Problems

1. A decrease in current total factor productivity shifts the aggregate demand curve to the left, as in the figure below. Output decreases and the price level increases. The increase in the price level shifts the *LM* curve to the left, so the interest rate increases. Since the nominal wage is fixed, the increase in the price level decreases the real wage. The higher real interest rate decreases investment, and the increase in the real interest rate and the decreases in income both imply a decrease in consumption. The decrease in z also shifts the labor demand curve to the left, while the decrease in w implies a downward movement along the new labor demand curve. The net effect on employment is ambiguous, although it may be more likely that employment decreases.

The direction of all of the effects is the same in both the Keynesian model and the monetary intertemporal model. The primary difference is that in the monetary intertemporal model, the economy returns to a Pareto optimum, while in the Keynesian model, the adjustment to the disturbance is not optimal.

2. Complete indexation of wages.
   
   (a) With perfect indexation of wages, the real wage rate becomes sticky. Changes in the price level have no effect on the real wage, and so changes in the price level have no effect on labor demand and employment. The aggregate supply curve becomes vertical.
(b) An increase in the money supply shifts the aggregate demand curve to the right. Because the aggregate supply curve is vertical, there is no effect on output, and the increase in prices is quantitatively larger than when wages are not indexed. We also know that for output to be unchanged, the rightward shift in the $LM$ curve due to the increase in the money supply must exactly be reversed by the increase in the price level. In this case, money is neutral. Prices and nominal wages increase in proportion to the increase in the money supply. There is no effect on any real variable. Keynesian unemployment remains equal to zero.

(c) A decrease in current total factor productivity shifts the vertical aggregate supply curve to the left. Output decreases and the price level increases. The increase in the price level shifts the $LM$ curve to the left, intersecting the original $IS$ curve at the new, lower level of output. The real interest rate therefore increases. In the monetary intertemporal model, the labor demand curve shifts to the left and the equilibrium real wage decreases. In this problem, the real wage is fixed, and the resulting excess supply of labor generates Keynesian unemployment. The higher price level raises the nominal wage rate in proportion to the higher price level.

3. A temporary increase in government purchases.

(a) The increase in current government purchases shifts the aggregate demand curve to the right, so output increases and the price level also increases. The increase in government purchases also shifts the $IS$ curve to the right, while the higher price level shifts the $LM$ curve to the left. The result is depicted in the figure below. As shown, the real interest rate increases. Therefore, both investment and consumption decrease. The increase in the price level decreases the real wage, so employment increases.
(b) The model wrongly predicts that consumption and investment are countercyclical. The model also wrongly predicts that the price level is procyclical and the real wage is countercyclical. Government spending shocks in the Keynesian sticky wage model cannot explain the typical business cycle.
   (a) A reduction in investment demand, as caused by a decrease in anticipated future total factor productivity, shifts the aggregate demand curve to the left. The price level decreases and output decreases. The decrease in investment spending shifts the IS curve to the left. The decrease in the price level shifts the LM curve to the right. The real interest rate therefore decreases. The decrease in the price level increases the real wage, so employment decreases.
   (b) To clarify the discussion, provisionally assume that labor supply is barely affected by changes in the real interest rate. This means that eliminating Keynesian unemployment is equivalent to restoring the real wage to its original value. The appropriate response is an increase in the money supply. Without any change in policy, the rightward shift in the LM curve is smaller than the leftward shift in the IS curve, and that accounts for the reduction in output. The money supply needs to be increased so that the overall shift in the LM curve is of equal size as the original shift in the IS curve. Output returns to its original value, and the real interest rate is lower. This policy move also shifts the aggregate demand curve to its original position, so the price level returns to its original value. With a fixed nominal wage, this policy also restores the original real wage, so employment returns to its original value.

   The lower interest rate increases consumption and investment relative to their levels if no policy action were taken. Government purchases and output are unchanged from their original values. Therefore, on net, investment decreases and consumption increases relative to their initial values. If we factor in the response of labor demand to the real wage, then a smaller dose of policy is required. The reduction in the real interest rate reduces labor supply, and so labor demand cannot be returned all the way to its original value. On net the price level decreases, so that the higher real wage makes the labor market equilibrate at a lower level of employment.

   (c) The appropriate fiscal policy response is to increase the level of government purchases. The aggregate demand curve and the IS curve are returned to their original positions. The real interest rate and the price level are unchanged, and output and employment are unchanged. Consumption is also unchanged, so the absolute value of the increase in government spending is exactly equal to the absolute value of the decrease in investment. In this case, there are no further effects on labor supply to be concerned with.

   (d) In the absence of a policy response, investment and consumption decrease and government spending is unchanged. When fiscal policy is used, the entire shift in investment spending is offset by increased government purchases. Investment spending is lower than in the absence of policy, because there is no offsetting effect of a lower real interest rate. When monetary policy is used to offset the disturbance, the net effect on investment spending is smallest.

5. As developed in the text, a temporary increase in government purchases increases output and employment, increases prices, and increases the interest rate. A permanent increase in government purchases reduces lifetime wealth. If the permanent income hypothesis is correct, consumption decreases by the same amount that government purchases increase. Neither the aggregate demand curve nor the IS curve shift, so there is no effect in the Keynesian sticky wage model. There is an increase in labor supply due to the reduction in lifetime wealth, but labor supply has no effect on employment in the Keynesian sticky wage model.
6. Nominal interest rate equal to zero.
   (a) Once the nominal rate of interest has reached zero, the demand for bonds drops to zero and the demand for money is boundless. Therefore, there is an excess demand for money. Any further reduction in income cannot restore equilibrium in the money market. The LM curve therefore becomes horizontal at a zero rate of interest.
   (b) The increase in the money supply only shifts out that portion of the LM curve for interest rates above zero. The intersection of IS and LM is therefore unchanged by an increase in the money supply. Changes in the money supply have no effect on the economy in this case.
   (c) If the nominal rate of interest is zero, the Keynesian sticky wage model predicts that monetary policy cannot be used to increase output and employment. Monetary policy can only improve matters if there is some other, direct channel of transmission between money and aggregate demand.

7. In the absence of policy, a reduction in current total factor productivity reduces output and employment and increases the price level. If the monetary authority wanted to stabilize the price level, it would need to reduce the money supply. In the Keynesian sticky wage model, the decrease in the money supply reduces output and employment even more than would be the case otherwise. If the fiscal authority wanted to achieve zero Keynesian unemployment, it would need to increase government purchases to prevent an excess supply of labor. In this case, monetary and fiscal policy are working against one another. A possible remedy would be to instruct the monetary authority to stabilize the price level from money demand shocks, but not from aggregate demand and supply shocks. Fiscal policy would therefore be assigned to stabilize the economy from real shocks.

8. In the absence of any policy, a reduction in the demand for investment goods decreases output and employment and decreases the real interest rate. If the money supply remains fixed, the decrease in the real interest rate partially insulates the economy from the reduction in investment demand. The decrease in the real interest rate provides a partial offset to the reduction in investment spending, and also stimulates consumption spending. If the monetary authority adjusted the money supply to reach an interest rate target, output would decrease by the full amount of the original decrease in investment spending.

9. If Ricardian equivalence is correct, changes in taxes, holding government spending fixed, do not affect the level of spending. If the deficits and surpluses are generated by changes in taxes, then running deficits in recessions and surpluses in booms makes no difference. There are two cases in which the statement may be true. First, if the deficits and surpluses are generated by changes in government spending, then a deficit stimulates the economy and a surplus restrains the economy. The other possibility is that Ricardian equivalence does not hold. In this case a deficit generated by a tax cut in a recession stimulates the economy, and a surplus generated by a tax increase in boom restrains the economy.

10. Money demand shifts with sticky prices.
    (a) An increase in money demand in this context implies a leftward shift in the LM curve. Thus the AD curve also moves to the left, and it must be that output and employment decline, along with an increase in the interest rate and the real wage, while obviously the price level stays constant. This is not desirable, as output declined.
    (b) An increase in the money supply would neutralize the increase in money demand with no real consequences.

11. Real interest rate targets with sticky prices.
    (a) Assume an increase in money demand. This implies a leftward shift of the LM curve, thus an increase of the real interest rate. To bring it back to the target $r^*$, all the monetary authority can do is shift the LM curve back to its original place with an increase in the money supply.
(b) An expected decrease in future total productivity decreases current investment, and thus shifts the $AD$ curve to the left. This means the $IS$ curve also shifts to the left, thus reducing the interest rate. To bring the latter back to the target $r^*$, a leftward shift of $LM$ is necessary, that is, a decrease in the money supply.

(c) A decrease in current total factor productivity implies a decrease in $AS$ (and a smaller decrease in $AD$), thus a shift of $IS$ to the right. As in (b), the prescription is a decrease of the money supply.

12. If consumption and investment do not change much in response to a change in the real interest rate, then the $IS$ curve will be relatively steep. For the sharpest comparison, consider the case in which consumption and investment are independent of the real rate of interest. In the first figure below, the $IS$ curve labeled $IS_2$ would correspond to the case in which demand is insensitive to the real interest rate, as opposed to $IS_1$, for which demand is sensitive to the real interest rate. In constructing the aggregate demand curve, we perform the experiment of changing the price level and noting the change in the level of real output at the intersection of $IS$ and $LM$. A reduction in the price level from $P_1$ to $P_2$ shifts the $LM$ curve to the right. Note that with $IS_1$, output increases to $\bar{Y}$. Alternatively, with $IS_2$, output is unchanged at $Y_1$. Therefore, when consumption and investment are insensitive to the real interest rate, then the aggregate demand curve becomes vertical. This case corresponds to $AD_2$, in the second figure below.
Next, compare the responses of the economy to monetary and fiscal policy actions. When demand is insensitive to the real rate of interest, changes in monetary policy, which also shift the $LM$ curve, have no effect on $AD$. In the limit, monetary policy cannot influence the level of real output, and so fiscal policy is the only available way to stabilize output. Fiscal policy shifts the $IS$ curve. The size of the shift, measured horizontally, does not depend on the sensitivity of demand to the real rate of interest. Two cases are depicted in the figure below. Again the $IS$ curves are labeled $IS_1$ and $IS_2$. In both cases, the new $IS$ curve passes through the point $(\bar{Y}_t, r_t)$. Fiscal policy provides a bigger shift in $AD$, when demand is insensitive to the real interest rate. Furthermore, this case also corresponds to the case in which $AD$ is vertical, so the new intersection with the upward sloping $AS$ curve also results in an increase in real output all the way to $Y_2$. 