\[ Y = C + I + G \]

\[ \frac{G}{Y} \approx 33\% \text{ in the US, and this number varies across countries, increases with level of development.} \]

for each period:

- Government budget constraint under lump-sum taxes

\[ G_t + V_t = T_t + \frac{M_t - M_{t-1}}{p_t}, \text{ real purchases + real transfers = real taxes + real revenue from money printing} \]

- if we further assume there is no real revenue from money printing, that is, \( M_t - M_{t-1} = 0 \),
  \( G_t + V_t = T_t \),
  \( V_t \) is the transfer payment to households
  \( G_t \) is the government purchases (services, defense, education, etc)
  \( T_t \) is the real taxes that government collected.

- Consumer’s budget constraint under lump-sum taxes

  - one-period budget constraint:

  \[ C_t + (\frac{1}{p_t}) \cdot \Delta B_t + \Delta K_t = (\frac{w}{p_t}) \cdot L^*_1 + r_{t-1} \cdot (\frac{B_{t-1}}{p_{t-1}} + K_{t-1}) + V_t - T_t, \text{ consumption + real saving = real disposable income} \]

  - two-period budget constraint:

  \[ C_1 + \frac{C_2}{1 + r_1} = (1 + r_0)(\frac{B_0}{p_0} + K_0) + (\frac{w}{p_1}) \cdot L^*_1 + \frac{(\frac{w}{p_2})}{1 + r_2} \cdot L^*_2 - \frac{(\frac{B_2}{p_2} + K_2)}{1 + r_1} + (V_1 - T_1) + \frac{(V_2 - T_2)}{1 + r_1} \]

  - life-time budget constraint:

  \[ C_1 + \frac{C_2}{1 + r_1} + ... = (1 + r_0)(\frac{B_0}{p_0} + K_0) + (\frac{w}{p_1}) \cdot L^*_1 + \frac{(\frac{w}{p_2})}{1 + r_2} \cdot L^*_2 + ... + (V_1 - T_1) + \frac{(V_2 - T_2)}{1 + r_1} + \frac{(V_3 - T_3)}{(1 + r_1) \cdot (1 + r_2)} + ... \]

- Two effects of G on Y and C

- \( V_t - T_t = -G_t \)

  consumption effects: \( \alpha \), if G increases by 1 unit, \( \alpha \) units of private consumption C substituted out.

  production effects: \( \beta \), if G increase by 1 unit, Y goes up by \( \beta \) units. where total marginal benefit of G, \( \alpha + \beta < 1 \), marginal cost of G
Exercise 1' in class, professor has shown us how temporary increase and permanent increase in G affects C, I, K. similarly, work out the effect of temporary decrease and permanent decrease in G on C, I, K.

Exercise 2' suppose that people expected some increase in future $G_t$, however, the current government spending $G_1$ will not change. use the two-period budget constraint as well as life-time budget constraint to figure out what happen in the current year consumption, and investment and real GDP.

Exercise 3' what is the relationship between growth rate of real money balance, $\frac{M_t}{P_t}$, and the growth rate of nominal money, $\mu$.

(a) how the increase in the money growth rate affects price level?

(b) if we release the assumption that revenue from printing money is not zero, first, can you rewrite the revenue of printing money in terms of money growth rate, and level of real money balances?

(c) can the government always increase its real revenue from printing money by raising the money growth rate, $\mu$, how the answer depend on the responsiveness of real money demand, to the nominal interest rate, $i$. (recall, $i=r+\mu$)