Christiano
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Lecture #17: Imperfect Asset Substitutability

1. Introduction: Delusions that can Lead a Central Banker to Produce a First Generation Currency Crisis. There are several reasons why central bankers may take actions that result in a 'first generation' currency crisis. They may find themselves in a situation where the conflict between maintaining a fixed exchange rate and domestic priorities is acute. This could happen when there is a bad aggregate demand shock. Then, a fixed exchange rate policy requires reducing the money supply, exactly the opposite from what domestic priorities would dictate. Similarly, if the country with which the central banker has a fixed exchange rate raises its interest rate, then the central banker must raise domestic rates to preserve the fixed exchange rate regime. But, this may conflict sharply with domestic priorities if the economy is already in a recession, for example.

   Central bankers who find themselves in a conflict between domestic and fixed exchange rate priorities may try and delude themselves into believing that they have two tools available. One is the money supply, and one is something else. The money supply can be used to pursue domestic priorities, while the 'something else' can be used to keep the exchange rate fixed.

   There are various other tools a central banker may appeal to. The more difficult the situation, the more exotic set of tools the central banker may try out. One possibility, for example, is to send high-level government ministers to make pronouncements on television that 'everything is under control'. Such a policy may in practice work for a while, if it convinces potential speculators that the government may do something serious to defend the exchange rate. A more sophisticated strategy may be to take an action, like convert part of the government's debt into foreign denominated debt. By making a devaluation of the currency costly for the government, this may also convince people for a while that the government must be pursuing policies that are consistent with the maintenance of the fixed exchange rate regime.

   A still more sophisticated version of the idea that the government has two tools available for the conduct of monetary policy is based on 'imperfect asset substitution'. This is the subject of these notes.

   If a central banker comes to believe that he/she has the ability to maintain an exchange rate target and pursue domestic priorities independently, they may be tempted to do so. They might, for example, try to stimulate the economy by increasing the money supply, while

maintaining that they are committed to the exchange rate peg. Initially, traders may believe this, perhaps because they are not aware of the open market operations that the bank is doing to increase M. Although the central banker may 'get away with it' for a little while, in reality this is not likely to last for long. With this policy, the exchange rate peg is becoming increasingly unrealistic. Initially, individuals here and there are aware of what is going on, despite the central bank's claim that 'everything is fine'. At some point, as more people become aware that the government is pursuing an inconsistent monetary policy, E^e starts to go up in people's minds. Then, at some stage, a herd mentality sometimes takes over, as everyone starts thinking that everyone else is going to run and sell the domestic currency. People think, rationally, that if that happens the currency will depreciate for sure. In this case, a general 'rush to the exits' begins and a classic currency crisis is underway (see the last lecture).

2. Imperfect Asset Substitutability. To understand this, recall how we broke down total financial wealth, W, into money, M, and bonds, B :

$$W = M + B.$$

(Recall, what we call 'bonds' here actually includes all assets which promise a payoff.) The idea up to now has been that the way a central bank affects the economy is by changing the composition of wealth between money and bonds. The central bank can affect this composition by conducting open market operations, in which it buys bonds with money (an operation that expands the money supply) or sells bonds for money (an operation that contracts the money supply). According to the theory, the effects of these open market operations depend exclusively on their impact on the quantity of money. In particular, the effect does not depend on exactly *what* assets the central bank buys. In B, of course, there are lots of different types of assets. There are domestic government bonds and other assets issued domestically, as well as foreign government bonds and assets. The notion that the economic effect of an open market operation is the same, regardless of what asset the central bank buys corresponds to the notion that all assets in B are essentially the same to investors. This corresponds to the idea that there is *perfect asset substitutability.*

But, in reality assets are only *imperfectly substitutable.* Even assets that generate the same expected return are *not* the same. Different assets have different risks associated with them. This is why people like to diversify their holdings.[1] They don't want their portfolio to contain too

[1]In some respects, the amount of diversification in real-world households' wealth portfolio is very small. For example, a huge component of the typical family's portfolio is its own house.

much of one asset. To compensate them for holding a disproportionate amount of some asset, its rate of return has to be high.

The sensible idea that assets are imperfectly substitutable is the basis for a dubious idea that central banks can independently control the exchange rate *and* pursue domestic objectives. Last time, we pointed out how things can happen (a rise in R^*, a fall in aggregate demand) which appear to place a fixed exchange rate regime in conflict with domestic policy objectives (i.e., the objective of maintaining employment and output at their efficient level.) It would be dream come true for the central banker if at a time like this, it had *two* instruments, one that allowed it to target the exchange rate and the other that allowed it to pursue domestic objectives. Unfortunately, the evidence suggests that, at best, the central bank has only one instrument, its control over the stock of money, M, that it can use to affect the economy. Still, enough people believe the two-instrument theory coming under the heading, 'imperfect asset substitutability', that it deserves to be spelled out.

This is how it works. Let's split bonds, B, into two parts, B^d and B^f. B^d is domestic assets and B^f is foreign assets. Domestic government debt is contained in B^d and the debt of foreign governments is contained in B^f. By conducting the right set of open market operations, the central bank can alter the composition of B^f and B^d in B, while leaving M unchanged. To see how this works, suppose the central bank buys \$100 worth of B^f. This has the following effect on the central bank's balance sheet:

Assets	Liabilities
+\$100 B^f	+\$100 M

Now, suppose that the central bank 'sterilizes' the impact of this operation on the money supply. It can do so by selling \$100 of domestic assets to the public. The combined effects of the two transactions is given in the following table:

Assets	Liabilities
+\$100 B^f	+\$100 M
-\$100 B^d	-\$100 M

Note that the net effect of the two transactions is to keep the money stock unchanged and to alter the composition of assets in the possession of the central bank. The theory we have developed up to now has the implication that there is no impact on the economy of these two operations. They have no effect because they have no impact on M.

Those who focus on the limited substitutability of assets believe that

these transactions do have an effect. They note that the two open market operations leave the public holding a larger share of B in the form of B^d. The idea is that to get them to accept the risk of holding a relatively larger fraction of their eggs in one basket (i.e., a higher fraction of B in the form of B^d), they have to be compensated with a higher interest rate. That is, the return on domestic assets, R, must exceed the expected return on foreign assets, $R^* + (E^e - E)/E$, when B^d/B is higher. The amount by which the domestic interest rate must be higher is called the risk premium, which is which is captured by the function, $\rho(B^d/B)$. The function, ρ is increasing in its argument. Then, the interest parity relation, modified to accommodate limited asset substitutability, boils down to:

$$R = R^* + \frac{E^e - E}{E} + \rho(\frac{B^d}{B}).$$

This says that the return on domestic assets, R, has to be equal to the foreign nominal return plus the anticipated rate of depreciation in the exchange rate, *plus* a risk premium. That is, the expected rate of return on domestic assets has to be *higher* than the expected rate of return on foreign assets, $R^* + (E^e - E)/E$, if a large fraction of B is in the form of B^d. Another way to put all this is that, if when B^d/B is high the expected return on domestic assets were simply equal to the expected return, $R^* + (E^e - E)/E$, on foreign assets, then people wouldn't be happy with the composition of their portfolios. They would try to reduce their holdings of domestic assets, and increase their holdings of foreign assets.

These are the kinds of considerations that underlie the notion that there are, in effect, two channels by which the central bank can affect the domestic economy. One operates via its control over the fraction of wealth held in money and bonds. The other operates via its control over the fraction of domestic and foreign assets in B. To see the implications of this for monetary policy, let's consider a few experiments. In each case, they involve temporary policy actions, so that we don't have to worry about any changes in E^e.

(a) Example 1. Imperfect Asset Substitutability and the Effect of a Sterilized Purchase of Foreign Assets. Suppose the central bank executes the operation described above: a sterilized purchase of foreign assets. Let's see what the effects of this are in the $AA-DD$ model, modified to incorporate imperfect asset substitutability. The first step is to figure out how the AA and DD curves shift. Obviously, the DD curve does not shift, since no variable in that curve has changed. To understand the impact on the AA curve,

it is useful to first look at the curves from which it is constructed, namely, the UIP and money market equilibrium curves. These are displayed in Figure 1. Note how the UIP curve shifts up by the increase in the risk premium, $\rho(B^d/B)$. Now, if the level of output stays constant, then the change in E required to restore equilibrium in the asset markets is the horizontal shift from E_0 to E_1. Alternatively, if E remained constant, then the level of output, Y, necessary for equilibrium in the asset market would be a higher one. This would produce the higher money demand that would result in a higher interest rate, which would rationalize E_0 (shift money demand to the right, in Figure 1). These arguments establish that the AA curve shifts up and to the right with a sterilized purchase of foreign assets. This is indicated in Figure 2. Then, in the usual way, the economy starting from point 1 ends up at point 2 in the short run equilibrium.

What's the intuition about the move from point 1 to point 2? In the first instance after the sterilized purchase of foreign assets, the economy is at point 1, which is a point where the asset markets are out of equilibrium. People are uncomfortable with the compositions of their portfolios. At the given rate of interest and anticipated depreciation, they feel they're holding a greater fraction of their portfolios in domestic assets than they think is wise. So, they all try and sell domestic assets with the purpose of buying foreign assets. In doing this, they try to sell the domestic currency to buy the foreign currency. These attempts have the effect of producing a depreciation of the currency. The disequilibrium dynamics of the model are such that the exchange rate moves instantly to clear asset markets, so E jumps vertically from point 1 to the new AA curve in Figure 2. At the higher exchange rate the expected return on foreign assets has fallen because, given the unchanged E^e, the anticipated degree of depreciation, $(E^e - E)/E$, has become smaller. The expected return on foreign assets has fallen just enough so that the differential between returns on domestic assets and foreign assets compensates market participants for having their portfolios relatively concentrated in B^d.

With the depreciation of the exchange rate, the disturbance - which initially only affected asset markets - spills into the goods market. Now, foreign goods are relatively more expensive than domestic goods. To see this, recall that the relative price of domestic and foreign goods, q, is $q = EP^*/P$, and that we assume prices of goods are fixed in the short run. With the rise in q, CA rises and the demand for domestically produced output goes up. This causes unintended inventory accumulation, which leads producers to hire more workers and produce more output. The

increase in output generates feedback effects back into the asset market, as money demand rises (the horizontal move in Y puts us above the AA curve..also, recall that $L(R, Y)$ is increasing in Y). This generates a rise in the domestic rate of interest (so far, there has been no change in that!). The rise in R produces an appreciation of the currency, so that E falls back somewhat relative to the high level it jumped to in the immediate aftermath of the sterilized purchase of foreign assets. In this way, the economy 'slides' down the new AA curve in Figure 2 following the arrows, until all markets are in equilibrium at point 2.

So, by changing the composition of B, the central bank has managed to move the economy. It has done so without changing M at all. This shows how imperfect asset substitutability in effect gives the central bank a 'second tool'. One tool it has for affecting the economy operates via its control over M/B. The other operates via its control over B^d/B. Later we will argue that the existence of the second tool is doubtful, essentially because B^d and B are excessively large numbers for the central bank to have any appreciable impact on them. To a first approximation, it makes sense to think of ρ as being beyond the central bank's ability to control. But, for now we continue to explore the implication that ρ is a function of B^d/B, and that the central bank can exert a big enough impact on B^d/B to have a significant impact on ρ.

(b) Example 2. Imperfect Asset Substitutability and the Zero Bound Constraint on R. Recall from before that if the interest rate is zero, then our model implies the monetary authority loses the ability to stimulate the economy by engineering a depreciation of the currency. This is because in that model the channel by which the monetary authority accomplishes a depreciation operates via its ability to reduce the domestic rate of interest, R. When $R = 0$, the interest rate is at its lower bound and further reductions are impossible. It is useful to briefly review this result. The situation in the asset market is displayed in Figure 2a. Note how the money demand curve flattens out at $R = 0$. That's because at this point people are indifferent about how they split their financial assets between money and bonds. In this case, the increase in money demand that occurs with an increase in income, as Y increases from Y_1 to Y_2 in the figure, has no impact on the interest rate, and therefore on the exchange rate. Since the AA curve is the set of R, Y where the asset markets clear, it follows that the AA curve is flat, as depicted in Figure 2b. It is easy to verify that an increase in M has no impact on the interest rate in Figure 2a and therefore on the exchange rate. In terms of Figure 2b, an increase in M does not shift the AA curve up, as it does in our analysis

with $R > 0$. It follows that in the $AA - DD$ model, an increase in M has no impact on Y in the short run. With M having no impact on either the AA curve or the DD curve, it cannot have an impact on equilibrium output, Y. Even in the 'alternative model', where I is a negative function of the interest rate, and increase in M has no effect when $R = 0$.

From the previous example, it is perhaps obvious that with imperfect asset substitutability, the central bank does have the ability to move the economy after all, even if $R = 0$. A sterilized purchase of foreign assets by the central bank would shift the AA curve up and produce the effects indicated in Figure 2, with one possible important exception. In the discussion underlying Figure 2, the slope of the AA curve was negative, so that as the economy expanded with the depreciation in E, money demand rose and drove up R somewhat (this corresponds to the arrows in Figure 2). This would mitigate the rise in E produced by the central bank action, softening the ultimate impact of that action on Y. When $R = 0$, the increase in money demand that occurs with a rise in Y might not lead to a rise in R.[2] This is what happens when AA is horizontal. Thus, with $R = 0$, we don't get the secondary feedback loops into the goods market, with the initial rise in E being cut back as the economy expands. Thus, the channel of monetary policy operating through imperfect asset substitutability is actually stronger than when $R > 0$.

In this example, we considered the impact of a *sterilized* purchase of foreign debt, B^f, by the central bank. The sterilization part of this action is actually irrelevant when $R = 0$. The sterilization involves 'mopping up', through open market sales of domestic government debt, the increase in the money supply generated by the purchase of foreign debt. The mopping up part is of no consequence in the present situation because when $R = 0$ people are indifferent between M and interest-bearing assets.

It has been argued that the model with imperfect asset substitutability is the right way to think of the situation of the Bank of Japan. This has motivated some people to argue that even though $R = 0$, the Bank of Japan nevertheless has the ability to stimulate the economy. Although it can't do it through the normal channels emphasized up to now, it can do so by executing large-scale purchases of foreign assets. That would result in a depreciation of the currency, and a rise in demand for Japanese products.

(c) Example 3. Imperfect Asset Substitutability in a Fixed Exchange Rate Regime When Investment Is Exogenous. Suppose the central

[2] I am taking for granted that M/P lies to the right of the point where the two money demand curves in Figure 2a hit the $R = 0$ line.

bank is committed to a fixed exchange rate. The situation is depicted in Figure 3. The fixed exchange rate is E_0, which is indicated by the horizontal line. What it means for the central bank to target the exchange rate is that it manipulates its tools to make sure that the intersection of the AA and DD curves always occurs at a point on the horizontal line.

Consider first the effect of increasing B^d/B through a sterilized purchase of foreign assets. As before, this shifts the AA curve up. If the central bank does nothing to the money supply, the economy would jump vertically up to the AA' curve, and then slide down to the right where AA' intersects DD, as in example 1. But a central bank in a fixed exchange rate regime cannot accept this, because it would violate the exchange rate target, E_0. So, it has to pull the AA curve back from AA'. It can do so by reducing the money supply. Suppose the central bank does this without changing B^d/B, so we don't have to worry about any more changes in ρ. If R does not enter into the DD curve, then the AA curve must be pulled back to where it was before, with no effect on the equilibrium level of output. Thus, in the model with imperfect asset substitutability and exogenous I, the central bank cannot control output. One way to see why this is is to notice that the location of the DD curve cannot be influenced by policy in this case. This means that the location of the intersection of DD with the horizontal line indicating the exchange rate target cannot be affected by the central bank.

(d) Example 4. Example 3, In the Model Where I is a Decreasing Function of R. Let's think of two 'pure' policy actions. The first one reduces B^d/B without changing M. This is accomplished by an open market purchase of domestic assets, with the effect on M sterilized by an appropriate open market sale of foreign assets. The second one increases M without changing B^d/B. This is accomplished by purchasing all assets in equal proportion.

The situation in the DD and AA curves is depicted in Figure 4. The reduction of B^d/B shifts the AA curve back. This is just the reverse of the policy considered in example 1. If nothing else were done, this would cause a drop in E and in output. A central bank under a fixed exchange rate cannot accept this, and must move the AA curve back up to the right, to ensure that the exchange rate peg remains the market exchange rate, i.e., to ensure that the AA curve intersects the DD curve at the horizontal line. The second policy action in the previous paragraph accomplishes this. The increase in M shifts the AA curve to the right, by reducing R and thereby raising E back up to E_0. But note that as R falls

with the right-shift in AA, the DD curve begins to shift right. As a result, the new short run equilibrium is one in which the equilibrium level of output is higher. Thinking of the two pure policy operations simultaneously, what the central bank has done is to purchase domestic debt and not fully sterilized the purchase. The beauty of this is that this is precisely what a central bank under a fixed exchange rate and a weak economy would want to do! The imperfect asset substitutability story rationalizes this and says it's ok. Of course, suppose the imperfect asset substitutability story were false. Then, the net effect of the central bank's policy is to shift the AA curve to the right of the original position, with the consequence that the appropriate market exchange rate is higher.

This example shows how an expansionary monetary policy can in principle expand the economy while remaining consistent with the fixed exchange rate. This is the 'holy grail' of the central banker caught in a conflict between domestic priorities and the fixed exchange rate regime. It is too bad that the imperfect asset substitutability hypothesis on which it is based is dubious.

3. Does the Central Bank in fact Have Two Tools? The previous discussion suggests that, in principle at least, the central bank can independently target the exchange rate and the domestic economy. Most economic researchers who have tried to use the data to determine if this is in fact true come away with the conclusion that a central bank cannot, over a reasonable time horizon like a month or more, influence the exchange rate by changing B^d/B. One problem is that the open market operations necessary for a central bank to significantly affect the ratio B^f/B, would have to be very large. The situation is very different with respect to M. When the central bank does an open market purchase of B, it has a potentially large effect on M. This is because the resulting increase in M is likely to be a multiple of the actual increase in banking system reserves generated by the open market purchase itself. (See the 'money multiplier' in any standard intermediate macro text such as the one you would have used in 311).

4. Costs and Benefits of Fixed Exchange Rates.

   In the past several lectures we have emphasized the downside of fixed exchange rates: they deprive the central bank of the ability to stabilize the economy and they require that the central bank take socially costly measures to defend the exchange rate when there is a loss of confidence in the peg.

   Yet, countries in various times and places have adopted fixed exchange rates. What did they hope to gain from this? They obviously thought the benefits would outweigh the costs. So, what are these benefits?

The main benefit is that fixed exchange rates reduce the incidence of high inflation that a lot of countries have experienced. These high inflation episodes reflect one of several things. Governments bring pressure to bear on the central bank to increase the money supply. This can happen when the government wants to spend money, but it is unwilling or unable to raise taxes. Under these circumstances, the central bank essentially prints the money for the government by a mechanism in which the government issues debt, and the central bank buys the debt (this is how the money supply increases over time in countries like the US). High inflation can also occur if the central bank simply tries to expand the economy repeatedly over a period of time because it wants to expand the economy.

Going to fixed exchange rates can help. Ignoring the dubious story about limited asset substitutability, a central bank essentially loses control over the money supply when it is on fixed exchange rates. Then, it cannot simply print money to finance government expenditures, or to fine tune the economy. Similarly, there is some chance that it reduces its vulnerability to 'expectation traps', in which private expectations of high inflation drive the central bank to supply high inflation. For example, it is possible to work out that if people expect higher prices, and just raise the price level in response the rise is self-fulfilling as the central bank feels it has to validate the higher prices to avoid a recession.[3] If there was a general perception that the central bank had no control over the money supply, then it would not make sense for anyone to raise their prices in anticipation that inflation might take off.

Of course, there is the downside of fixed exchange rates, the crises that occur when speculators lose confidence in the peg, raise E^e and impose the need for the central bank to mount a costly defense. However, this downside can be minimized. One option is to adopt an institutional reform that makes the fixed exchange rate regime much more credible. Then, at least, you may reduce the instability that can come from speculation.

There are three types of institutional reforms that countries have adopted. One, adopted in Argentina in the early 1990s, is to adopt a currency board. A currency board is required to hold given amount of foreign currency as backing behind the domestic currency. Since the amount of foreign currency is limited, a currency board in effect limits the extent to which domestic money can be over-issued. In practice, this type of reform does not drive speculators away completely. They understand

[3]The hypothesis that this is part of the story of the high inflation in the 1970s is discussed in Christiano and Fitzgerald, 'The Expectation Trap Hypothesis', Federal Reserve Bank of Chicago *Economic Perspectives*, 2000.

that the law behind the currency board can be changed at any time, especially times when the fixed exchange rate regime comes into conflict with domestic priorities, as it has recently in Argentina. These considerations have driven some people to consider alternative institutional reforms that might work better.

Two such types of reform are currency unions and 'dollarization'. A currency union occurs when a group of countries gets together and adopts the same currency. This is what the thirteen US colonies did at the time they ratified the US constitution. This is what the European economies have just done. Here, you have to be a little careful. As discussed in previous lectures, you don't want to form fixed exchange rates with countries that are very different from yours.

Dollarization is an institutional reform being considered by several countries in the Western Hemisphere. This is like a currency union, but with a twist. Under dollarization, a country adopts the US dollar as its currency. However, that country has no control over how monetary policy is conducted. This is different from a currency union, where all the members in the union participate as equals in making monetary policy.

Whether a country dollarizes or goes into a currency union, it probably would reduce the likelihood of a loss of confidence by currency speculators. (See the paper by Marcello Veracierto and Francois Velde on the web site.)

One very small institutional change that can help ward off the problem of speculators is capital controls. Under laws like this, the government can declare, in case of emergency, that people are not allowed to 'take currency out of the country', i.e., sell domestic currency. This can certainly cool the heels of people contemplating a 'run for the exits'. There are several potential problems with capital controls. First, the fear of creating a currency crisis is one factor that disciplines governments to adopt the kind of responsible (i.e., low money growth) policies that are consistent with a fixed exchange regime. By removing this disciplining device, a currency board may, paradoxically, increase the likelihood of irresponsibility. Second, capital controls are a little like a draw bridge between a country and the rest of the world. If people understand that that bridge may be raised and stop you from getting out of the country, they may choose not to go there in the first place. Of course, this can cut the other way too. An investor who is aware that the country can impose capital controls in the event of a crisis, may be *more* willing to invest in that country if he/she believes the capital controls will enhance the stability of the country.

The upshot of all this is the following. There are some potential gains to fixed exchange rates. However, one downside is the credibility of the

regime. Lack of credibility can put the government in situations where a costly defense is required. People argue that there are two responses to this. One is to just forget about fixed exchange rates altogether. The other is to get much more serious about it, by dollarizing or forming a currency union.

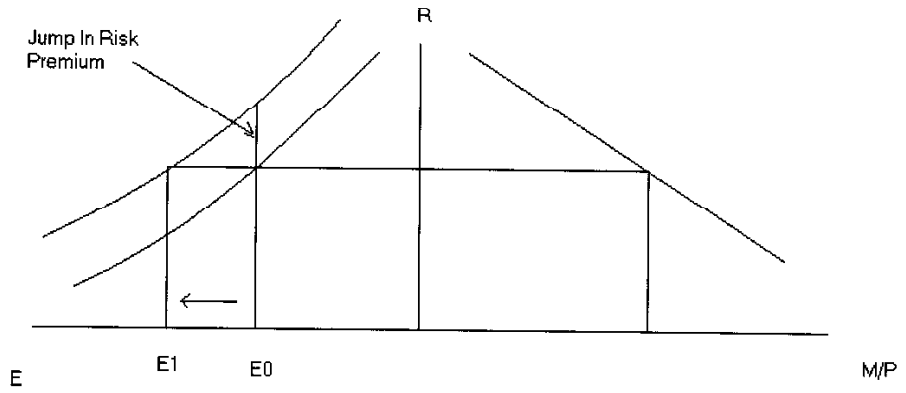

Figure 1: Effect of Open Market Operation That Leaves Money Stock Unchanged, But Increases Private Holdings of Domestic Government Debt

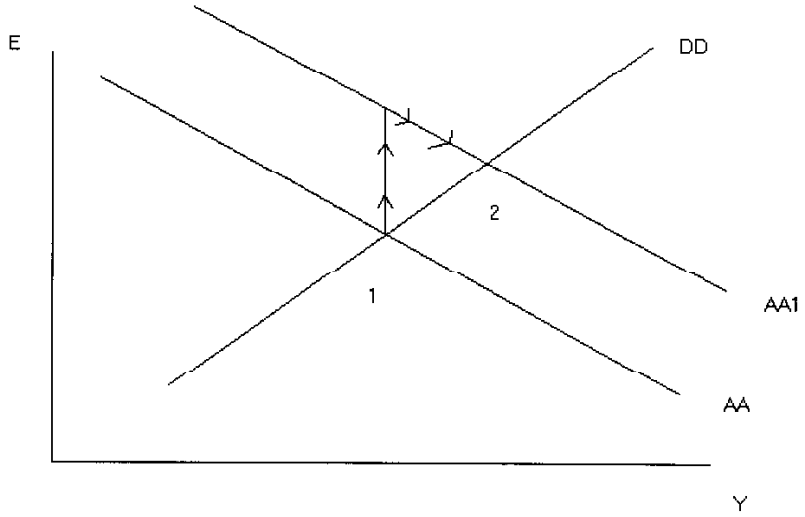

Figure 2: The Effect of a Sterilized Purchase of Foreign Assets, Under Imperfect Asset Substitutability.

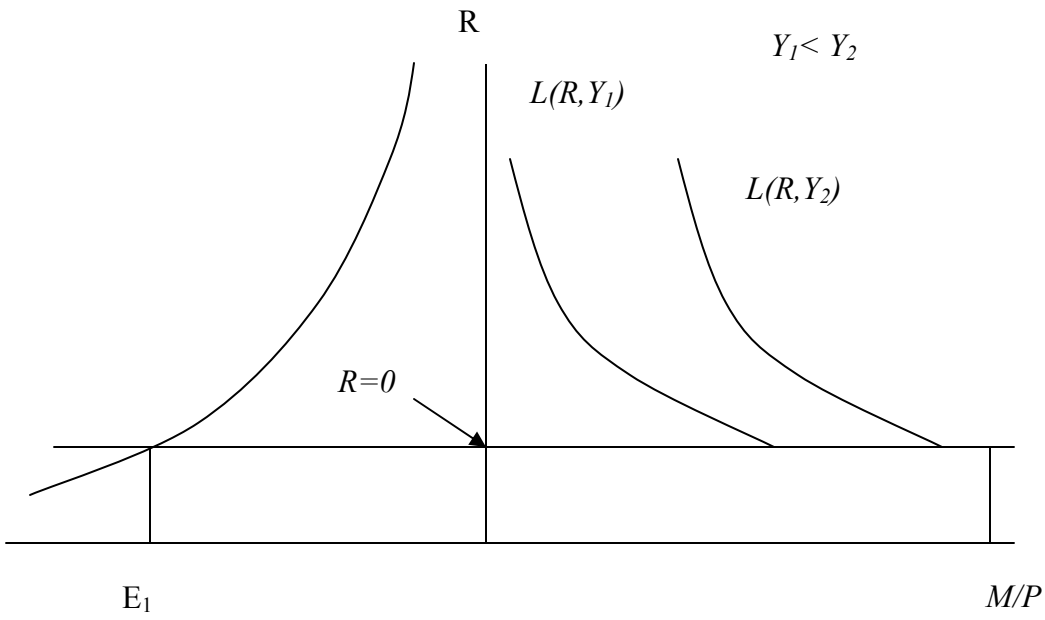

Figure 2a: No Effect on E and R when Y Increases and R=0

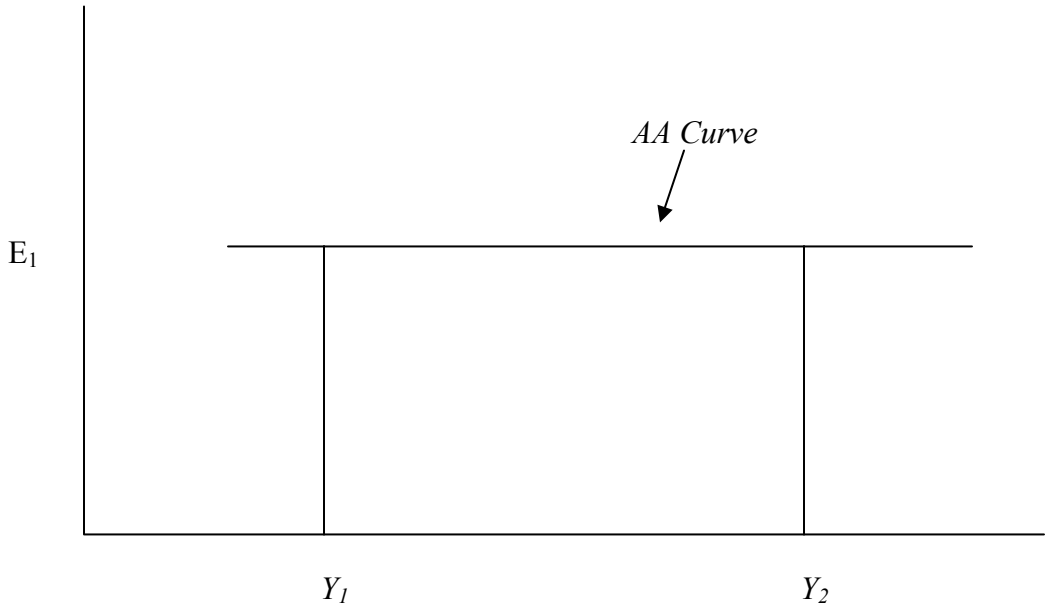

Figure 2b: AA Curve Corresponding to Situation in Figure 2a

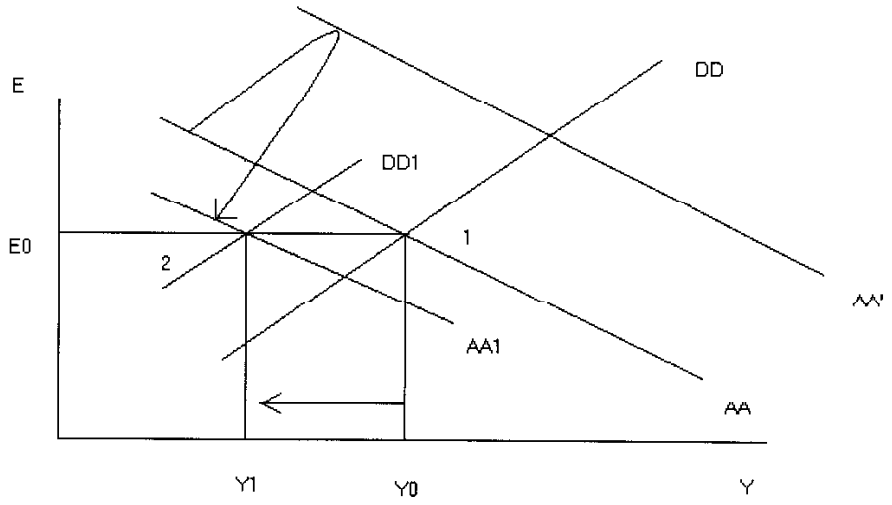

Figure 3: The Effects of a Contractionary Open Market Operation Which Keeps the Exchange Rate Fixed, When Foreign and Domestic Assets are Imperfect Substitutes

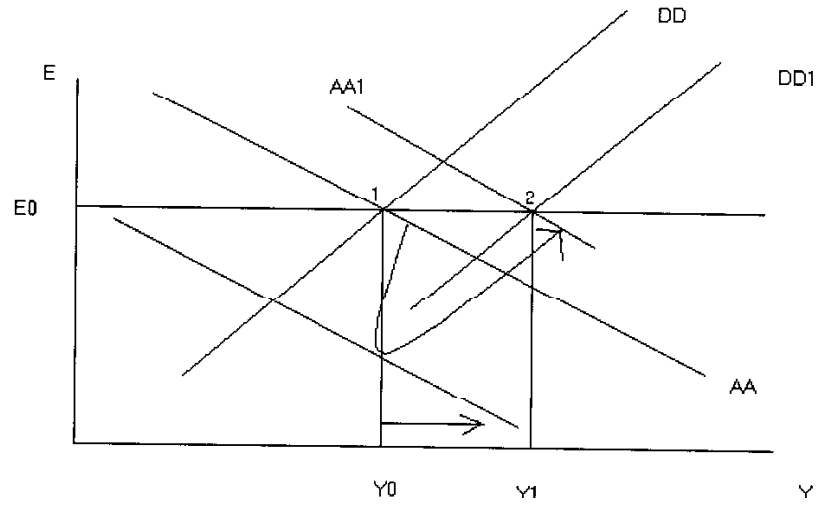

Figure 4: Effect of Expansionary Monetary Policy Under a Fixed Exchange Rate Regime When Domestic and Foreign Bonds are Imperfect Substitutes.