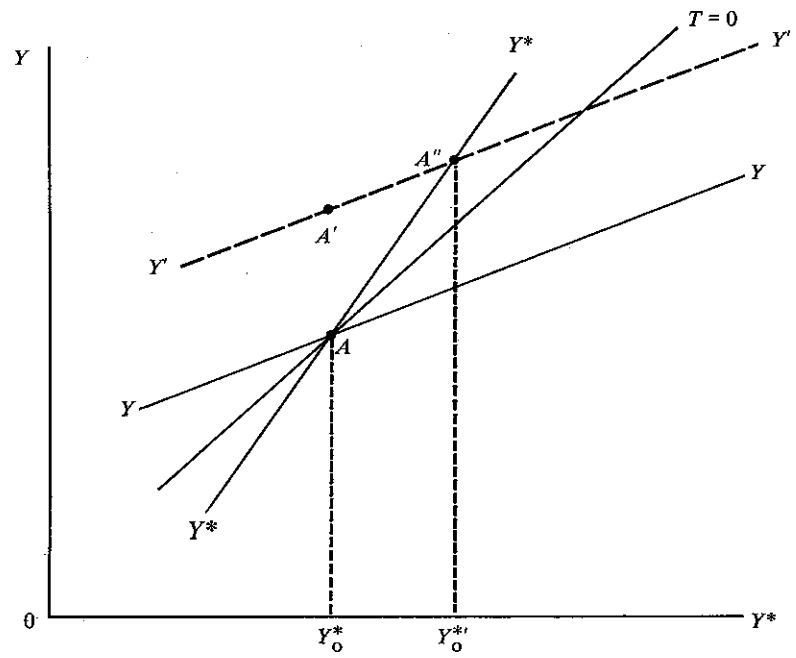
and is thus intermediate between the YY and Y^*Y^* schedules. Initial equilibrium is assumed to obtain at point A with balanced trade.

2. An Increase in Domestic Spending

We return now to our earlier comparative static questions to assess the limitation of the "small-country assumption." How much difference does it make, and for what questions, to assume away repercussion effects? To study that question we look again at a reduction in saving that falls entirely on domestic goods. In the same way, we can think of it as an increase in government spending on domestic output.

In Figure 3-7 we show that at the initial equilibrium point A the increased

FIGURE 3-7



spending implies an excess demand. Our output will have to rise in order to restore equilibrium or foreign output, and therefore foreign demand for our goods, would have to decline to make room for our increased spending. Accordingly, the YY schedule shifts up and to the left. (Remember our assumption that all the increased spending falls on domestic goods. There is no change in autonomous import spending, and thus neither the $T=0$ nor the Y^*Y^* schedule is affected.)

Neglecting repercussion effects amounts to moving from A to A', where equilibrium in the domestic goods market is restored, but where foreign output is held constant. Of course A' is not an equilibrium point. Our income expansion has raised our demand for foreign goods and there is excess demand leading to a foreign income expansion. The income expansion abroad, in turn, feeds increased demand for our exports and thus a further domestic expansion. These repercussion effects lead to a new equilibrium at point A''. Here output in both countries has fully adjusted to world demand.

The importance of repercussion effects can easily be recognized by comparing points A' and A''. Repercussion effects add to the income expansion. To the small country increased imports appear as a "leakage" from the income flow. The analysis of interdependent income determination developed here shows that in part these increased import expenditures reappear as increased foreign demand for our goods.

We can study these points formally with the help of equations (3) and (11). (See Appendix.) Differentiating the system and assuming an exogenous increase in domestic spending $d\bar{E}$ we have

$$dY/d\bar{E} = 1/[(s+m) - mm^*/(s^*+m^*)] \qquad (14)$$

It is apparent that the multiplier in (14) is larger than that for the small economy. An adjustment term appearing in the denominator arises from the induced import spending per dollar increase in our income m times the increase in foreign income that originates as our imports expand $1/(s^*+m^*)$ times the marginal propensity abroad to spend on our goods as their income rises m^*. The adjustment term thus reflects that part of induced imports which is recaptured through increased foreign income and spending on our goods. This fact is responsible for increasing our income expansion when repercussion effects are recognized.

The foreign income expansion can be calculated from (3) and (11) to be

$$dY^*/d\bar{E} = m/[(s^*+m^*)(s+m) - mm^*] = [m/(m^* + s^*)]\, dY/d\bar{E} \qquad (15)$$

and thus the trade balance worsens by

$$dT/d\bar{E} = -m \;\; [1 - m^*/(s^*+m^*)]/[(s+m) - mm^*/(s^*+m^*)] \qquad (16)$$

which is to be compared with (10) (for $d\bar{M}/d\bar{E} = 0$). It is apparent from (16) and Figure 3-7 that the trade balance must worsen as a consequence of our expansion. But will the foreign induced expansion and increased imports dampen or worsen the deterioration of the balance of trade? It is readily shown that the process of deterioration will be diminished in intensity once repercussion effects are taken into account because the additional income expansion leads to increased saving at home.

The role of repercussion effects can also be directly incorporated in our analysis of either Figure 3-3 or 3-4. All we require is the recognition that foreign demand for our exports depends, indirectly, on *our* income. Our income expansion raises our imports, their income, and consequently their demand for our goods. This positive relation between our income and their import demand implies that the trade balance schedule will be flatter: now a rise in our income not only raises our imports but induces also an export expansion.* Accordingly, a shift in aggregate spending will raise income by more and will worsen the trade balance by less than in the absence of repercussion effects.

3. A Shift in Demand

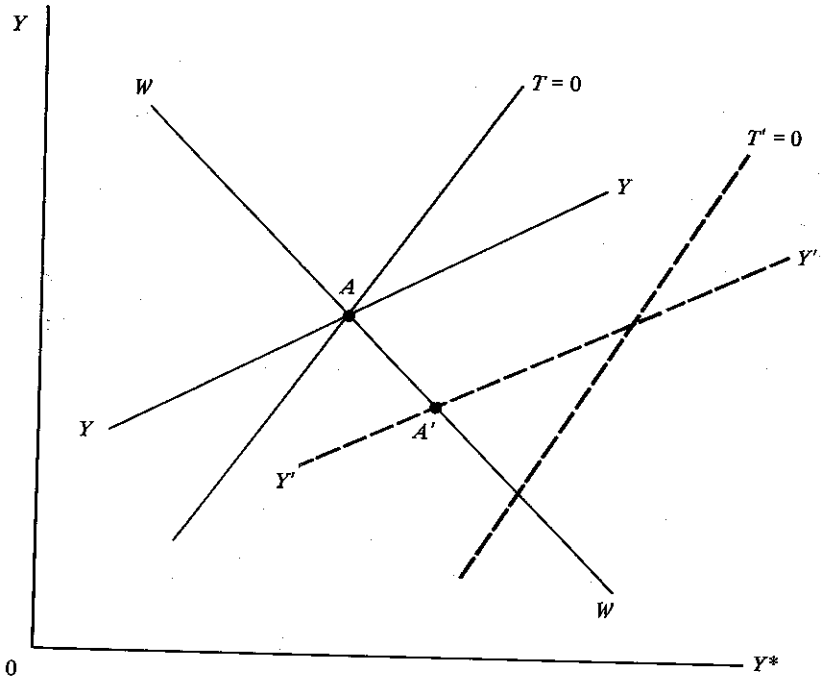
Let us consider now a shift in spending from domestic goods to imports in the home country. We study that question with a slightly modified presentation of our equilibrium conditions. Rather than using (3) and (11), let us use (3) and the condition that world income equals world spending; or

$$Y + Y^* = E(Y,G) + E^*(Y^*,G^*) \qquad (17)$$

which, of course, is equal to the sum of (3) and (11). Equation (17) is shown in Figure 3-8 as the downward-sloping schedule WW. Along that schedule world income equals world spending. Points above correspond to a world excess supply of goods, and points below to a world excess demand. Along YY, as before, demand is equal to supply for domestic goods. At the equilibrium point A both the level and composition of world spending are in equilibrium. We also assume an initially balanced level of trade.

*You will want to show that a rise in our income raises exports by a fraction $m^*m/(s^*+m^*)$ and that the trade balance schedule, whose slope equals $m[m^*/(s^*+m^*) - 1]$, is still negatively sloped.

FIGURE 3-8



Suppose now a shift in demand from domestic goods to imports. With no change in the world *level* of spending the WW schedule is unaffected. But at A there is an excess supply of domestic goods and a deficit. To restore domestic goods market equilibrium output would have to decline. The YY schedule shifts down by $1/(s+m)$ times the shift in demand. To restore trade balance, given foreign income, our income would have to fall by $1/m$ times the demand shift.

The trade balance schedule also shifts down, but by more than the YY schedule. The new equilibrium is shown at point A'. Our income falls and income abroad rises. This is a first, perhaps not surprising, implication of the demand shift. It is worth noting that the foreign income expansion dampens, but does not reverse, the decline in our income.

The second point to note from Figure 3-8 is that our trade balance must worsen. Even though our income falls and the foreign level of income rises, the increased autonomous import spending dominates, leaving us with a net deficit.*

*In terms of Figure 3-8 we note that the horizontal shift of the YY and $T=0$ schedules is equal and amounts to $d\bar{M}/m^*$. Accordingly, point A' must be a deficit point.

The two-country model thus confirms the predictions already derived in the small-country example. A demand shift toward imports reduces income and worsens the trade balance. What we also learn about here is the dampening effect caused by the foreign income expansion. This dampening effect means that our income will fall less and that the trade balance will worsen by less than in the absence of repercussion effects.

4. The Transfer Problem

The transfer problem will reappear frequently in this book. It makes a first appearance here as the question: Will a transfer from one country to the other leave the current account in balance once the induced changes in incomes are allowed for, or will there be a deficit or surplus for the paying country? The question is of interest because, as we shall soon see, a deficit would imply the need to have a deterioration in the terms of trade and thus a further burden over and above the initial transfer payment. Now suppose that the home country pays an international transfer in the amount K, raised at home through taxes and redistributed abroad through tax cuts. Because spending depends on disposable income, a contraction in total spending will ensue at home in contrast to an increase in total spending abroad. Our demand for all goods—domestic and foreign—will decline, and foreign spending on all goods will rise.

Are there conditions under which equilibrium output will remain unchanged? Yes, if the foreign increased spending precisely offsets our spending reductions. In particular, increased spending abroad must match our spending reduction in amount—that means the same saving propensities out of disposable income—and in proportions. The latter requirement means that their propensity to spend on our goods is equal to our own, and similarly for our propensity to spend on their goods. This is clearly the benchmark case, wherein world demand for each country's output is unchanged and outputs therefore remain unaffected.

In this case of no distribution effects, what would happen to our current account? The account worsens as a direct function of the amount of the transfer; however, it improves when we cut our disposable income (hence imports) while disposable income is increased abroad, with the consequent rise in our exports. The net effect is thus:

$$dCA/dK = -1 + m + m^* \qquad (18a)$$

where CA denotes the current account and K the transfer.

Thus the current account improves or deteriorates as the sum of the marginal propensities to import exceeds or falls short of unity. The transfer is said to be *overeffected* if the payment of a transfer leads to a current account surplus. Conversely it is *undereffected* if net exports increase by less than the transfer, leaving us with a deficit in the current account.

We return now to (18a) to recognize that the condition was derived for the case of no distribution effects. Specifically it was derived on the assumption that the foreign propensity to spend on our goods equals our own. That means $m^* = d$, or

$$dCA/dK = -1+m+d = -s \qquad (18b)$$

Thus it is apparent that in the case for which there are no distribution effects the transfer *must* be undereffected. The reason? Part of the taxes at home are financed by a reduction in savings, rather than by decreased consumption. Accordingly, our net exports do not increase by the full amount of the transfer, giving us a current balance deficit.

Generally, where saving propensities or spending proportions differ between countries, we have a less clear-cut pattern. From our equilibrium conditions we derive the following comparative static results (see appendix):

$$dY/dK = (m^*s - s^*d)/\Delta \qquad dY^*/dK = (sd^* - s^*m)/\Delta \qquad (19)$$

where

$$\Delta = (s+m)(s^*+m^*) - mm^* \geq 0$$

Conditions leading to an expansion in our output are those for which there is an excess demand at the initial level of output. That means either a rise in world spending with unchanged marginal spending patterns ($s > s^*$, $m^* = d$) or unchanged world spending despite a redistribution of demand in favor of the home country ($s = s^*; m^* - d > 0$).

Even if distribution effects work favorably so as to create an excess demand for our goods, the output expansion will be insufficient to compensate for the transfer. Disposable income $Y - K$ must fall. This outcome is readily established from the definition of disposable income and equation (19):

$$d(Y-K)/dK \equiv dY/dK - 1 = -s^*/\Delta \qquad d(Y^*+K)/dK = s/\Delta \qquad (20)$$

Our disposable income falls, but spending falls by less, because part of the

transfer is financed by dissaving. It is immediately apparent, therefore, that the home country will experience a deficit in the current account, while the receiving country enjoys a surplus.

IV. INTERDEPENDENCE

In this part we look at some empirical evidence of international interdependence. Such evidence is provided by econometric models of the world economy, such as project LINK or the recent OECD International Linkage Model.* We follow here the OECD model.

We start by looking at Table 3-1, which shows the impact of a 1 percent

TABLE 3-1

Interdependence and Repercussion Effects on Growth and the Current Account

Country	United States		Germany		Canada		Japan		OECD	
	%	$	%	$	%	$	%	$	%	$
United States	1.5	(−3.4)	0.2	(0.4)	0.7	(0.4)	0.3	(0.9)	0.7	(−0.7)
Germany	0.1	(0.5)	1.3	(−2.4)	0.1	(0.2)	0.1	(0.3)	0.2	(−0.4)
Canada	0.1	(0.6)	0.0	(0.1)	1.3	(−1.0)	0.0	(0.1)	0.1	(−0.1)
Japan	0.0	(0.4)	0.1	(0.1)	0.1	(0.0)	1.3	(−1.2)	0.2	(−0.3)
OECD	1.8	(−1.1)	2.4	(−0.1)	2.3	(0.0)	1.8	(0.7)	2.0	(−1.7)

Numbers in parentheses represent billions of dollars.
SOURCE: OECD (1979).

change in autonomous spending in selected countries listed in the left-hand column on income of the countries listed across the top row.

For each country we show two numbers. The first number represents the percentage increase in growth induced by the domestic or foreign autonomous demand expansion. The numbers in parentheses represent the current-account impact of the expansion measured in U.S. $ billion. Thus, for example, a 1 percent increase in U.S. autonomous spending raises U.S. real growth by 1.5 percent and worsens the U.S. current account by $3.4 billion.

Consider now a U.S. expansion. We already noted that income in the United States will rise. But we also see spillover effects of the U.S. expansion.

*See OECD (1979) Ando et al. (1976) and Fair (1979). Early work on interdependence is reported in Modigliani and Neisser (1953).

in Germany income will rise by 0.2 percent, in Japan by 0.3 percent, and in Canada by as much as 0.7 percent. This is evidence of international interdependence through induced changes in imports. For OECD countries as a group, growth would rise by 0.7 percent, reflecting both the importance of spillover effects and the fact that the United States is one of the largest countries in that group.

Consider by contrast expansion in Japan. The direct impact on Japan is a multiplier effect. The side effects on other countries such as the United States or the major OECD countries are substantially smaller than in the case of the United States. U.S. growth would increase by 1/20th of 1 percent, and growth for the major OECD countries would rise by only one-fifth of 1 percent.

Consider next the row appropriate to a *joint* expansion by the OECD countries. If each of the OECD countries raised their spending by 1 percent U.S. growth would rise by 1.8 percent or one-third of 1 percent more than if the United States expanded alone. There are thus substantial side effects from a joint expansion. These side effects are even more substantial for the other major countries. For Japan the extra expansion would be nearly one-half of 1 percentage point (1.8 rather than 1.3), and for Canada it is a whole percentage point.

Table 3-1 also shows the effects of expenditure increases on the goods and service balances. The diagonal shows again the effects of an isolated expansion on the expanding country's balance. Consider first the United States. A 1 percent increase in autonomous spending leads to an increase in the trade deficit of more than $3 billion.

The impact of expansion on the current account differs substantially across countries. German expansion yields a very large deficit, whereas Japanese expansion (despite the same growth effect) yields a deficit that is only one-half that of Germany. These large differences in the trade-balance effect arise to some extent from differences in import propensities. For Germany and the United States the model assumes large import elasticities with respect to an income expansion. By comparison, for Japan the elasticity is only 1.5 percent. The comparison between the German and Japanese trade effects demonstrates that German expansion has a bigger effect on OECD growth than does a Japanese expansion, notwithstanding the fact that Germany is a smaller country (as a share of OECD GNP) than is Japan. Why the difference? German expansion spills over much more substantially into increased growth abroad because of higher induced imports.

Suppose next that all OECD countries expand together. We observe from Table 3-1 that the combined effect is a trade deficit for the group of $1.7

billion. How is the deficit shared among the major countries? Canada would stay in balance, despite the expansion of domestic demand. Japan would enjoy a surplus of nearly $0.7 billion. The United States, however, would show large deficits. These important differences in the trade effects of a *joint* expansion are puzzling. They arise because of differences in import propensities and multipliers and because of marginal export shares. Thus Japan, for example, not only has low import elasticities but also enjoys an above-average share in the expansion of world trade. Accordingly her trade balance improves despite her own expansion.

V. CONCLUDING REMARKS

Our first approach to open-economy macroeconomics has focused on output determination for the small economy and on the interdependence between economies. The results we have derived will stand up to the more complex models that we will examine shortly. But as yet our model is incomplete. The next step is to focus on relative prices and to study their role in changing the composition of aggregate spending. Combined with the present analysis, we will then have a basic model to work with.

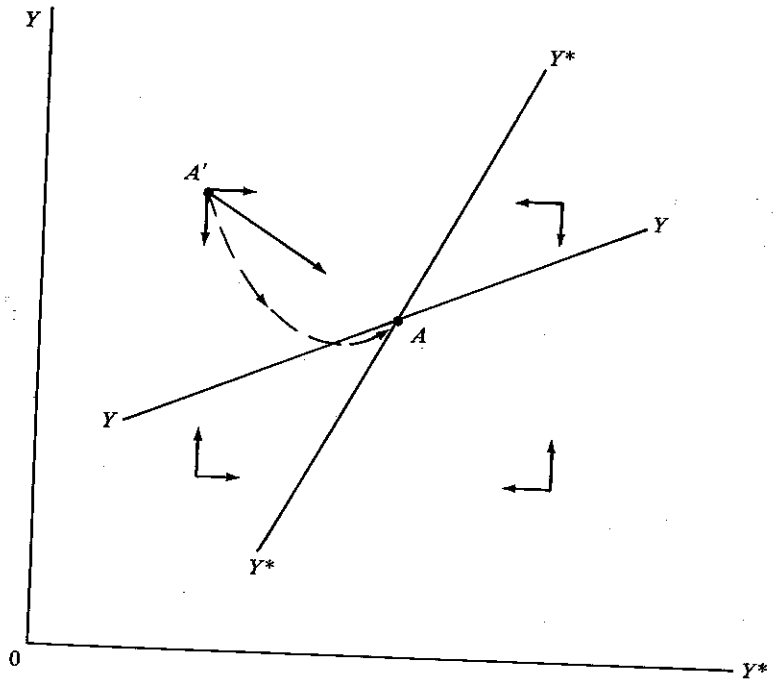
APPENDIX

Figure 3-6 showed the determination of equilibrium income. Here we extend the analysis to ask whether that equilibrium will in fact be reached or, to put it another way, whether the system is dynamically stable. For that purpose we make a simple assumption about output adjustment: Output in each country adjusts in proportion to excess demand, or

$$\begin{aligned} \dot{Y} &= k_1 [E(Y,G) + T(Y,Y^*) - Y] \\ \dot{Y}^* &= k_2 [E^*(Y^*,G^*) - T(Y,Y^*) - Y^*] \end{aligned} \tag{A-1}$$

where an overdot on a variable designates the time derivative $d(\,)/dt$ and k_i are speeds of adjustment.

FIGURE A-1



To investigate the stability we linearize the system around equilibrium and, for the sake of simplicity, assume equal unitary speeds of adjustment $k_i = 1$:

$$\begin{aligned} \dot{Y} &= -k_1(s + m)(Y - \overline{Y}) + k_1 m^*(Y^* - \overline{Y}^*) \\ \dot{Y}^* &= k_2 m(Y - \overline{Y}) - k_2(s^* + m^*)(Y^* - \overline{Y}^*) \end{aligned} \qquad \text{(A-2)}$$

where $\overline{Y}$ and $\overline{Y}^*$ denote the long-run equilibrium levels of income. Defining the operator $\lambda = d()/dt$ and noting that $\lambda(Y - \overline{Y}) = \dot{Y}$, since by definition long-run equilibrium $\overline{Y}$ is a constant, we can write (A-2) as follows:

$$\begin{bmatrix} -(s+m) - \lambda & m^* \\ m & -(s^*+m^*) - \lambda \end{bmatrix} \begin{bmatrix} Y - \overline{Y} \\ Y^* - \overline{Y}^* \end{bmatrix} = 0 \qquad \text{(A-3)}$$

To determine stability, we evaluate the characteristic equation or the determinant of the matrix in (A-3):

$$\lambda^2 + \lambda(s+m+s^*+m^*) + (s+m)(s^*+m^*) - mm^* = 0 \qquad \text{(A-4)}$$

Stability requires that both the coefficient of λ and the determinant be positive. With positive savings and import propensities, stability is ensured.

The dynamics are shown in Figure A-1, where we have drawn arrows to indicate the adjustment process formulated in (A-1). At a point A' we have an excess supply of domestic goods and an excess demand for foreign goods. Thus our income will fall and foreign income will rise. The adjustment paths are either direct or a half-cycle, as indicated in Figure A-1.

We next come to comparative statics. First we look at the effects of an increase in aggregate demand, then at a transfer. Our model is shown in equations (A-5) to (A-7):

$$Y = E(Y) + M^*(Y^*) - M(Y) \qquad \text{(A-5)}$$
$$Y^* = E^*(Y^*) - M^*(Y^*) + M(Y) \qquad \text{(A-6)}$$
$$T = M^*(Y^*) - M(Y) \qquad \text{(A-7)}$$

Differentiating the system totally and taking $d\overline{E}$ as the increase in autonomous spending we obtain

$$\begin{bmatrix} 0 & s+m & -m^* \\ 0 & -m & s^*+m^* \\ 1 & m & -m^* \end{bmatrix} \begin{bmatrix} dT \\ dY \\ dY^* \end{bmatrix} = \begin{bmatrix} d\overline{E} \\ 0 \\ 0 \end{bmatrix} \qquad \text{(A-8)}$$

Using Cramer's rule, we solve for the changes in output and trade balance:

$$dY/d\overline{E} = (s^*+m^*)/\Delta \qquad dY^*/d\overline{E} = m/\Delta \qquad dT/d\overline{E} = -m^*s^*/\Delta \qquad \text{(A-9)}$$

where

$$\Delta = (s+m)(s^*+m^*) - mm^* > 0$$

For the case of a transfer we note that spending will depend on disposable income $Y - K$ at home and on $Y^* + K$ abroad. Making that substitution in (A-5) through (A-7) we obtain the following equations:

$$\begin{bmatrix} 0 & s+m & -m^* \\ 0 & -m & s^*+m^* \\ 1 & m & -m^* \end{bmatrix} \begin{bmatrix} dT \\ dY \\ dY^* \end{bmatrix} = \begin{bmatrix} (m^*-d)dK \\ (d^*-m)dK \\ (m^*+m)dK \end{bmatrix} \qquad \text{(A-10)}$$

Solving these equations for output and the trade balance we have

$$dY/dK = (m^*s - ds^*)/\Delta \qquad dY^*/dK = (sd^* - s^*m)/\Delta$$
$$dT/dK = (m^*s + ms^*)/\Delta \qquad (A\text{-}11)$$

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CHAPTER

4

Relative Prices, Equilibrium Output, and the Trade Balance

Chapter 3 introduced output determination and the trade balance on the assumption of given relative prices. The only policy instrument we considered were variations in the level of aggregate demand induced by general fiscal policy. That model is a useful first approximation, but it does leave out important instruments of policy and adjustment. In particular, tariffs, devaluation, and export subsidies cannot be discussed unless we explicitly focus on relative prices as an integral part of our macro model. The same is true for adjustments to changes in demand through the classic process of wage and price adjustment. The topic of this chapter, then, is to round out our analysis by introducing relative prices. In section I we lay down the general model.