Suggested Solutions to Problem Set 2

Problem 1

First note that $r^e = R - \pi^e$, that is, the real interest rate equals the nominal interest rate minus the expected inflation rate. When we studied the effect of an unexpected permanent increase in the money supply we concluded that (i) the increase in the money supply M^s lowers the interest rate R since the price level P is fixed, (ii) by the neutrality of money we know that an increase in M^s will ultimately produce an increase in P, that is, there is a positive expected inflation rate π^e. Hence, we know that the real interest rate r will decrease even more than what the nominal interest rate does because of the expectation of inflation. This is depicted in Figure 1. Then, once prices start to increase, the nominal interest rate increases. Moreover, as prices increase some of the expected inflation becomes realized inflation and hence less inflation is expected in the future. This causes the initial gap between the nominal and the real interest rate to shrink. Finally, in the long run, prices have fully adjusted and hence there are no more expectations of future inflation and the nominal and real interest rates equalize.

The real interest rate can become negative if the increase in M^s is large enough as to produce a large drop in the nominal interest rate and a large increase in future expected inflation. In Figure 2 we see such case.

Problem 2

The economy starts with long-run levels of M_0, P_0, R_0, and E_0. A permanent decrease in the money supply makes E^e fall because people expect the dollar to appreciate in the future. The real money supply falls from M_0/P_0 to M_1/P_0 as Figure 3 shows. Since the level of prices is fixed at P_0 in the short run, the interest rate increases from R_0 to R_1 to put the money market back in equilibrium.

In the foreign exchange market we see that the return on dollar deposits exceeds the return on euro deposits (measured in dollars) and hence the dollar appreciates today to E_1. Also, the decrease in E^e makes the arbitrage curve to shift down and hence the exchange rate appreciates even further to E_2.

As time goes by, the price level begins to fall towards it's long-run level at P_1. Hence, the real money supply increases until $M_0/P_0 = M_1/P_1$. This causes the interest rate to go down back to R_0 and thus the exchange rate depreciates to its long-run value E_3.

Regarding the time paths, we see that the exchange rate undershoots its long-run value ($E_2 < E_3$), the interest rate moves back to its original value and prices drop as much as the money supply decrease to make real money balances remain unchanged.

Problem 3

(a) When prices are fully flexible, an increase in M^s produces an immediate increase in prices in the same proportion. Hence, the real money balances M/P remain unchanged and the interest rate remains at its initial level. In the foreign exchange market, the increase in the money supply produces an increase in the expected exchange rate E^e and hence the current exchange rate E jumps instantly to its new equilibrium. Note that since there is no interest rate differential there is no need for the exchange rate to overshoot its long-run value.

Figure 4 shows the effect of the monetary shock in the two-sided diagram and the time paths for the relevant variables.

(b) If an increase in M^s raises real output Y in the short run, then the fall in the interest rate that is produced by the increase in M^s will be reduced by an outward shift of the money demand curve since an increase in real output increases the demand for money. In Figure 5, the increase in the money supply line from M_0/P_0 to M_1/P_0 is coupled with a shift out in the money demand schedule from L_0 to L_1. The interest rate falls from its initial value of R_0 to R_1, rather than to the lower level R'_1, as explained above.

Since the interest rate does not fall as much when output rises, the exchange rate depreciates by less, increasing from its initial value of E_0 to E_1, rather than to E'_1. In both cases we see that the exchange rate appreciates to E_2 in the long run.

Undershooting occurs if the new short-run exchange rate is initially below its new long-run level. This happens only if the interest rate rises when the money supply rises, that is, if Y increases so much that R increases. This is an unlikely possibility because the reason we tend to think that an increase in M^s may boost output is due to the effect of lower interest rates. Hence, we generally do not expect the response of Y to be so significant as to increase R.

Problem 4

(a) **Uncertain.** In the short-run model of exchange rate determination, prices are assumed to be fixed. So when M^s increases the nominal interest rates R decreases. However, in the long-run model of exchange rate determination, prices are flexible so an increase in the level of M^s is accompanied by an increase of equal amount in P. Hence, R does not change. Finally, if the increase in M^s is due to an increase in the growth rate of M^s, this produces an increase in expected inflation π^e so R increases (recall Fisher's relation: $R = r + \pi^e$).

(b) Different assumptions about the speed of price level adjustment lead to contrasting predictions about how exchange and interest rates interact. One answer to this question involves the comparison of a sticky price with a flexible price model.

The first case can be thought of as a model with sticky prices (Chapter 14). A reduction in the money supply causes the nominal interest rate to rise (since prices can't adjust) and, by the interest parity relationship, the nominal exchange rate to appreciate. The real interest rate, which equals the nominal interest rate minus expected inflation, increases both because of the increase in the nominal interest rate and because there is expected deflation.

The second case can be analyzed in a model with flexible prices, for example, the monetary approach. In the case of a rise in monetary supply growth rate, an interest rate increase is associated with higher expected inflation and a currency that will be weaker in the future. The result is an immediate currency depreciation. (The increase in interest rate reduces money demand, such that there is potential excess supply. This leads to a jump in the level of prices. An increase in prices implies an increase in the exchange rate by PPP.)

(c) **False.** According to this theory, the overshooting of the exchange rate occurs due to the unresponsiveness of prices to adjust upon money supply shocks. Important assumptions include price stickiness and that the interest parity condition holds. This model helps explain the seemingly puzzling empirical fact on the large volatility of exchange rates using a framework with forward-looking, rational agents.

Problem 5

In the first case we have $\pi_{EU} - \pi_{RO} = -0.077$. This implies that, to keep the exchange rate at the PPP level, we should expect a 7.7% appreciation of the euro. But we actually see that $(E_t - E_{t-1})/E_{t-1} = 0.044$, so there is a depreciation of the euro and the RON is overvalued. In the second case $\pi_{EU} - \pi_{RO} = 0.08$, so we expect an 8% depreciation of the euro to keep it at the PPP level. But, it depreciates by less, so the RON is not overvalued anymore, but undervalued.

We can also solve this by using absolute PPP rather than relative PPP, which after all is an approximation. In December 2005, absolute PPP states that $E_{€|RON} = P_{EU}/P_{RO} = 0.2620$. By the end of year 2006, with 2% inflation in the US and 9.7% inflation in Romania, then absolute PPP predicts that

$$E_{€|RON} = [1.02 \times P_{EU}]/[1.097 \times P_{RO}] = 0.93 \times 0.2620 = 0.2436 < 0.2735.$$

So if the PPP value is lower the actual exchange rate, then RON is too expensive in euros, that is, it is overvalued according to PPP. If the inflation rates were reversed, then

$$E_{€|RON} = [1.10 \times P_{EU}]/[1.02 \times P_{RO}] = 1.07 \times 0.2620 = 0.2803 > 0.2735,$$

and therefore gives us the same conclusion as before, that in this second situation the RON is undervalued.

(Note that an implicit assumption in the answer here is that we start at an exchange rate equal to the PPP exchange rate. If this doesn't hold true, then what we calculate here is just the overvaluation or undervaluation of the RON occurring during the year 2006.)

Problem 6

(a) The increase in relative productivity of the Czech economy means more output being produced in the Czech Republic. However, because output and, hence, income in France do not change, the demand by foreigners for domestic goods is still the same. This means that there will be an excess relative supply for Czech output at the previous real exchange rates. To eliminate this excess supply, a decrease in the price of Czech products relative to French products has to occur. This price change is a real depreciation of the Czech currency.

If the nominal exchange rate is $E_{Kuna|€}$, then: $q = E \times P_{FR}/P_{CR}; \downarrow P_{CR} \rightarrow \uparrow q$.

To learn what happens to the price level, we also have to think about the impact of an increase in Czech productivity on the aggregate real money demand. As output in the Czech Republic rises due to the increase in productivity, aggregate real money demand also rises, as people have more goods and services to buy with their money. This pushes the price level down in order to make the supply of real money balances increase and equilibrate the money market (the relevant equilibrium equation here is: $M^s/P = L(R, Y)$). Because the price level in the Czech Republic falls and the real exchange rate depreciates, the net effect on nominal exchange rates is ambiguous. $E = q \times P_{CR}/P_{FR}; \downarrow P_{CR}$ and $\uparrow q \rightarrow E$?

(b) In the case of a permanent productivity increase, there is a continued expected real depreciation of the Czech currency against the euro and a continuous decrease in prices in the Czech Republic. The change of the nominal exchange rate is still ambiguous.

Problem 7

Over the long run, price levels are flexible and have completed their adjustments to equilibrium levels. Taking the hint from the problem set about how firms engaged in international trade may react to large and persistent cross-border price differentials, we can see why relative PPP holds more closely in the long run. Think of two economic regions, the US and Europe. Recall that relative PPP says that depreciation from time t to $t + 1$ is given by $(E_{t+1} - E_t)/E_t = \pi_{US,t} - \pi_{EU,t}$. Suppose in the short run, European inflation exceeds US inflation and that relative PPP does not hold. In the case of this inflation differential, then trading firms will face an incentive to substitute, where possible, US goods for European goods in their purchases on both sides of the Atlantic. If many firms over time behave in this way, then, all else equal, this should drive down the euro and drive up the dollar. This means that the dollar price of the euro will fall over time, leading the left side to become smaller and more negative. This brings the left side of the expression more into line with $\pi_{US,t} - \pi_{EU,t}$. The same reasoning follows symmetrically if $\pi_{US,t} > \pi_{EU,t}$. Thus, it is conceivable that purchases by international trading firms can lead to more of an alignment between inflation differentials and currency depreciation in the long run.

Problem 8

(a) The Balassa-Samuelson theory provides an explanation for why price levels are lower in poor countries than in rich countries. The central argument can be illustrated in a model in which a country produces both traded and non-traded goods using labor, where labor is mobile between sectors, and the price of tradable goods is the same in all countries (i.e., the law of one price holds for tradable goods). Further, based on empirical observation, we note that countries do not differ much in the productivity with which they produce non-traded goods, but richer countries are more productive at producing tradable goods than poor countries. Then, given that all countries face the same price for tradable output, countries with high productivity in tradables (rich countries) will have high wages. As a result, they will also have high prices of non-traded goods relative to poor countries. Thus, the overall price level (simply an average of traded and non-traded goods prices) will be higher in rich countries.

(b) The actual market exchange rate between the US and Kenya is approximately 76.5 KES/$. Then if the price of a massage in Kenya is 3,195 KES, its price in dollars (using the market exchange rate) is (approximately) $42. Clearly, this is lower than the US price of a massage. This is largely consistent with the Balassa-Samuelson theory of international price differences. Because the US is more productive at producing tradable goods than Kenya, we expect prices of non-traded goods (and the overall price level) to be higher in the US than in Kenya.

(c) The implied PPP equilibrium exchange rate between the dollar and the Kenyan Schilling is $E^{PPP}_{\$|KES} = P_{US}/P_{Kenya} = \$80/3195KES = 0.025\ \$/KES$ (or, the direct quote for the KES is 40 KES/$). Then using the PPP exchange rate, we see that the Kenyan GDP in dollars is $1,200\ billion\ KES \times 0.025\$/KES = \$30\ billion$. If we use the market exchange rate instead, then Kenyan GDP in dollars is $1,200\ billion\ KES \times (1/76.5)\$/KES = \$15.7\ billion$. So, Kenyan GDP in dollars is higher when we use the PPP exchange rate. This makes sense because the PPP exchange is constructed so as to make currency conversions in a way that accurately represents the purchasing power of the currency. For example, at the PPP exchange rate, someone starting with $80 in the US can pay for a massage. Converted at the PPP exchange rate, this $2.71 yields exactly 3195KES, which allows one to pay for a massage in Kenya as well. In general, because prices are lower in poor countries, a poor country's GDP measured in dollars using PPP exchange rates will exceed their GDP in dollars using market exchange rates to convert currencies.

Figures

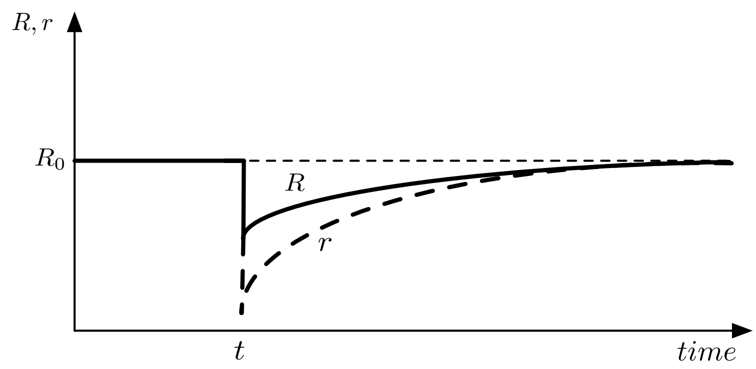

Figure 1: Time path of the nominal and real interest rate

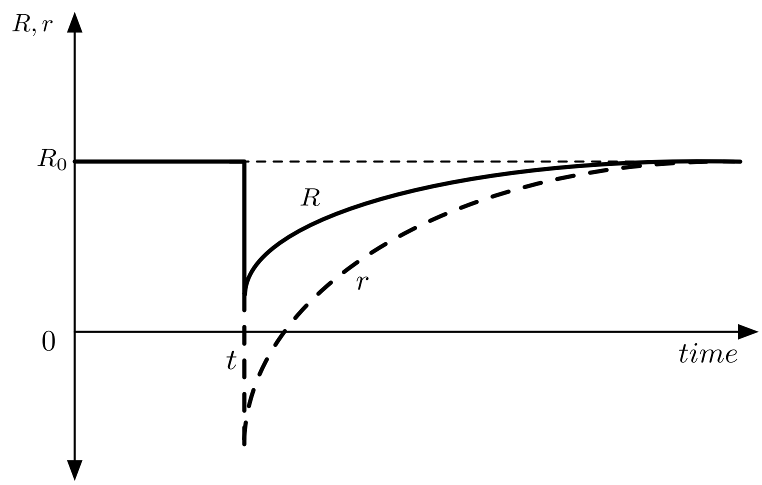

Figure 2: Alternative time path of the nominal and real interest rate

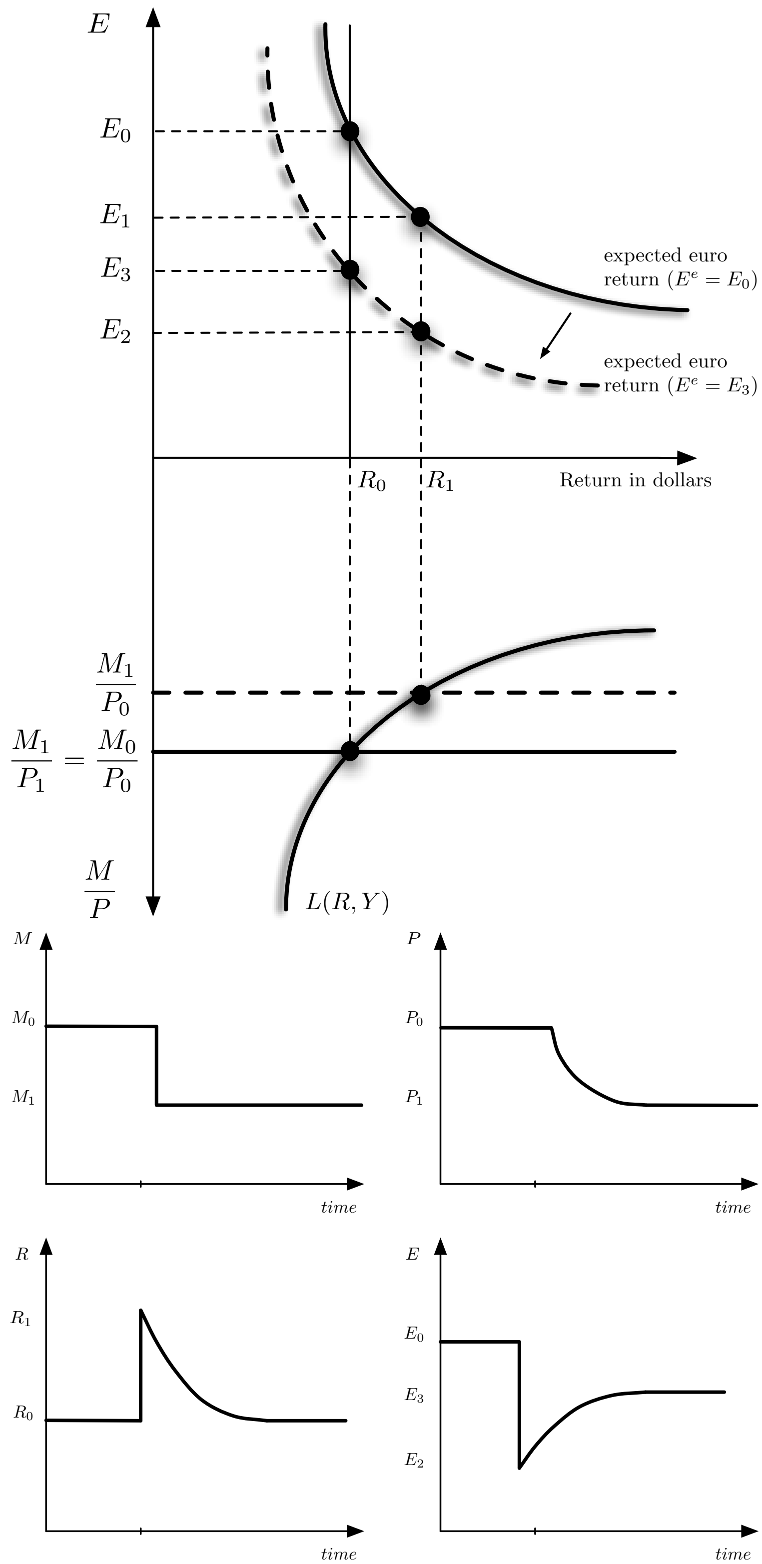

Figure 3: Effects of a permanent decrease in M^s

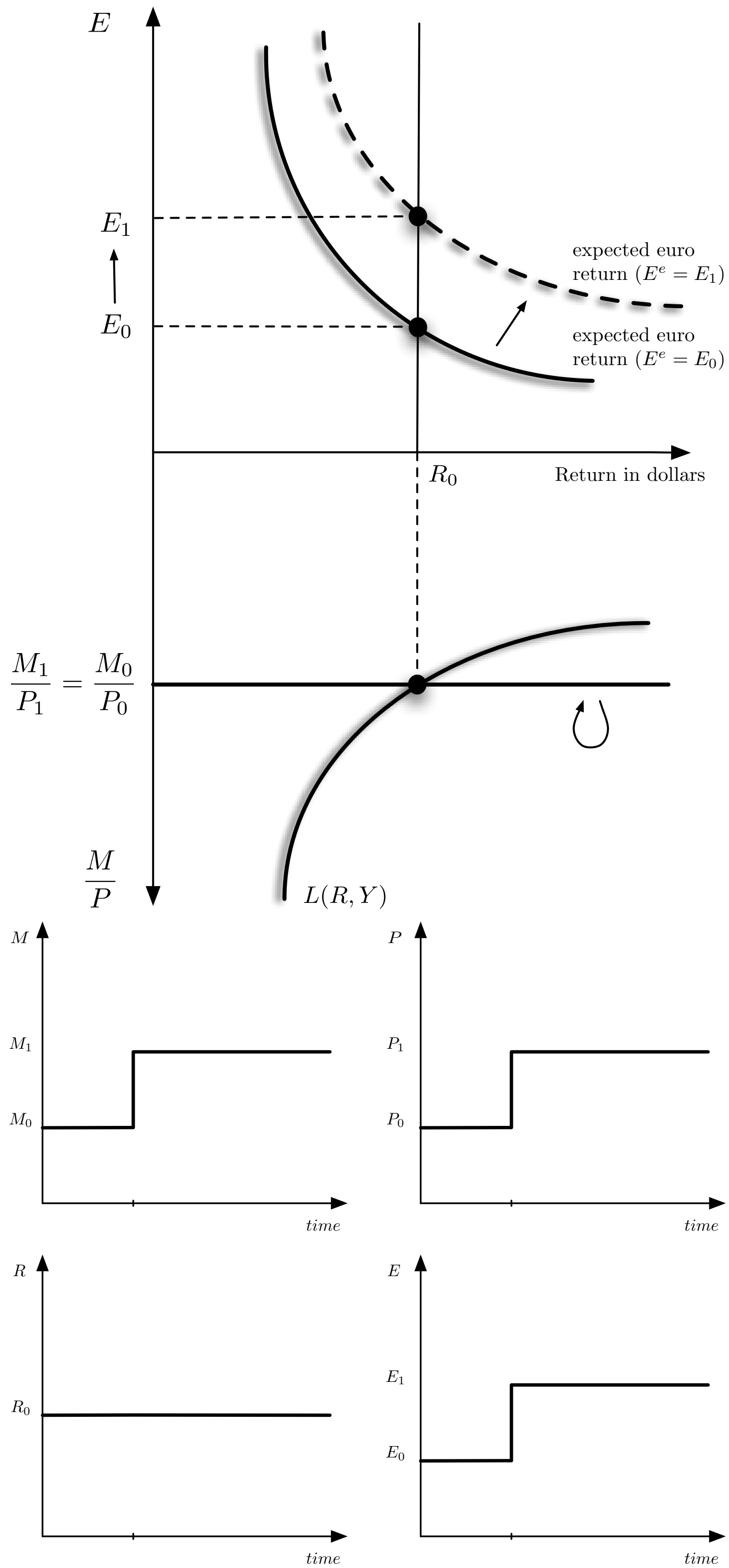

Figure 4: Effects of increase in M^s with flexible prices

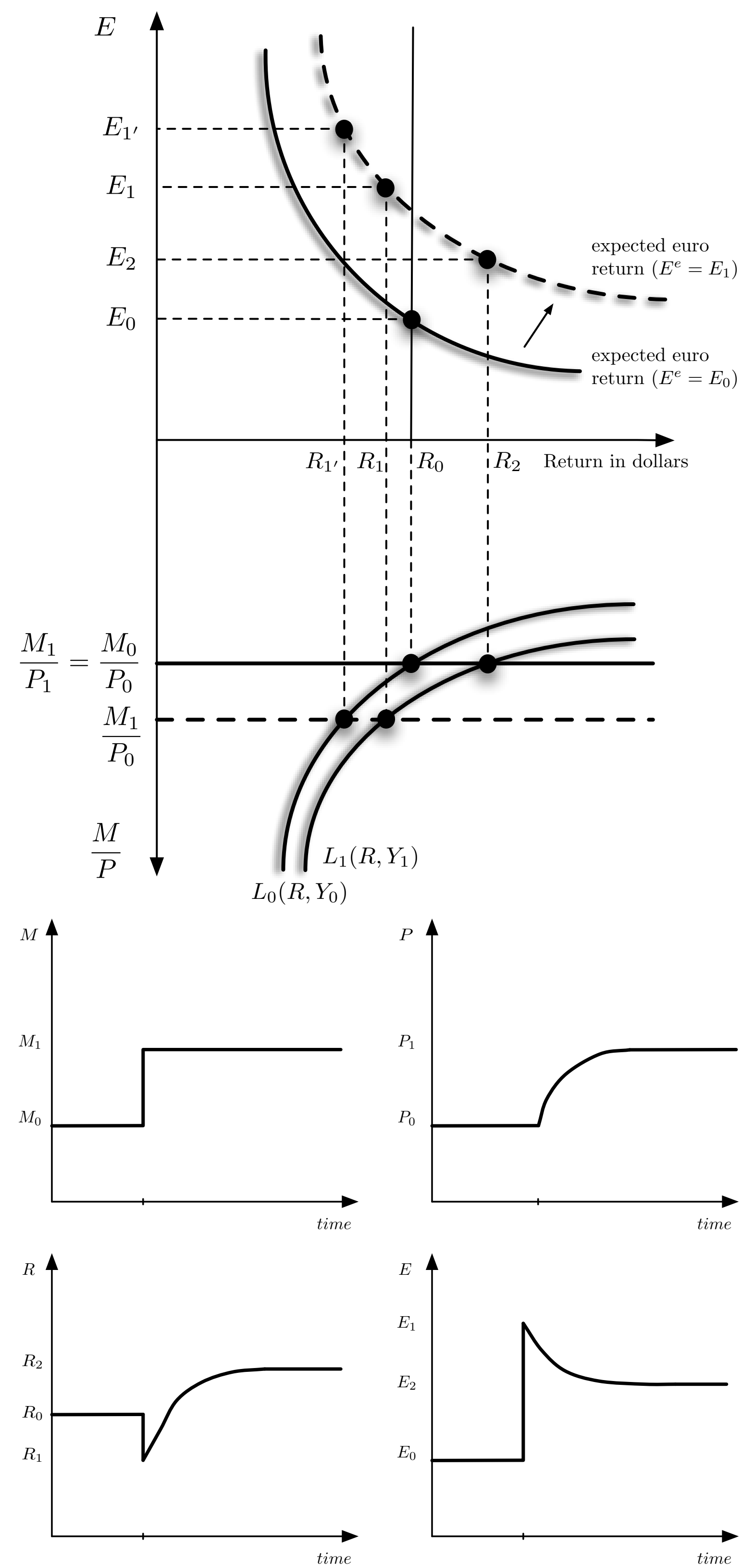

Figure 5: Effects of increase in M_s with variable output