

**ECON 300 Spring 2007 Midterm  
Essay**

1. (30 points) In the general equilibrium model of chapter 3, Mankiw assumes that consumption is a function of disposable income alone:  $C = C[Y - T]$ . Modify the consumption function to make consumption depend on both after tax income and the level of real money balances ( $M/P$ ) consumers hold (The assumption is that real balances are a part of wealth, and wealth affects how much we consume). Show that if money demand (the demand for real balances) depends on the nominal rate of interest,  $i = r + \pi$ , then an increase in the rate of money growth now affects consumption, investment, and the real interest rate.

Mankiw assumes that consumption only depends on disposable income. However, it is also possible that consumption depends on real wealth, and because real money balances is part of real wealth, we can rewrite the consumption function as,

$$C = C\left[Y - T, \frac{M}{P}\right], \quad (1)$$

where  $\frac{M}{P}$  is real money balances. Real money balances could be thought of as the average balance in your checking account deflated by the price level. By assumption, the higher the level of real wealth, the greater the level of consumption, so real money balances and real consumption are directly related. Now, consider the impact of an increase in the rate of growth of money on real money demand (real balances) and hence on real consumption, savings, etc.

Equilibrium in the money market may be written as

$$\frac{M}{P} = L[r + \pi, Y], \quad (2)$$

where  $M$  is the nominal money supply,  $P$  is the price level,  $i = r + \pi$  is the nominal rate of interest, i.e., the real interest rate plus the inflation rate, and  $Y$  is real income. The right hand side of equation (2) is the real demand for money. Real money demand depends on the transactions demand for money so that an increase in real income leads to an increase in the demand for money. An increase in the nominal interest rate leads to a decline in the real demand for money because money balances do not pay interest, i.e., the nominal interest rate is the opportunity cost of holding money. Any increase or decrease in real money demand that is not met with a corresponding increase or decrease in nominal money supply,  $M$ , leads to an adjustment of the price level,  $P$ . In other words, for a given stock of money, equilibrium occurs via adjustment of prices.

An increase in the rate of money growth leads to an increase in the rate of inflation. To see this, assume that the initial rate of inflation, real interest rate and real income are fixed. As a result, real money demand is fixed, so its growth rate is zero. Converting equation (2) to growth rates then shows that any change in the rate of growth of money will lead to a change in the rate of inflation.

$$\begin{aligned} \% \Delta M - \% \Delta P &= \% \Delta L = 0 \\ \% \Delta M &= \pi \end{aligned} \quad (3)$$

Given the real rate of interest, determined by equilibrium between real savings and real investment, an increase in inflation leads to a rise in the nominal interest rate. As the opportunity cost of holding money increases, real money demand falls. (Note we are holding real income constant given the assumption of fixed  $K$  and  $L$ .) In equilibrium, real money demand and

supply are equated through adjustment of the price level. That is, the increase in the rate of growth of money is offset by a larger increase in the rate of growth of prices so that real money balances (both supply and demand) decline. Since money is part of wealth, real wealth also falls, and by equation (1) above, real consumption falls.

As consumption falls, national savings increases. The increase in saving leads to an outward shift of the saving schedule, as in Figure 4-1. The resulting excess supply of loans leads to a lower real interest rate and a higher level of investment.

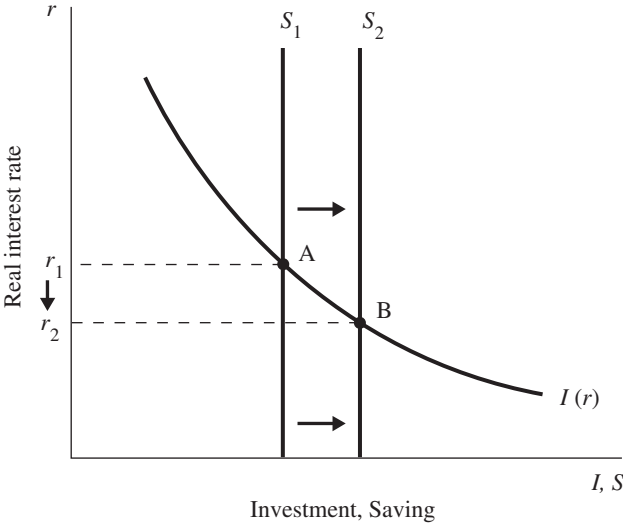


Figure 1: US Savings and Investment

The classical dichotomy states that a change in a nominal variable such as inflation does not affect real variables. Yet in this case, the classical dichotomy does not hold; the increase in the rate of inflation leads to a decrease in the real interest rate. The Fisher effect states that  $i = r + \pi$ . In this case, since the real interest rate  $r$  falls, a 1- percent increase in inflation increases the nominal interest rate  $i$  by less than 1 percent. Most economists believe that this Mundell-Tobin effect is not important because real money balances are a small fraction of wealth. Hence, the impact on saving as illustrated in Figure 1 is small.

2. (20 points) Now, using your results from part (a) above, and taking into account the fact that the US is a large open economy, show the impact of an increase in the rate of growth of money (assume foreign money growth is unchanged) on

(a) net capital flows, net exports and the real exchange rate for the U.S.

Because the U.S. is an open economy, it faces the world real interest rate when borrowing and lending; because it is a large economy, large changes in U.S. borrowing or lending will also affect the world real interest rate. We can think of world savings as the sum of US and ROW (rest of world) savings,  $S_w = S_{us} + S_{row}$ . Assuming that the U.S. and ROW investment demand remains unchanged, the world investment demand curve ( $I_w$ ) will not shift. So you would expect that a large decrease in US consumption and the corresponding increase in US savings would lead to an increase in world savings, excess supply of loans, and a decrease in the world real interest rate. The graph for world savings and investment would look qualitatively like Figure 1 above. However, you may recall from your homework assignment that most economists believe that the Mundell-Tobin effect is small because real money balances are a small fraction of wealth. Hence, the impact on both US and World saving is likely to be small. As a result, the change in world interest rates will be quite small. From here on we assume that the changes are sufficiently small that world real interest rates do not decline. The qualitative answer will not change if the world real interest rate declines slightly.

To determine the full effect on net capital flows, net exports, and the real exchange rate, consider the supply and demand for currency (NFI-NX) graph.

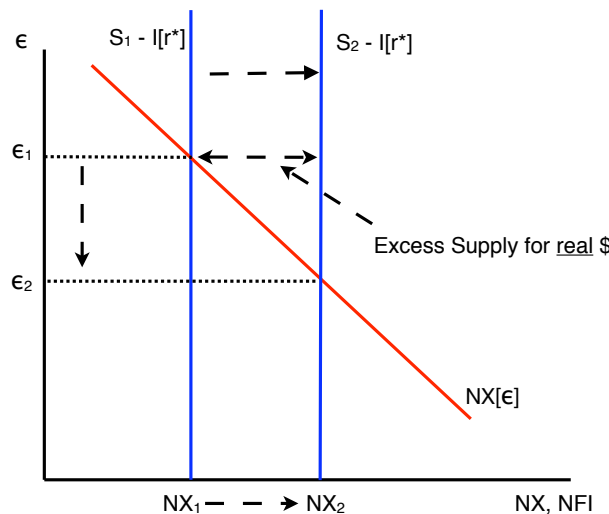


Figure 2: US NFI and NX: Supply and Demand for \$

We know from the analysis above that US savings increases  $S_2 > S_1$ , but for a fixed world real interest rate,  $r^*$ , US investment is unchanged at  $I[r^*]$ . Because the US can borrow from and lend to the ROW, US Savings exceeds US Investment at the world real interest rate, and NFI increases. So the  $S_1 - I[r^*]$  curve shifts rightward to  $S_2 - I[r^*]$ . The result is an excess supply of real dollars, and downward pressure on the real exchange rate. The real exchange rate depreciates until US goods are sufficiently cheap abroad that US exports rise (and imports fall) enough to equate the trade balance and the net capital outflow at  $\epsilon_2$  where  $NX[\epsilon_2] = S_2 - I[r^*]$ .

In summary, US real output is unchanged because of our assumption of fixed factor inputs, i.e.  $\bar{Y} = F[\bar{K}, \bar{L}]$ . With an increase in US money growth and inflation, the nominal interest rate rises leading to a decline in real wealth and real consumption spending,  $C = C[\bar{Y} - \bar{T}, \frac{M}{P}]$ . Because we have assumed that the changes are not sufficient to cause a change in the world real interest rate, US investment,  $I[r^*]$ , does not change, and the increase in US saving is lent to the ROW. As the US currency depreciates (in real terms) due to excess supply, US real net exports increase, offsetting the decreases in domestic consumption.

$$\bar{Y} = C \downarrow + I[\bar{r}^*] + \bar{G} - NX \uparrow \quad (4)$$

- (b) the nominal exchange rate in inflation rate in the US. (Assume that the US and foreign central banks are not changing their monetary policy)

Recall that the nominal exchange rate is determined by the real exchange rate and the US and ROW price levels.

$$e = \epsilon \cdot \frac{P^*}{P} \quad (5)$$

$$\% \Delta e = \% \Delta \epsilon + \pi^* - \pi \quad (6)$$

We know that the real exchange rate is decreasing due to the changes in US savings and the assumption of constant world real interest rate. With no change in monetary policy in the ROW, but an increase in the growth of the US money supply, we can assume that inflation in the US will be higher than inflation in the ROW. With  $\% \Delta \epsilon < 0$  and  $\pi^* - \pi < 0$ , We conclude that the increase in the rate of growth of money and resulting inflation will lead to a depreciation of both the real and nominal exchange rates.