1. Numerical Problem # 4 on Chapter 10: An economy has the following AS-AD curves:

- **AS Curve** \( y = 300 + 30(M/P) \)
- **AD Curve** \( Y = \bar{Y} + 10(P - P^e) \)

(a) What are the equilibrium levels of the price level, \( P \), and output, \( Y \)?

**ANSWER:** \( P^e = 60 \). Setting \( AD = AS \) to eliminate \( Y \), we get \( 300 + 30(M/P) = 500 + 10(P - P^e) \). Plugging in the values of \( M \) and \( P^e \) gives \( 300 + (30 + 400/P) = 500 + 10(P - 60) \), or \( 300 + (12,000/P) = 500 + 10P - 600 \), or \( 400 + (12,000/P) = 10P \). Multiplying this equation through by \( P/10 \) gives \( 40P + 1200 = P^2 \), or \( P^2 - 40P - 1200 = 0 \). This can be factored into \( (P - 60)(P - 20) = 0 \). \( P \) can’t be negative, so the only solution to this equation is \( P = 60 \). At this equilibrium \( P = P^e \), so \( Y = 500 \), and the economy is at full-employment output.

(b) An unanticipated increase raises money supply to \( M = 700 \).

**ANSWER:** With an unanticipated increase in the money supply to \( M = 700 \), the expected price level is unchanged at \( P^e = 60 \). The aggregate demand curve is \( Y = 300 + 30(M/P) = 300 + (30 \times 700/P) = 300 + (21,000/P) \). The aggregate supply curve is \( Y = 500 + 10(P - P^e) = 500 + 10(P - 60) = 10P - 100 \). Setting \( AD = AS \) to eliminate \( Y \) gives \( 300 + (21,000/P) = 10P - 100 \), or \( 400 + (21,000/P) = 10P \), or \( P - 40 - (2100/P) = 0 \). Multiplying through by \( P \) gives \( P^2 - 40P - 2100 = 0 \). This can be factored as \( (P - 70)(P - 30) = 0 \), which has the positive solution \( P = 70 \). From the AD curve, \( Y = 300 + (21,000/P) = 300 + (21,000/70) = 600 \).

(c) The Fed announces that the money supply will be increased to \( M = 700 \), which the public believes.

**ANSWER:** When \( M = 700 \) and is anticipated, \( P = P^e \). Then the AD curve is \( Y = 300 + (21,000/P) \) and the AS curve is \( Y = 500 \). Setting \( AD = AS \) gives \( 500 = 300 + (21,000/P) \), which has the solution \( P = 105 \).
2. (a) Suppose that the discovery of a new technology increases the expected future marginal product of capital, but does not affect current productivity. Explain how and why this new technology shifts the IS curve.

**ANSWER:** The IS curve represents the equilibrium between investment and savings. An increase in the future marginal productivity of capital raises desired future capital and therefore raises desired investment at any given interest rate. As figure 2a shows, this implies that at any level of output the IS curve— which consists of the different equilibrium points in the asset market— rises. Panel (a) shows investment and savings, and the equilibrium interest rate that are determined by the I=S condition for different values of Y. Panel (b) shows the IS curve, which consists of each of the (r,Y) pairs which form an equilibrium in panel (a).

![Figure 1: Movement of the IS curve](image)

(b) Use the classical IS-LM model to determine the effects of the new technology on current output, the real interest rate, employment, the real wage, consumption, investment, and the price level. To keep things simple, suppose that expected future wages and future income are unaffected by the new technology.

**ANSWER:** In the classical IS-LM model an increase in the IS curve immediately moves the economy along the full employment level of output, increasing interest rates. The LM curve must match this movement and for it to do so the price
level must increase. Figure 2b presents this fact.

(c) Explain how and why the discovery of the new technology shifts the AD curve.

**ANSWER:** The new equilibrium of the economy implies a higher level of prices for every level of output. The increased demand brought about by higher investment implies the economy is in equilibrium only if the interest rate is higher, which implies there must be a decrease in the real money supply in the economy, and therefore, that prices have risen. As in the first part of the question, this can be seen by building the AD curve from the different IS-LM equilibria. Figure 2c describes this procedure. Panel (a) represents the different equilibrium values of $P$ and $Y$, by finding $Y$ for changing values of $P$. Panel (b) plots these equilibrium points as the AD curve.

(d) Use the “misperceptions” version of the AS-AS model to determine the short run effects of the new technology on current output and the price level (that is, keep the expected price $P^e$ fixed at its value before the discovery of the new technology).

**ANSWER:** The misperceptions theory suggests supply is determined by expected prices rather than equilibrium prices. Keeping $P^e$ at its original level means output increases when demand increases, instead of staying at its long run equilibrium. Figure 2d shows the corresponding movement in the AS-AD
diagram from starting point A to short term equilibrium B. As time passes and firms update their expectations, changing $P^e$ upwards, the short term AS curve moves up. The economy eventually moves on to point C as prices increase for the economy to be in equilibrium.

3. This problem studies the effects of temporary shocks to government spending in the
classical IS-LM model. Before working this problem, you read carefully the section in Chapter 10 entitled Fiscal Policy Shocks in the Classical Model (pp. 366-369)...

(a) Suppose that shocks to government spending are the only source of fluctuations in the macroeconomy (productivity is assumed to be constant)...

**ANSWER:** Pages 366-369 describe this problem. In the labor market a positive shock to government spending results in an increased supply of labor. The intuition is that the increased government spending is assumed to cause a decrease in consumers current or future disposable income, because they expect to be taxed more to pay for this spending. This results in higher output and lower wages. Figure 3a presents this fact.

There are three effects of government spending on savings. Consumption as a fraction of income goes down, since agents feel poorer, and output goes up, which suggests higher savings, but government expenditures are part of national consumption too. We assume output doesn’t grow that much and consumers don’t save much more, and therefore the overpowering effect is that of reduced saving from increased government spending. Figure 3a presents this fact.

Therefore the effect on the IS-LM diagram is that the IS curve goes up, with higher equilibrium interest rates for any level of output, and the FE curve moves forward. We assume the magnitude of the IS movement is larger than that of
the FE movement, in such a way that the new IS-FE crossing point is above the old LM curve. This then implies that to achieve equilibrium, the LM curve must move up, or equivalently that prices must rise. Figure 3a presents this fact.
As is shown in Table 1, the model driven by fiscal shocks fits the behavior of prices in the US economy, while the one driven by productivity shocks does not, it also fits the behavior of employment. Otherwise, the model driven solely by fiscal shocks mostly fails in terms of the rest of the variables. In particular investment is countercyclical, as can be seen in figure 6 and can be inferred from the resulting higher interest rates. Also, consumption is countercyclical. This is somewhat ambiguous since there is an increase in output that might lead to higher consumption, contemporaneous with higher interest rates and lower wealth from the expected higher taxes, both of which imply lower consumption. We take the increase in output to produce a lower increase in consumption than the decrease in this variable that results of higher interest rates and higher present or expected taxation. Notwithstanding these shortcomings, the fact that labor productivity is countercyclical in the fiscal shocks setup suggests that a model with both types of shocks can produce a lower correlation of output and labor productivity. This result would be more in line with the data, and therefore reconcile the real business cycle model with the low correlation of productivity shocks and labor productivity in the data.

(The entries on table 1 come directly from the IS-LM and AS-AD analysis.)

Table 1: Productivity Shocks vs. Fiscal Shocks

<table>
<thead>
<tr>
<th></th>
<th>Output</th>
<th>Employment</th>
<th>Real Wage</th>
<th>Productivity</th>
<th>Consumption</th>
<th>Investment</th>
<th>Price Level</th>
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<td>Pro</td>
<td>Pro</td>
<td>Pro</td>
<td>Pro</td>
<td>Pro</td>
<td>Pro</td>
<td>Pro</td>
</tr>
<tr>
<td>Classical Model with Productivity Shocks</td>
<td>Pro</td>
<td>Pro</td>
<td>Pro</td>
<td>Pro (more than data)</td>
<td>Pro</td>
<td>Counter</td>
<td>Pro</td>
</tr>
<tr>
<td>Classical Model with Fiscal Shocks</td>
<td>Counter</td>
<td>Counter</td>
<td>Counter</td>
<td>Counter</td>
<td>Counter</td>
<td>Pro</td>
<td>Counter</td>
</tr>
</tbody>
</table>

(b) Now consider a classical model with shocks to both productivity and government spending...

**ANSWER:** A government wishing to make employment acyclical would use countercyclical fiscal policy to balance the effects of productivity shocks. The classical model predicts employment and output increases with increases in government spending. If the government wants to offset the lower employment and output levels in a recession, it could spend more, driving employment and output back up. However, the intuition of the model is that employment increases because consumers are worse-off. Therefore, if the government’s objective is to make
consumers as well off as possible, government should spend only if the project benefits exceed the costs, regardless of the business cycle. More generally, the ’classical’ view is that agents are acting optimally in the economy, and therefore any action by the government to impact their behavior leads to suboptimal outcomes.