Handout #7 – A Fixed Price Model of Aggregate Output

Introduction
This and the following handout construct a model of Y (i.e., aggregate real output or real GDP) known as the Aggregate Demand/Aggregate Supply (AD/AS) model. The reason for presenting the model is that it helps develop intuitions regarding the effects of exports, imports, and capital and financial account flows on output, and vice versa. Its construction will be accomplished in three steps. This handout will first present the Keynesian Cross model, which will then be used as the foundation for the IS-LM-BP model. Both these models are known as fixed-price models because they assume away the possibility of price changes, which makes the two models effectively deny that resources are actually scarce. Although such an assumption is obviously unrealistic, it actually allows the models to demonstrate the qualitative effects of particular kinds of economic shocks more starkly. Then in Handout #8 the IS-LM-BP model will be integral in building the AD/AS model, which improves upon the IS-LM-BP model by permitting prices to be either flexible or “sticky” as opposed to being fixed.

The Keynesian Cross Model
As was presented in Handout #2, a nation’s output (Y) is divided across the four different sectors of the economy: Households that consume (C), businesses that conduct planned investment (I), the government that makes purchases (G), and the foreign sector in which foreigners buy domestic exports (X) and domestic residents purchase foreign goods (M):

\[ Y = C + I + G + X - M \]  

(7.1)

Whereas C, G, X, and M are all carried out deliberately, investment can be unplanned. This is because changes in business inventories are classified as investment, and it is often the case that some if not all the change in a business’ inventory is unintended. Dividing investment into its planned (I\textsubscript{P}) and unplanned (I\textsubscript{UP}) components permits rewriting Equation 7.1 as

\[ Y = C + I\textsubscript{P} + I\textsubscript{UP} + G + X - M \]  

(7.2)

Note that I\textsubscript{UP} can quite possibly be negative in the case where inventories unintentionally fall.

Distinguishing between planned and unplanned investment also allows one to specify an economy’s planned expenditures (E) as:

\[ E = C + I\textsubscript{P} + G + X - M \]  

(7.3)

Substituting Equation (7.3) into Equation (7.2) reveals the simple relationship between Y and E:

\[ Y = E + I\textsubscript{UP} \]

The central feature of any economic model is its specification of equilibrium, which captures the economic forces that bring about equilibrium values of the variables within the model. The Keynesian Cross’ equilibrium condition is simply that output equals expenditures (i.e., \( Y = E \)) or, equivalently, I\textsubscript{UP} = 0. This particular condition being met is referred to as equilibrium in the “goods market.” It constitutes an equilibrium condition because if \( Y \neq E \), then – the model’s rationale maintains – forces are at work pushing Y towards the level of E. For example, if \( Y > E \), then unplanned inventories accumulate. As goods pile up, retailers and wholesalers call their suppliers saying that they can skip a shipment or two, and the suppliers cut back production: Y falls towards E. (Note that retailers do not consider lowering the price of the good in the Keynesian Cross environment because prices are assumed to be fixed. Again, the AD/AS model presented in Handout #8 will drop this strong assumption.) Alternatively, if \( Y < E \), then inventories are falling and retailers request more goods from their suppliers who, in turn, step up production to accommodate their customers: Y increases to accommodate E.
The model reasonably assumes that C and M both depend on Y, or, more accurately, disposable income \((Y_D = Y - T)\), where T is taxes. But, T also is a function of Y and the tax rate \((t)\), so that \(T = tY\). Therefore, the consumption function is:

\[
C = mp_c (Y - T) = mp_c (Y - tY) = mp_c (Y(1-t))
\]  

(7.4)

Where \(mp_c\) is the marginal propensity to consume and is simply the fraction of disposable income that is spent on consumption. The comparable import function is

\[
M = mpm (Y(1-t))
\]  

(7.5)

where \(mpm\) is the marginal propensity to import.

Before continuing with this presentation of the Keynesian Cross model, a few more words regarding economic models may be helpful. Economic models specify “exogenous” and “endogenous” variables. **Exogenous variables** are those variables in the model whose value is assumed in the construction of the model. **Endogenous variables** are variables whose value depends on how they are related to the exogenous variables in the model. For example, thus far in the construction the Keynesian cross model, \(mpc, mpm, t, I_p, G,\) and \(X\) are all exogenous since their values need to be given to – rather than being generated by – the model. However, \(C\) and \(M\) are endogenous because their values are functions of other variables in the model as specified in Equations 7.4 and 7.5. One test of a model is to assume a change in one of the exogenous variables and then see how it, given the structure of the model, ends up affecting the endogenous variables. To the extent that the structure of the model captures (in a simple way) the structure of the actually economy, the model will accurately demonstrate how those variables in the economy change relative to each other. Generally speaking, the more endogenous and fewer exogenous variables a model has, the more sophisticated and complicated it is.

If we leave \(I_p, G,\) and \(X\) as exogenous and substitute Equations 7.4 and 7.5 into 7.3, then

\[
E = mpc (Y(1-t)) + I_p + G + X - mpm(Y(1-t))
\]  

(7.6)

Which can be substituted into our equilibrium condition (i.e, Equation 7.1) to give

\[
Y = mpc (Y(1-t)) + I_p + G + X - mpm(Y(1-t))
\]  

(7.7)

Which is an equation of one endogenous variable \((Y)\), and six exogenous variables. Therefore, we can solve for the endogenous variable in terms of all the exogenous variables:

\[
Y = (mpc - mpm) (Y(1-t)) + I_p + G + X
\]

\[
Y - (mpc - mpm)Y(1-t) = I_p + G + X
\]

\[
Y (1 - (mpc - mpm) (1-t)) = I_p + G + X
\]

\[
Y = (I_p + G + X) / (1 - (mpc - mpm) (1-t))
\]  

(7.8)

Which identifies the equilibrium value of \(Y\) in the model given the exogenous variables. For example, if \(mpc = 0.85, mpm = 0.10, t = 0.20, I_p = 30, G = 40,\) and \(X = 50\), then the equilibrium level of \(Y\) is 300.

The above equations and their determination of equilibrium output can also be presented in graphical form. Equation 7.6 showing how \(E\) is a function of \(Y\) (given particular values of all the exogenous variables) is represented in Figure 7.1 as the E line. Note that the vertical axis intercept of the E line is the sum of the injections, whereas its slope is \((mpc - mpm) (1-t)\). All the points that meet the equilibrium condition (i.e., \(Y = E\)) are found along the 45 degree line that bisects the two axes in the figure. The intersection of the E and 45° lines identifies the equilibrium given the exogenous variables that determine the E line.
The right hand side of Equation 7.8 is composed of two terms. The first is the sum of planned investment, government spending, and exports which together serve as exogenous “injections” of spending into the model’s circular flow. The second term in Equation 7.8, i.e.,

$$1/(1 – (mpc - mpm) (1-t))$$  \hspace{1cm} (7.9)

is multiplied by the sum of the injections to produce the equilibrium level of Y. This second term is referred to as the injection’s multiplier. Using the same sample numbers from above (i.e., $mpc = 0.85$, $mpm = 0.10$, $t = 0.20$) causes the multiplier to be 2.5. Essentially, the equilibrium value of Y (300) is the product of the amount of injections (120) and the multiplier (2.5). If we wanted to consider the effects of increasing an injection by 1 (and, because all three of the injections are exogenous variables, it is possible to conduct this experiment), we find that the increase causes Y to rise by 2.5. Examining the effect of an increase in an exogenous variable on an endogenous variable like this is, as noted above, a typical use of an economic model.

Why does an increase in an injection by 1 cause Y to increase by 2.5? It is because of the circular flow: The injection of 1, increases disposable income by (1-t), which increases consumption by $mpc(1-t)$ and imports by $mpm(1-t)$, which constitutes further expenditures in the domestic economy of $(mpc - mpm)(1-t)$ that, in turn, generate income for someone else, and so on. The circular nature of macroeconomic activity causes a $1 injection to increase equilibrium Y by more than the $1 as if it were multiplied.

Because there is an equilibrium level of Y and E in the model, these injections are necessarily matched by “leakages” in the form of private saving ($S_{PRIV}$), T, and M. For example, using the same numbers as in the example above that generated an equilibrium value for Y of 300, $S_{PRIV} = (1 – mpc)Y(1-t) = 36$, $T (= tY) = 60$, and $M (= mpm (Y(1-t))) = 24$. Therefore, the sum of these leakages (36+60+24 = 120) dependably equals the sum of the injections (30 + 40 +50 = 120).

There are basically two kinds of changes that can be examined under the Keynesian Cross framework: a change in injections or a change in the multiplier. As already discussed, the effect of a larger injection on Y is amplified by the multiplier effect. And because Y increases, those other variables specified as functions of Y (i.e., C, T, and M) all increase, too. One consequence of this is that a $1 increase in X will not increase net exports by $1, because the increase in X brings about the increase in Y and, therefore, M as well. In the graphical representation of the model, an increase in an injection simply increases the vertical axis intercept of the E line so that the equilibrium Y found at the intersection of the E and 45° lines increases (as shown in Figure 7.2).

A change in the multiplier occurs with changes in the $mpc$, $t$, or $mpm$. As one example, an increase in $t$ will cause the multiplier to fall, thus decreasing equilibrium Y. Note the graphical portrayal of the increase in $t$ in Figure 7.3.

The IS/LM/BP Model: The IS Curve

A disturbing problem with the Keynesian cross model is that the interest rate and the level of investment are exogenous. To correct for this problem, we first add the investment schedule introduced in Handout #2. The investment schedule relates the amount of investment that is profitable at each level of the interest rate: the higher the real interest rate ($r$), the fewer investments are worthwhile and, therefore, planned (see Figure 7.4). Considering the investment schedule and the Keynesian Cross model together allows one to associate a particular $r$ with a particular level of equilibrium Y. This is because a given $r$ will bring about a level of $I_p$ that
leads to a particular level of output. Furthermore, there is a negative relationship between $r$ and $Y$ since an increase in $r$ causes $I_P$ to fall, which, in turn, causes equilibrium $Y$ to fall (assuming that $G, X, mpc, t, \text{ and } mpm$ all remain unchanged). Each possible value of $r$ and its accompanying equilibrium $Y$ can be plotted in $r$ and $Y$ space and is referred to as the “IS” curve (see Figure 7.5).

The slope of the IS curve is determined by the same variables that influence the slope of the E line in the Keynesian cross model (i.e., $mpc$, $mpm$, and $t$). A change in any of the three types of injections given interest rates (which includes a change in $I_P$ caused by a shift in the investment schedule) does not alter the slope of the Keynesian Cross’ E line and, therefore, does not change the slope of the IS curve. Instead, a change in the level of an injection causes the IS curve to shift laterally. For example, Figure 7.5 shows the effect on the IS curve of an increase in $G$.

The IS curve effectively represents an infinite number of possible combinations between $r$ and $Y$ where the condition $E = Y$ is met and, therefore, where equilibrium in the goods market exists. To expand the model further, we next include the financial markets.

**The IS/LM/BP Model: The LM Curve**

In this model the financial markets are assumed to be composed of only two kinds of assets: money and nonmonetary assets (including equities, bonds, real estate, etc.). As was true of the monetary and portfolio balance approaches presented in Handout #5, people want to hold their wealth in money (due to the transactions and asset demands for money) as well as nonmonetary assets. The exact desired mix of the two assets depends on $Y$ as well as the return on nonmonetary assets ($r$): Increases in $Y$ cause the transactions demand for money to rise and, therefore, the demand for nonmonetary assets to fall, while higher returns on nonmonetary assets increases their demand and lowers the demand for money.

If we assume there exists a particular level of real balances ($M^S/P$), then equilibrium in the money market occurs when the real balances are equivalent to real money demand ($L$). But the level of $L$ is determined in the financial markets jointly with the demand for nonmonetary assets and the equilibrium level of $r$. (This dependence of each demand for assets on the demand for other assets and those asset prices was introduced in the discussion on interest parity in Handout 4, and continued with the presentation of the portfolio balance approach of Handout #5.) If, at some moment the $r$ generated by the nonmonetary asset market was teamed with an $L$ that was less than existing real balances, then the excess real balances would be promptly spent on (goods and) nonmonetary assets, thus bidding up their price and, corresponding, $r$ falling and the value of $L$ rising to the level of real balances.

Given the joint determination of $L$ and the demand for nonmonetary assets and $r$, the effect of different levels of $Y$ on the equilibrium $r$ can be considered: Increases in $Y$ bring about increases in $L$ and the demand for nonmonetary assets to fall, thus causing the price of nonmonetary assets to fall, or, $r$ to rise. This ultimately positive relationship between the level of $Y$ and $r$ can be graphed on the same diagram as the IS curve and is labeled the “LM” curve (see Figure 7.5). The LM curve indicates the equilibrium level of $r$ associated with each possible $Y$.

Shifts in the LM curve can occur due to changes in the either the level of real balances or $L$. A change that causes real balances to exceed $L$ (either due to an increase in $M^S$ or a drop in $L$ due to changing tastes) will lead to spending of the unwanted balances on nonmonetary assets until the price of assets have been driven up and the returns on those assets ($r$) driven down to the point that $L$ has risen and the financial markets are back in equilibrium. This fall in $r$ occurs
regardless of what the $Y$ may be, so every point on the LM curve drops: the whole LM curve shifts down as in Figure 7.6. By similar reasoning, a shock that causes $M^2/P$ to be less than $L$ would shift the LM curve up.

The intersection of the IS and LM curves identifies a single combination of $Y$ and $r$ where both the goods and financial markets are in equilibrium; these values of $Y$ and $r$ are assumed to prevail in the economy in the short run. We can consider changes in any of the exogenous variables and observe how they affect the endogenous variables such as $Y$ and $r$. For example, an increase in $G$ or $X$ will shift the IS curve to the right (as in Figure 7.5), causing it to intersect the LM curve where both $Y$ and $r$ are greater. Of course, this mechanical use of the model is accompanied by a compelling story: The increased injection promotes a greater equilibrium $Y$, but the higher $Y$ will push $L$ up and, therefore cause the equilibrium $r$ to rise as well. It should be noted that the rise in $r$ will, given the investment schedule, reduce $I$, i.e., some $I$ will be crowded out as a result of the increase in $G$ or $X$.

**The IS/LM/BP Model: The BP Curve**

The combination of $Y$ and $r$ identified by the intersection of the IS and LM curves does not yet consider how the CA is affected by the level of $Y$ or how the KFA is influenced by the equilibrium level of $r$. Specifically, the higher the level of $Y$, the greater the country’s imports and, therefore, the more domestic currency is supplied in the foreign exchange markets. The greater the $r$, the more desirable domestic assets are compared to foreign assets. Therefore, a higher $r$ increases the demand for the domestic currency by foreigners wanting to invest domestically, and reduces the supply of domestic currency supplied in the foreign exchange markets since domestic investors are now more inclined to invest at home.

The term **external balance** is used to describe the situation when the BOP activity taking place does not put pressure on the country’s $e$ to change. Imagine that an economy is at a particular combination of $Y$ and $r$ and is in external balance with a stable, equilibrium $e$. What would happen if $Y$ were to increase for some reason? The increase in $Y$ would increase $M$ and the supply of domestic currency in the foreign exchange markets. Because this would put pressure on $e$ to fall, meaning the country would no longer be in external balance. However, a change in $r$ could counter the effect of the increase in $Y$ and maintain external balance. Specifically, an increase in $r$ would increase the desirability of domestic assets, which would increase the demand for the domestic currency in the foreign exchange markets (with which to buy domestic assets), which would bring pressure for $e$ to rise. If the increase in $Y$ that increased imports was matched with just the right increase in $r$, then the exchange rate would not be affected and external balance would be maintained at this second combination of $Y$ and $r$. Continuing this reasoning, it would be possible to find all the combinations of $Y$ and $r$ where external balance exists and plot them as is done in Figure 7.7. This curve indicating all the combinations of $Y$ and $r$ where external balance exists is called the “BP” curve. Notice the positive slope of the BP curve is consistent with the changes in $Y$ and $r$ needed to prevent pressures for $e$ to change.

Although the general slope of the BP curve is positive as just discussed, its exact slope depends on how easily capital flows across its borders to other countries. For example, given an increase in $Y$ that increases debits in the CA by $X$, how much would $r$ need to rise to bring about $X$ worth of credits in the KFA that will counter the CA debits and preserve external balance? The answer depends on how freely capital flows across the border. The less inhibited the exchange of assets across borders is, the less $r$ needs to rise before the $X$ of credits in the
KFA occur. Therefore, the greater the capital mobility, the flatter the BP curve. Similarly, greater friction in capital markets steepen the BP curve.

At the theoretical extremes, one can imagine *perfectly mobile capital*. In this case, \( r \) would only have to change by an infinitesimal amount to affect KFA flows sufficiently to offset any change in CA debits brought on by \( Y \)’s change in \( M \). In this case, the BP curve is effectively horizontal (see Figure 7.8). As an example to characterize highly mobile (albeit, if not perfectly mobile) capital, consider the capital flow conditions between Massachusetts and Connecticut. Investing in Massachusetts by residents of Connecticut involves few if any additional obstacles or costs than investing in their home state. Of course, the fact the assets are denominated in the same currency and are subject to similar tax laws is a leading reason for their similarity.

At the other extreme, one can envision *perfectly immobile capital*, which assumes that private KFA activity is prohibited. In this case, no matter how much \( r \) changes, there will be no change in KFA credits or debits because no KFA exists in the first place. Therefore, the BP curve is vertical at the level of \( Y \) that generates the quantity of \( M \) that just match the quantity of \( X \). I.E., since no KFA exists, external balance requires the credits and debits in the CA to offset each other (at the given level of \( e \)).

Between these two extremes there are an infinite number of capital mobility conditions that can be depicted, with the steepness of the BP curve reflecting the difficulty in capital flowing across the border. If the BP curve is not horizontal, but has a smaller slope than the LM curve, then capital is considered to be *relatively mobile*. If the BP curve is steeper than the LM curve but not quite vertical, then it is said to depict *relatively immobile capital*.

If the combination of \( Y \) and \( r \) is such that external balance does not exist, then the pressure exerted on \( e \) depends on which side of the BP curve the combination lies. If \( Y \) is either too low or \( r \) is too high (i.e., if the combination of \( Y \) and \( r \) is to the left or above the BP curve), then the greater demand than supply for the currency in the foreign exchange markets will tend to push \( e \) up. Similarly, if \( Y \) is too high or \( r \) too low (the combination of \( Y \) and \( r \) is to the right or below the BP curve), there will be pressure on \( e \) to fall.

**The IS/LM/BP Model**

If the IS and LM curves intersect at a combination of \( Y \) and \( r \) where external balance does not exist (i.e., not on the BP curve), then equilibrium has not been attained in the IS-LM-BP model, and equilibrium forces will be at work that will bring the three curves to a common intersection where the equilibrium levels of \( Y \) and \( r \) are found. The specifics of the equilibrating process depends on whether \( e \) is flexible or if it is fixed. We begin by assuming the monetary authority is maintaining a fixed \( e \).

**The IS/LM/BP Under a Fixed Exchange Rate**

Consider an economy that begins in equilibrium, meaning that the IS, LM and BP curves all intersect at the same combination of \( Y \) and \( r \) in the IS-LM-BP diagram. An increase in \( G \), \( X \), or the investment schedule that shifts the IS curve to the right (see Figure 7.9) will have different effects depending on the mobility of capital. Assume, to begin with, that capital is relatively mobile as in Figure 7.9. The new combination of \( Y \) and \( r \) resulting from the injection is above or to the left of the BP curve (at point B) and, therefore, there is pressure for the currency to appreciate. This is because the rise in \( r \) has increased KFA credits by more than the rise in \( Y \) increases \( M \) and its CA debits. In order to honor the fixed rate, the monetary authority needs to prevent the currency from appreciating by printing more of it and selling it in the foreign
exchange markets. The foreign currencies it purchases with the newly issued currency is held on reserve by the monetary authority. In this situation, there are more credits than debits in the BOP: the BOP is in surplus (and, of course, there is an equivalent deficit in the OSB or KFA_{GOV}).

Because a BOP surplus involves selling new domestic currency in the foreign exchange markets, it increases the domestic M^S. This will increase M^S/P, thus temporarily throwing the financial markets out of equilibrium as M^S/P>L. The unwanted real balances will be spent driving up the price of nonmonetary assets and driving down their return \((r)\) for every \(Y\) imaginable: The LM curve will shift down. As long as the IS and LM curve intersect above the BP curve – or, in other words, as long as there is a BOP surplus – the M^S will be increasing and the LM curve falling until the IS, LM, and BP all intersect at the same combination of \(Y\) and \(r\) once again, thus determining the new equilibrium in the model (at point \(C\) in Figure 7.9).

The effect of an increase of an injection to the goods market (possibly an increase in government spending) when capital is relatively mobile has just been demonstrated by the IS-LM-BP model. Because of the exogenous change in the injection:

i) \(Y\) increased. Because \(C\), \(M\), and \(T\) are all functions of \(Y\), those variables have changed with it, which also causes changes in the CA and the government surplus or deficit.

ii) \(r\) increased. If the investment schedule has not changed (i.e., the injection was due to an increase in \(G\) or \(X\)) the higher \(r\) indicates that \(I\) has fallen. In this case investment has been crowded out by the increased injection. Alternatively, iff the source of the increased injection was an outward shift of the investment schedule, there will be more investment, although the increase in \(r\) will dampen the increase from what it would have been otherwise.

iii) there has been capital inflow (a.k.a., KFA credits) due to the higher interest rates that attracted the foreign investors.

Take a minute and consider how the analysis would have changed if capital was relatively immobile instead of relatively mobile. In this case, the shift of the IS curve would have led to its intersection with the LM curve below the BP curve and BOP deficits would occur. BOP deficits include purchases of the domestic currency by the monetary authority with its foreign currency reserves, which effectively lowers the outstanding M^S, and the LM curve shifts up until all three curves share a common intersection once again and equilibrium \(Y\) and \(r\) are re-established.

The model can also be used to analyze shocks to the financial market under a fixed exchange rate. For example, assume either a positive shock to M^S (possibly due to expansionary monetary policy by the monetary authority) or a fall in \(L\) (possibly due to a change in tastes regarding desired money holdings). In either case, the resulting temporary disequilibrium in the money market (M^S/P>L) and, therefore, the nonmonetary asset market as well, will cause the unwanted real balances to be spent. This spending will promote higher \(Y\) as well as higher asset prices that corresponds to lower \(r\). Given that this would occur for every point on the original LM curve, the entire LM curve drops (see Figure 7.10).

The intersection of the IS and this new LM curve will be to the right and/or below the original BP curve – regardless of the degree of capital mobility – which brings about BOP deficits (i.e., the lower interest rate and higher income both precipitate debits in the BOP accounts). Once again, BOP deficits are associated with a fall in the domestic money supply as
the monetary authority purchases the domestic currency in the foreign exchange markets with its currency reserves. Thus, with the reduction in $M^S$, the LM curve returns to its original position.

This analysis has revealed something very important about fixed exchange rates: A fixed e policy eliminates the possibility of a monetary policy different from the monetary policy of the foreign currency that the currency is fixed against. As was just shown, an increase in $M^S$ brings about BOP deficits that reduce $M^S$ until the $M^S$ is the same as before the increase. Similarly, a decrease in the $M^S$ under a fixed e will cause BOP surpluses that will return the money supply to its original level. To demonstrate this important point further, assume the foreign monetary authority conducts expansionary monetary policy. This would shift out the foreign country’s LM curve causing pressure for its currency to depreciate or, equivalently, the domestic currency to appreciate. If the domestic country has its currency pegged to the foreign currency, the domestic country is running BOP surpluses to forestall the appreciation, thus increasing its $M^S$. Ergo, the expansionary monetary policy on the part of the foreign country causes the domestic country with the fixed e policy to increase its money supply in a comparable way.

It has been shown in several different ways in previous handouts how greater levels of the $M^S$ cause e to be lower. Therefore, it is not surprising that a policy of pegging a particular e requires a particular money supply to maintain that e. If other market forces pressure e to rise, then a monetary authority honoring the fixed e must increase the money supply to counter these forces. Just as pressures for e to fall requires the monetary authority to reduce $M^S$ to maintain the market e. Therefore, although it is reasonable to think that a fixed e policy eliminates the possibility of an active monetary policy, it is more direct to recognize that a fixed e dictates whatever money supply is needed to uphold that promised e. Therefore, a fixed exchange rate policy qualifies as a monetary rule, i.e., it is a method of determining the money supply for an economy that does not vary discretionarily over the course of the business cycle.

It is important to remember the money supply, in addition to determining the exchange rate, also is a major determinant of the interest rate as well as the price level and, therefore, the inflation rate. The monetary authority has the often impossible job of using its one tool – determining the money supply – to bring about desirable levels of e, $r$, and $\pi^E$. For example, it has often been the case that countries with fixed e policies have experienced BOP deficits that have reduced the money supply to the point that $r$ is painfully high and stifling investment.

Governments have tried to get around their fixed exchange rate’s indirect determination of interest rates and inflation rates through the sterilization of changes in the money supply resulting from BOP surpluses or deficits. For example, if the monetary authority needs to buy its currency in the foreign exchange markets to maintain the pegged e, the resulting reduction in the money supply could cause $r$ to increase. Therefore, the monetary authority could sterilize the effect of its intervention in the foreign exchange markets by conducting open market operations that increase the money supply within the economy and, it is hoped, prevent $r$ from rising. Attempting to sterilize interventions is usually a desperate measure and, as might be guessed, is effective temporarily at best. In the case of sterilizing the effects of BOP deficits, sterilizing the government’s purchases of the domestic currency in the foreign exchange market can only occur as long as they have sufficient reserves of foreign currencies available to carry out the BOP deficits.
The IS/LM/BP Under a Flexible Exchange Rate

When shifts in either the IS and/or LM curves cause a new combination of Y and r where external balance does not hold, the return to short run equilibrium is different under a flexible e. For example, consider an increase in government purchases for an economy that has relatively mobile capital. The shift in the IS curve will bring about a combination of Y and r that is above the BP curve (see Figure 7.11). Thus, the higher interest rates causes capital inflows with the corresponding demand for domestic currency in the foreign exchange markets. Under flexible e, this will cause e to appreciate. The lack of external balance due to the new combination of Y and r not being on the BP curve would generate a BOP surplus if e was fixed as described above. In this case, the imbalance is often referred to as an incipient BOP surplus, as if the BOP surplus was on the verge of occurring when the exchange rate appreciated instead.

The appreciation of the currency will decrease exports and increase imports and (assuming the Marshall Lerner Condition holds), shift the IS curve back. But in addition to shifting the IS curve, the decrease in net exports also moves the BP curve. To assess how, examine the effect of one point on the BP curve – one combination of Y and r where external balance held – before the rise in e. With the increase in e that decreases net exports, that combination of Y and r is now associated with an incipient BOP deficit. In order to find the new level of Y that, along with the initial r, generates external balance, Y would have to drop to reduce M and debits until the incipient BOP deficit no longer prevailed: That point on the BP curve would shift to the left due to the rise in e. Given that all points on the BP curve will behave similarly, the entire BP curve shifts left. In fact, the change in e will cause the BP curve to shift further than the IS curve.  

Figure 7.11 shows how the economy returns to short run equilibrium in response to the initial shift in the IS curve. Starting in equilibrium at point A, the increased government spending shifts the IS curve to intersect at point B causing an incipient BOP surplus. Thus, the domestic currency will appreciate causing net exports to fall, which will shift both the IS curves and BP curves to the left until short run equilibrium is re-established at point C.

This IS/LM/BP analysis of expansionary fiscal policy shows how the injection affects r and e in such a way that other injections are reduced as a result. The increase in r between point A and point C indicates that, given the investment schedule, investment has fallen: I has been “crowded out”. And the increase in e has caused net exports to fall: Net exports have been crowded out, too. Although, in this case, the crowding out was only partial since equilibrium Y increased due to the policy.

Figure 7.12 illustrates IS/LM/BP analysis of expansionary monetary policy when capital is relatively mobile: Starting from equilibrium at Point A, the increase in the money supply shifts the LM curve down. The new combination of Y and r where the IS and LM intersect at point B causes an incipient BOP deficit and the currency depreciates. The drop in e will increase net exports, which shifts the IS curve to the right, and the BP curve farther to the right until all three curves intersect once again – i.e., until short run equilibrium is once again re-established – at point C. The analysis shows that the policy is effective at increasing Y, primarily due to the depreciation of the domestic currencies affect on net exports.

1 When the reduction in debits needed to re-attain external balance were to occur by reducing imports, then, given the small size of the typical mpm, Y needs to fall significantly to cause imports to drop. Therefore, the BP curve moves farther to the left than the shift in the IS curve due to the same increase in e.
Note that it is possible for a government with a flexible exchange rate to generate an increase in $Y$ without compromising external balance and, therefore, without causing the exchange rate to fluctuate. It accomplishes this by the appropriate combination of fiscal and monetary policies, which is referred to as \textbf{fiscal and monetary policy coordination}. As an example, consider an economy with relatively mobile capital. The appropriate levels of expansionary fiscal and monetary policies would shift the IS and LM to the right such that their intersection remains on the BP curve (see Figure 7.13).

\section*{The IS/LM/BP Model and Shocks to External Balance}

In addition to goods-market shocks that shift the IS curve, and financial market shocks that shift the LM curve, there are also shocks that move the BP curve. In fact, it is important to distinguish between two different types of shocks to the BP: current account-oriented shocks and capital and financial account-oriented shocks.

Current account-oriented shocks (or CA shocks) change the conditions in which external balance is met by changing the level of net exports that corresponds to each possible level of output ($Y$). For example, consider the effect of an increase in foreigners’ tastes for domestic goods. This would increase exports (and, therefore, net exports) for every possible level of $Y$, which would mean an increase in credits relative to debits for any $Y$ considered. All the pairs of $Y$ and $r$ where external balance previously held would now, with the increase in credits, represent conditions where there is pressure for the currency to appreciate, i.e., those combinations of $Y$ and $r$ where external balance exists after the change? Because either fewer credits and/or more debits are needed to regain external balance, each point on the initial BP curve needs to move to the right (i.e., the increase in $Y$ increases imports and, therefore, debits in the CA) and/or move down (i.e., a decrease in $r$ reduces capital inflow and, therefore, credits in the KFA, as well as promoting capital outflow recorded as debits in the KFA).

From the standpoint of any single combination of $Y$ and $r$ that initially provided external balance (i.e., any point on the initial BP curve), we can hold $r$ constant and consider the increase in $Y$ needed to regain external balance. Of course, the necessary increase is a function of the economy’s $mpc$, $t$, and $mpm$, since they help determine the actual level of imports for a given level of $Y$. But the same increase in $Y$ would be required regardless of the mobility of capital. Thus, one could think of the increase in foreigners’ tastes for domestic goods as shifting (all points of) the BP curve to the right (see Figure 7.14). Although it is also possible to assess the decrease in $r$ needed to re-attain external balance, the required decrease would vary with the degree of capital mobility. This complicating feature makes such an assessment an interesting exercise, but the former, simpler view that the shock shifts the BP curve to the right is reliably correct.

Whereas this particular CA shock shifts the BP curve to the right, similar reasoning would show that a decrease in foreigner’s tastes for domestic goods would cause the BP curve to move to the left. Another example was provided above (in the discussion of the IS/LM/BP model under flexible exchange rates) of how a CA shock – in the form of a change in $e$ – shifts the BP curve laterally. The same reasoning from these examples supports the general rule that any CA shock shifts the BP curve laterally. Consequently, the effect of a CA shock varies with capital mobility. At one extreme, consider the case of a CA shock on an economy with perfect
capital mobility: A lateral shift of the horizontal BP curve would effectively leave the BP curve unmoved!

In contrast, capital and financial account-oriented shocks (or KFA shocks) change the conditions in which external balance is met by changing the level of capital flows that corresponds to each possible interest rate (r). For example, an increase in foreign interest rates by 1% (assuming the rrp remains unchanged) would cause capital outflow (as per the portfolio balance approach). All the combinations of Y and r that formerly maintained external balance would now include more KFA debits as people sold the domestic currency in route to purchasing the high-yielding foreign bonds. Re-establishing external balance would require more BOP credits and/or fewer debits, which would be generated by higher domestic interest rates and/or reduced Y (and the corresponding reduction in imports/debits).

For any given combination of Y and r that originally satisfied external balance, the increase in foreign interest rates by 1% would, in the absence of a change in Y, require domestic interest rates to rise by the same 1% to maintain external balance. Thus, the KFA shock could be interpreted within the model as a vertical shift of the BP curve by 1%. One could also figure how much Y would have to fall to counter the increased debits (and fewer credits) in the KFA account from the 1% increase in foreign rates, but the requisite change in Y would vary with the level of capital mobility. The simple vertical shift of the curve captures the same effect without needed to account for capital mobility.

It follows that a drop in foreign interest rates would cause the BP curve to shift down. Furthermore, comparable reasoning would show that any KFA shock causes the BP curve to shift either up or down. It is interesting that in the extreme case of a country with perfectly immobile capital, a vertical shift of the BP curve due to a KFA shock is essentially imperceptible.

In addition to CA and KFA shocks shifting the BP curve in different ways, they differ in one other respect: A CA shock not only shifts a country’s BP curve (laterally), it also shifts the IS curve since the country’s CA (i.e., its exports minus imports) influences equilibrium in the goods market. With the example of the increase in foreign tastes for domestic goods discussed above, the increased exports also shifts the IS curve to the right (see Figure 7.15). It is no coincidence that the BP and IS both move in the same direction, i.e., this will always be the case with CA shocks. Furthermore, the horizontal shift of the BP curve will always be farther than that of the IS curve for reasons parallel to those explaining why the BP moves farther than the IS due to a change in e (described in Footnote #1). An example of IS/LM/BP analysis of a CA shock is provided below in the section addressing revaluing and devaluing a currency.

In contrast, KFA shocks that shift the BP curve vertically are not automatically accompanied by shifts in either the IS or LM curves. As an example, Figure 7.16 illustrates the effect of an increase in foreign interest rates on an economy with a fixed e and relatively immobile capital. The KFA shock shifts the BP curve up, leaving the economy with a BOP deficit (still at point A). The associated reduction in the money supply shifts the LM curve to the left until the IS and LM once again meet on the BP line where there is external balance.

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2 Actually, it could be argued (and supported by the portfolio balance approach) that many FA shocks (such as an increase in foreign interest rates) would influence domestic money demand and would, therefore, modify the LM curve. But due to the relative weakness of that effect and the desire to simplify the IS/LM/BP model analysis, it is assumed away (i.e., ignored) in the examples and questions in these handouts.
Revaluing or Devaluing a Currency

An example of a policy induced CA shock is the revaluing or devaluing of a country’s currency by its monetary authority, i.e., the changing of a country’s fixed exchange rate. Consider the case in which a country devalues its currency. The lower $e$ would increase exports and lower imports, which would shift out the IS curve while simultaneously shifting out the BP curve (even farther). Figure 7.17 illustrates the effect of the devaluation for a country with relatively mobile capital. Note that the shifts of the two curves in response to the policy-induced shock cause the economy to be in BOP surplus (at point B). Given that the exchange rate is fixed at the new $e$, the BOP surplus increases the money supply until the LM curve has shifted out sufficiently for the BOP to be back in balance (at point C). Again, because external balance is regained at a higher $Y$, the policy is termed “effective.”

It is interesting to compare Figure 7.17 with Figure 7.12 that depicts expansionary monetary policy under a flexible exchange rate for a country with the same capital mobility. Together the diagrams reveal that the net effect of the two different policies is the same. In one case, devaluing the currency shifts the IS and BP curves and precipitates a BOP surplus that increases the money supply. In the other, an increase in the money supply causes the currency to depreciate, which brings about shifts of the IS and BP curves. The effectiveness of both policies depends on the same beggar-thy-neighbor increase in net exports. The great similarity between the two situations divulges how devaluing a currency is essentially a backdoor way of expanding the monetary policy when supposedly maintaining a fixed exchange rate. It remains true (as demonstrated above) that a fixed exchange rate precludes the possibility of discretionary monetary policy. But, if a country is willing to break its promise to honor one exchange rate and revalue or devalue it, then it can decrease or increase its money supply accordingly.

Key Terms

- BP Curve
- CA shock
- endogenous variable
- exogenous variable
- external balance
- KFA shock
- fiscal and monetary policy coordination
- incipient BOP surplus/deficit
- injection’s multiplier
- IS Curve
- Keynesian Cross model
- LM Curve
- marginal propensity to consume
- marginal propensity to import
- monetary rule
- perfectly immobile capital
- perfectly mobile capital
- sterilization
- unplanned investment