ADDITIONAL NOTES FOR MACRO 2A

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These additional notes are to be read in conjunction with your lecture notes and the readings prescribed for the course. The note deals with the following issues.

(1) Price and Exchange rate path in the flexible price model
(2) Central Bank's Balance Sheet and its management of money supply though the reserves
(3) Sterilised and Non-Sterilised intervention by the Central Bank
(4) Greek Tragedy: Flouting of Growth and Stability pact and its impact on the risk premium on Euro denominated bonds

1. FLEXIBLE-PRICE MONETARY MODEL

This is from International Lecture 2. The question seems to revolve around what happens in the Flexible-price monetary model when there is a change of money supply.

Discussion of the Model.

$$P = \frac{M}{L(i,Y)} \qquad \text{(Money Market Equation)}$$

$$e = \frac{P}{P^*} \qquad \text{(Exchange Rate Equation)}$$

$$i = r + \pi^e \qquad \text{(Fisher Equation)}$$

Due to price flexibility, nominal variables like price, exchange rate and interest rates are determined in the money market. The real variable are determined in the goods market. Important to remember that this is not a long–run model per se. Rather it is a model of price flexibility. We are often told that prices are flexible in the long run but this model would also describe the world if all the prices were instantaneously flexible.

The lecture notes seems to ignore what happens to the goods market. If the prices are flexible, the economy would always be on the potential output so that $Y = Y_P$.

> In $P - Y$ space, the aggregate supply curve is vertical and whatever the demand is, the output is always Y_P. Put another way, any fiscal or monetary policy is purely inflationary and the output remains unaffected.

So, the goods market would look as follows.

$$Y_P = C(Y_P - T) + I + G + CA(\epsilon, Y_P) \tag{Goods market}$$

With flexible-prices, the economy is always at Y_P. There is only one variable in the model, that is the real exchange rate ϵ. So, the good market solves for ϵ such that ϵ is constant. In the lectures notes, the model is simplified further and it is assumed that $\epsilon = 1$ so that exchange rate is $e = \frac{P}{P^*}$

Impact of the Money Supply. Money supply has a direct and indirect impact on the prices. The direct impact is through the money market equation above. The indirect impact is through the Fisher equation and the money demand L. The exchange rate just follows the price the exchange rate equation.

Policy: Decrease in Money Supply. If the money supply growth decreases $\hat{M} \downarrow$, the following process ensues.

- Money growth decreases, $\hat{M} \downarrow$, at t_0.
- This affect the price path in two distinct way. The first is the slope of the price path and the other is the instantaneous jump in the price path. Lets analyse the two process below.
  The Slope ...
    - *decrease in money growth* leads to slower growth of price or inflation $\hat{P} \downarrow$ at t_0.
  The Jump ...
    - *decrease in money growth* leads to drop in the interest rates due to lower expected inflation

$$i \downarrow = r + \pi^e \downarrow \tag{Fisher equation}$$

  - In the flexible-price model, price decreases instantaneously/jumps down $(P \downarrow)$ at t_0 due to increase in interest rate because

$$\downarrow P = \frac{M}{L(i \downarrow, Y)}$$

- *The price path ...*
    - In the $p - t$ space, the price path has a lower slope and the a jump down as soon the money growth slows down at t_0.
- *The Exchange rate path ...*
    -

– The Exchange rate is determined by the the following equation and thus follows the price path.

$$e = \frac{P\downarrow}{P*}$$

Like the price path the exchange rate path in the $e - t$ space has a smaller slope ($\hat{e}\downarrow$ exchange rate starts depreciating at a slow rate) after t_0 as well as jump down ($e\downarrow$, exchange rate appreciates immediately) at t_0 once the money growth slows down.

For the case of an increase in money supply, just the reverse the process and work through the same process.

2. CENTRAL BANK ROLE IN THE MONEY MARKET

The Central Bank's balance sheets looks like this.

Assets	Liabilities
Domestic Assets A	Currency C
Foreign Reserves F	Reserves of Domestic Banking System R

The domestic banking system keeps a certain amount of reserves with the Central Bank. The minimum requirement is calculated on average on a fortnightly basis. So, lets take the example of a particular bank in UK, the Barclays. Let R^{Barclays} be the amount Barclays leaves with the Central Bank over the period of the fortnight.

Barclays leaves a certain amount of money, which gets attributed to R^{Barclays}, in the Central Bank's balance sheet. The minimum requirement is calculated over a period of a fortnight. So, if it so happens that Barclays has left in the Central Bank's R more than required to, then the $R^{\text{Barclays}} > R^{\text{Barclays}}_{\min}$. This would mean that ex post Barclay's excess reserves $R^{\text{Barclays}}_{\text{e}} > 0$. On this $R^{\text{Barclays}}_{\text{e}} > 0$, the Central Bank would pay an interest rate which amounts to $i_{\text{repo}} - 100bps$. Similarly, if $R^{\text{Barclays}} < R^{\text{Barclays}}_{\min}$, then $R^{\text{Barclays}}_{\text{e}} < 0$ and the Barclays has effectively borrow the negative excess reserves from the Central Bank at $i_{\text{repo}} + 100bps$.

The question is why the R^d curve downward sloping with respect to the interest rate. That is because demand for excess reserves $R^{\text{Barclays}}_{\text{e}}$ is affected by the interest rate that Barclays pays for it. If the i_{repo} is low, the opportunity cost of leaving too much reserves with the Central Bank is low and by the same measure the demand for excess reserves is high. Conversely, if i_{repo} is high, the penalty for leaving not enough with the Central Bank is high. So, the Barclays would like to be cautious and leave more with the Central Bank and this in effect increases its demand for excess reserves. This is how the i_{repo} rate affect the reserves in the local banking system.

Where does the central Bank get money to buy Securities?

The printed money becomes the legal tender or IOU only once the Central Bank buys something with it. Before that, if these printed notes were lying in the Central Bank's vaults, they would not appear on its balance sheet. It is only once the Central Bank buy lets say securities with it appears on it balance sheet.

3. Sterilised and Non-Sterilised Intervention

What is the difference between Sterilised and Non-Sterilised Intervention?
Lets take the sterilisation process in steps. Lets say the sterilisation entails the Central Bank buying dollars. (You can follow the logic and analyse what would happen if the Central Bank was selling dollars.)

(1) Central Bank or Bank of England (BoE) is buys dollars which increases its Foreign Reserves ($F \uparrow$). The transaction means that BoE has more dollars now but has paid for it by giving out pounds to people it bought the dollars from. The dollar reserves in the Central Bank increase ($F \uparrow$) and so does the pounds held by the people in the economy. (Note that the pounds only became legal tender once dollar was bought with it. Before that they were in the BoE's vaults but since nothing had been bought with it, they were just fancy money and did not appear on the Central Banks balance sheet.)

What do the people do with the pounds they got from the Central Bank. Either they keep it in the form of currency or put it in Barclays or other high street banks like Natwest etc. All the pounds given out by the Central Bank would be accounted by increase in C and R. Either the people keep it in currency or deposit it in the high street bank, where is starts the money multiplier process.

So, increase in dollar reserves is accounted for by the increase in the high powered money ($H = C + R$) in the economy, that is $\Delta F = \Delta R + \Delta C = \Delta H$.

Consequently, this Intervention leads to increase in the high powered money in this case. If the process just ends here, we would call it an *Non-Sterilised Intervention*. But sometimes the Central Banks takes another step if they do not like the idea of money supply increasing in the economy as a result of the buying dollars.

(2) With the first step, the Central Bank has more dollars with it and the economy has more pounds in form of high powered money. The first step ended up creating more money in the economy. If the Central Bank wanted to increase its F without increasing the money supply in the economy, what would it have to do. If you look at the Bank's balance sheet, you would notice that this could only happen if in the next step the Central Bank decreases the A with the same amount. That is, is sells domestic bonds of commensurate value to counteract the increase in pounds in the economy.

The sale of bonds mean that people give the central bank the currency or pounds in return for the bonds. This mops up the increase in pounds that resulted from the first step. So, $F \downarrow$ and a commensurate $A \uparrow$ such that $\Delta F = -\Delta A$.

Buying dollars and then selling domestic bonds to mop up the increase in pounds that resulted from the first step of buying dollars is called *Non-Sterilised Intervention.*

What is the big difference between Non-Sterilised and Sterilised Interventions?

- Non-Sterilised Interventions results in the increase in money supply and increase in the Central Banks asset holdings.
- With Sterilised Interventions, there is no increase in money supply. Central Bank's asset composition changes. In the example above, the Central Bank's dollar reserves increases but holding of domestic bonds decrease leading to change in the composition of its asset holdings.

4. A Greek Tragedy: Risk Premium Increase
due to Flouting of Stability and Growth Pact

The Stability and Growth pact ensures that Euro zone's each constituent economy's fiscal debt is under control. Each Euro Zone economy is supposed to ensure that the following two constraints are adhered to:

(1) The annual budget deficit no higher than 3% of GDP.
(2) The national debt lower than 60% of GDP or lower.

There is mechanism in place where the Euro Zone countries are supposed to punish a member state that flouts the rule but in the past the members states have never been punished. Presumably because each country thinks that it could be flouting the rules in the future and thus hesitates to the punish the country flouting the rules currently.

To understand the impact of this on risk premium, we would have to look at a model of imperfect asset substitutability where domestic bonds are imperfect substitutes for foreign bonds.

The pure form of Uncovered Interest Parity (UIP) does not hold. The UIP has to account for the ρ risk premium on the domestic bonds.

$$i = i^* + \hat{E}(e) + \rho \qquad \text{(Risk premium adjusted UIP)}$$

The supply of domestic bonds is given by

$$B^S = B - A \qquad \text{(Bond Supply)}$$

where B is the bonds issued by the domestic government and the A is the amount of those domestic bonds held by the Central Bank. So, the net supply of domestic bonds is $B - A$. The private demand for bond is given by

$$B^d = B^d(\rho, \sigma_B)$$

where ρ is the risk premium people put on the domestic bonds and σ_B is the volatility of the domestic bonds. We would expect B^d to be decreasing in σ_B. Conversely, B^d is increasing in ρ the risk premium. That is because as the risk premium realised on buying a bond increases, people are more inclined to buy it.

Putting demand and supply of bonds together, we obtain the equlibrium in terms of the value of the risk premium given by

$$\rho = \rho(B - A, \sigma_B)$$

As the net supply of bonds $(B - A)$ increases or the bond volatility σ_B increases, the risk premium on the bonds ρ increases.

What impact does flouting the Growth and Stability pact have on Euro exchange rate?

When the Euro zone economies flout the Growth and Stability pact, they exercise their sovereign rights as independent countries to issue bonds. Issuing bonds increases the net supply of Euro denominated bonds in the Economy $(B \uparrow)$.

Sterilisation:: Once a Euro zone country issued a quantity of bonds $(B \uparrow)$, if the European Central Bank (ECB) wants to keep the net supply of Euro denominated bonds $(B - A)$ constant, they would have to *intervene* and buy those bonds up $(A \uparrow)$. This would in turn increase the supply of Euros in the economy. The central bank can only *sterilise this intervention* by selling foreign currency and buying up the Euros. Thus, an increase in bonds by a Euro zone country leads to the loss of foreign currency for the ECB if it wants to keep the money supply constant.

No Sterilisation:: If the banks does not buy up the bonds, the $(B_A) \uparrow$ leading to increase in the risk premium, leading to an upward shift of the risk adjusted UIP curve $(i = i^* + \hat{E}(e) + \rho)$ in the $e - t$ space, leading to an depreciation of the currency. To see this explicitly write down the Risk-Adjusted UIP as

$$(i - i^* - \rho(B - A, \sigma_B) + 1)e = E[e]$$

This is a rectangular hyperbola with the axis at $e = 0$ and $i = i^* + \rho(B - A, \sigma_B) - 1$. If $\rho \uparrow$, the curve shifts up. So, an increase in bonds to depreciation of the currency due to increased risk premium.

The ECB's position on the Growth and stability pact is that it is an extremely important component of the common currency policy. If the Growth and stability pact is constantly flouted, it leads to either decrease in the ECB foreign reserves (which are limited) or a depreciation of the Euro because of an increase in risk premium.

This is exactly most of the Latin American countries have fact in the last three decades with their currencies. The currency crisis has almost always resulted because of high government deficit.

What is the solution?

The solution is to ensure that there is clear co-ordination between the countries and ECB in terms of how many bonds can be issues.

Greek Crisis

The Greek Crisis has resulted from the Greece's high budged deficit being financed with issuance of bonds, which the Greek government is finding difficult to service. Thus, through the mechanism detailed above, it affects the Euro currency. Given the extent of the Greek budget deficit, both options are not palatable.