1 Introduction

My model idea is about how the relationship between business cycles and the labor market is affected by education.

There is a somewhat spread out literature documenting the counter-cyclical nature of enrolment into post-secondary education.[1] The mechanism is intuitive: during an economic downturn wages are suppressed and unemployment is higher, so the opportunity cost of education relative to being in the labor force becomes relatively lower.

Less work, however, has gone into how this stylized fact feeds back into the business cycle, and whether a cheap publicly funded education system amplifies or helps stabilize business cycle shocks. Ex ante, the sign of the effect is not clear. On the supply side, the supply of productive labor would be expected to fall, and thereby also goods supply, ceteris paribus. On the demand side, there are multiple mechanisms. If a household chooses education over working in a period, household income within that period falls, but (given that they chose education) future discounted household income increases to compensate for that. This will decrease demand for savings among these households, putting downward pressure on the interest rate, but whether within-period goods demand falls due to income loss, or raises due to future income expectations, is ambiguous. Further, the lower labor supply when households chooses to study puts upwards pressure on the wage, but (I think) in a general equilibrium effect this won't increase goods demand due to it making everybody poorer due to taxes and transfers.

The model I set up will be based on the HANC models we have seen in the course and will include many simplifying assumptions. I will use the bonds market clearing condition and tax policy proposed in the assignment to allow taxes to change gradually.

Ideally one would like to wrap this setting into a HANK model to better capture business cycle effects on demand and propagation, but I have opted for simplicity.

I have also ignored unemployment, for now, so the mechanism for choosing education over working only happens through expected wages.

In most models, we have seen households are infinitely lived, and I have opted to stick to this convention, and instead make the productivity effects from education depreciate over time. This avoids the implication of shocks to education choices making permanent changes to the economy. An alternative approach would be to model finitely lived agents with overlapping generations, as we have seen in De Nardi and Fella (2017).

1.1 Household problem

The household faces two choices: how much to consume and whether to work or study. If they work they receive a post-tax wage $(1 - \tau_t)w_t$ corresponding to their productivity $z_t e_t$, where z_t is

[1] See e.g. Betts and McFarland (1995), Barr and Turner (2013), Hillman and Orians (2013). There is also some evidence for Denmark, Sønnichsen and Kristensen (2016).

they idiosyncratic productivity shock, and e_t is their endogenous and deterministic productivity from education. If they choose not to work they give a persistent positive shock to e_t of ξ, which depreciates in each period by ς. If households newer choose to study they will simply have $e_t = 1 \forall t$. I allow for borrowing to give more room for consumption smoothing during periods when households study.

$$v_t(z_t, a_{t-1}, e_{t-1}) = \max_{c_t, l_t \in \{0,1\}} \frac{c_t^{1-\sigma}}{1-\sigma} + \beta \mathbb{E}\left[v_{t+1}(z_{t+1}, a_t, e_t) \,|\, z_t, a_t, e_t\right] \tag{1}$$

$$\text{s.t. } a_t + c_t = (1 + r_t^a) a_{t-1} + (1 - \tau_t) w_t l_t z_t e_t + (1 - l_t)\, \chi_t \tag{2}$$

$$\log z_{t+1} = \rho_z \log z_t + \psi_{t+1} \;\; , \psi_t \sim \mathcal{N}(\mu_\psi, \sigma_\psi),\, \mathbb{E}[z_t] = 1 \tag{3}$$

$$e_t = 1 + (1 - \varsigma)\, e_{t-1} + \xi\, (1 - l_t) \tag{4}$$

$$a_t \geq \underline{a} \tag{5}$$

This adds an additional state variable, e_t, to similar setups we have seen, but the main added difficulty to solving the household problem will be the introduction of the discrete choice, l_t that has to be made, simultaneously with the continuous choice, c_t. Luckily, the DC-EGM method proposed by Iskhakov et al. (2017) can help us. Very simplified, this approach performs the EGM-step over the state space *and* the space of discrete choices, then compute value functions for each discrete choice and chosen consumption rules, which allows for finding the optimal switching point between discrete choices. The authors also suggest that introducing random taste shocks smooths out the solution, which might be necessary if one were to implement this.

2 Model

To keep this section simple I have focused on the simpler HANK model. The full equation system proposed is in equation 6

$$\boldsymbol{H}(\circ) = \begin{bmatrix} w_t - (1-\alpha)\Gamma_t(K_t/L_t)^{\alpha} \\ r_t^K - \alpha\Gamma_t(\frac{K_t}{L_t})^{\alpha-1} \\ r_t - \left(r_t^K - \delta\right) \\ \frac{1+\delta q_{t+1}}{q_t} - (1+r_t) \\ 1 + r_t^a - \frac{1+\delta q_t}{q_{t-1}} \\ \tau_t - \left[\tau_{ss} + \omega q_{ss}\frac{B_{t-1}-B_{ss}}{Y_{ss}}\right] \\ q_t(B_t - \delta B_{t-1}) - \left[B_{t-1} + G_t + \chi_t \int (1-l_t^*)\, d\mathbf{D}_t - \tau_t Y_t\right] \\ q_t B_t + K_t - \boldsymbol{a}_t^{*\prime}\boldsymbol{D}_t \\ L_t - \int l_t^* z_t e_t d\mathbf{D}_t \\ \boldsymbol{D}_t - \Pi_z'\underline{\boldsymbol{D}}_t \\ \underline{\boldsymbol{D}}_t - \Lambda_t'\boldsymbol{D}_t \end{bmatrix} = \mathbf{0} \tag{6}$$

I have a Cobb-Douglass production function, which allows wages to adjust to technology shocks Γ_t and to the labor supply relative to the capital stock.

The return to capital is the marginal product. The real interest rate accounts for capital depreciation. The fourth equation is the arbitrage condition between the capital and bonds market. $r^a t$ denotes the ex-post rate of return. The sixth, seventh, and eighth equations are the same bonds market equations as in assignment 2, with the exception that χ_t is only paid out to the part of households that are not studying. The labor market also needs to clear, but only the non-studying part of the households supply labor.

3 Applications

The main interest of this model would be to look at how the education system feeds back into the economy when the economy is hit by a shock. One way of doing this would be to see the IRF to a shock to Γ differs by changing χ, or to compare the IRFs of this model, with an IRF of a simpler model without an education system.

My expectation would be that a negative shock to Γ, would lower the wages, which would push more households to study, exacerbating the shock initially as households reduce their labor supply, but as the shock disappears the economy would rebound as the better-educated households come back to the labor market.

Another interesting topic would be looking at the difference in supply and demand shocks. However to do this one would have to wrap the household problem in a New-Keynesian framework, to get more accurate responses to demand shocks in the model. This is doable and a lot of it can probably just needs to follow the outline of the model in lecture 9, but I was a bit time-constrained, so I opted for the simpler model.

References

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