Problem 1

(A) Labor Production Function

\[ F(L, K_0) \]

\[ Y \]

\[ Y_0 \]

\[ Y_1 \]

\[ L \]

\[ L_1 \]

\[ L_0 \]

(B) Capital Production Function

\[ F(L_1, K) \]

\[ F(L_0, K) \]

\[ K \]

\[ K_0 \]

(C) Labor demand and labor supply

\[ \left( \frac{w}{p} \right)_0 \]

\[ \left( \frac{w}{p} \right)_{L_1} \]

\[ \left( \frac{w}{p} \right)_{L_0} \]

\[ L \]

\[ L_1 \]

\[ L_0 \]

\[ L_D \]

\[ L_{S0} \]

\[ L_{S1} \]
Panel (C) shows the labor demand and labor supply diagram. The effect of the H1N1 flu is shown by the leftward shift in the labor supply curve. This increases equilibrium real wage (from $\frac{w_0}{P_0}$ to $\frac{w_1}{P_1}$) and reduce the amount total labor employed (from $L_0$ to $L_1$).

A decrease in labor holding capital constant (panel (A)) is a movement along the labor production function. The decrease of labor from $L_0$ to $L_1$ decreases output from $Y_0$ to $Y_1$. Since labor has decreased, the original capital production function (panel (B)), which was drawn on the assumption of labor at $L_0$ must shift downwards so that it intersects the new level of output immediately below the unchanged level of capital.

Since the labor production function remains unchanged, the labor demand curve (which we know it is derived from the labor production function) remains unchanged as well.

Under perfectly competitive assumption, real wage which equals mpl can be read as the slope of the line that tangent the production point on the labor production function and real profits (or real rental rate of capital) can be read as the slope of line that tangent the production point on the capital production function. Therefore, real wage increases while real profits decrease. The same story for the real wage can also be read off from the labor demand and labor supply diagram in which the leftward shift in the labor supply causes an increase in real wage discussed earlier.

Summarizing:  
  a) real wages rise;  
  b) real profit rates fall;  
  c) GDP falls;
Problem 2. First, note that \( rr = r - \hat{p}^e = 4.5 - 2 = 2.5 \).

(a) \[ Y = C + I + G \]
\[ Y = 0.8(Y - 0.4Y) + 500 - 20(2.5) + 1500 \]
\[ 0.52Y = 1950 \]
\[ Y = 1950/0.52 = 3750 \]
\[ T = 0.4Y = 0.4(3750) = 1500 \]
\[ I = 500 - 20(2.5) = 450 \]
\[ C = 0.8(Y - T) = 0.8(3750 - 1500) = 1800 \]
\[ T = 1500 = G, \] therefore the budget is balanced.

(b) In this case, taxes are endogenous, so that the government expenditure multiplier is
\[ \mu_G = 1/[1 - c(1 - t)] = 1/[1 - (1 - 0.4)0.8] = 1.9231 \]
\[ \Delta Y = \mu_G \Delta G = 1.9231(50) = 96.15 \]
\[ \text{new } Y = \text{old } Y + \Delta Y = 3750 + 96 = 3,846, \text{ so } \Delta T = 38 \]
\[ \text{Deficit } = 1550 - 1538 = 12 \]

(c) In this case, taxes are exogenous
\[ \mu_G = 1/(1 - c) \] and \( \mu_T = -c/(1 - c) \)
\[ \Delta Y = \mu_G \Delta G + \mu_T \Delta T = (\mu_G + \mu_T)\Delta G, \] since \( \Delta G = \Delta T \) for a balanced budget.
Therefore, \( \Delta Y = \Delta G \) and new \( Y = 3800, \) new \( T = 1550, \)
so that \( t = T/Y = 1550/3800 = 0.408. \)

(d) \( \Delta r = 1\% \), so that new \( r = 5.5\% \) and new \( rr = 3.5\% \).
\[ I = 500 - 20(3.5) = 430 \] or \( \Delta I = -20. \)
With endogenous taxes \( \mu_G = \mu_I = 1.9231 \) (see (b) above), so
\[ \Delta Y = \mu_I \Delta I = 1.9231(-20) = -38 \]
and new \( Y = 3750 - 38.46 = 3711 \)

(e) \[ Y = 0.8(Y - 0.4Y) + 500 - 20(rr) + 1500 \]
\[ 0.52Y = 2000 - 20rr \]
So, \( Y = 3846 - 38.46rr \)
or \( rr = 100 - 0.026Y \)
Problem 3.
(a) The balanced growth path is the path in which all inputs to the production process and GDP itself are growing at the same constant rate adjusted for the specific rates of productivity growth.

(b) \( \hat{K} + \hat{\phi} = \hat{L} + \hat{\theta} \) defines the balanced growth path. In practice in the United States \( \hat{\phi} \approx 0 \), and in the long-run which is appropriate to balance growth calculations \( \hat{L} = \) the rate of growth of the working-age population (\( n \)), so that \( \hat{K} = n + \hat{\theta} \) is a good approximation. In Narnia, \( n = \left[ \frac{1,070,567}{10,306,810} \right]^{1/6} = -1 = 0.0063 = 0.63 \) percent per year.

Labor productivities are: \( \theta_{2003} = \frac{1.643 \times 10^6}{58,618} = \hat{\theta} 28,029 \) per worker and \( \theta_{2009} = \frac{2,079 \times 10^6}{61,044} = \hat{\theta} 34,057 \) per worker. Thus \( \hat{\theta} = \left[ \frac{34,057}{28,029} \right]^{1/6} = 0.33 = 3.30 \) percent. The balanced growth path = \( n + \hat{\theta} = 0.63 + 3.30 = 3.63 \) percent per year.
(c) An unusually rapid increase in the capital stock would be a case of unbalanced growth in which capital would grow faster in the short run than labor adjusted for labor productivity and faster than the balanced growth path. But such an unbalanced increase in capital would push capital out to the level of diminishing returns to capital lowering the real rental rate and the incentive to invest and lowering capital productivity. This would over time lower the rate of growth of capital back to a level compatible with the (now higher) balanced growth path. See the diagram below in which the increase in capital shifts the balanced growth path upwards, but does not change its slope (i.e., increase its rate). To move from one balanced growth path to the other involves a short-run increase along the transition path and asymptotic convergence to the new higher path.

(d) The average rate of growth is \( \hat{Y} = \left( \frac{2079}{1643} \right)^{1/6} - 1 = 0.0400 = 4.00 \) percent per year. It is faster than the balanced growth path.

Problem 4.

(a) The average growth rates are GDP: \( \hat{Y} = \left( \frac{2079}{1643} \right)^{1/6} - 1 = 0.0400 = 4.00 \) percent per year; labor \( \hat{L} = \left( \frac{61044}{58618} \right)^{1/6} - 1 = 0.0068 = 0.68 \) percent per year; capital \( \hat{K} = \left( \frac{6581}{5602} \right)^{1/6} - 1 = 0.0272 = 2.72 \) percent per year. The growth accounting equations is then: \( \frac{\hat{A}}{\hat{Y}} + \frac{\alpha \hat{L}}{\hat{Y}} + \frac{(1-\alpha)\hat{K}}{\hat{Y}} = 1 \) Thus labor contributes \( \frac{0.7 \times 0.68}{4} = 0.12 = 12 \) percent; capital contributes \( \frac{(1-0.7) \times 2.72}{4} = 0.20 = 20 \) percent; while total factor productivity contributes \( 100 - 12 - 20 = 68 \) percent per year.

(b) \( A = \frac{Y}{L^\alpha K^{1-\alpha}} = \frac{2079 \times 10^6}{(61044)^{0.7} (6581 \times 10^6)^{0.3}} = 1052.97 \)
(c) \( Y_{pot} = A(LF)^{a} K^{1-a} = 1052.97(62866)^{0.7} (6581\times10^6)^{0.3} = \$2,122\) millions.

(d) \( \bar{Y} = \frac{Y}{Y_{pot}} = \frac{2079}{2122} = 0.98\) = 98 percent

Problem 5. Extra Credit.
(a) GDP growth rate = 3.5 percent; unemployment rate = 10.2 percent.
(b) China
(c) House of Representatives.
(d) One-sixth.