1. Final is set to be Thursday 4:15-6:15, 19 November 2020. You can take it remotely through Sakai.

2. Demographic dividend. Production function: Only middle aged work. Each middle aged guy produces 1 unit of output, no capital. Old and young don't work. Total output is

$$Q_t = n_{m,t}$$

Per capita GDP is

$$q_t = \frac{Q_t}{n_{y,t} + n_{m,t} + n_{O,t}} = \frac{n_{m,t}}{n_{y,t} + n_{m,t} + n_{O,t}}$$

3. Demographic transition and the saving rate.

4. Lifecycle saving model. People like smooth consumption. Over the life cycle, initially income is low, then high, then zero. So to keep consumption smooth, (if there are well developed borrowing and lending opportunities) borrow when income is low, save when income is high to keep consumption smooth.

   Take an OLG model with 2 generations. Middle and Old. Middle aged work, earn income and save. Old people are retired, earn no income and dissave (they eat their assets). Let middle-aged people save a fraction ω of their income. Then middle-aged saving is

$$s_{m,t} = \omega y_{m,t} = y_{m,t} - c_{m,t}$$

   The old eat their savings,

$$\begin{aligned} c_{o,t+1} &= s_{m,t} \\ s_{0,t+1} &= -s_{m,t} \end{aligned}$$

   National saving rate

$$\frac{S_t}{Y_t} = \frac{n_{m,t}\omega y_{m,t} - n_{0,t}\omega y_{m,t-1}}{n_{m,t}y_{m,t}}$$

   Let's assume each guy produces 1 unit of income. Then the national saving rate simplifies to

$$\frac{S_t}{Y_t} = \omega\left(1 - \frac{n_{0,t}}{n_{m,t}}\right)$$

   If there are many middle and few old, (low dependency ratio) n_0/n_m is low and national saving rate is high. When society gets old (high dependency ratio) n_0/n_m increases and saving rate goes down.