Advanced Macroeconomics

Lecture 7: growth theory and dynamic optimization, part six

Chris Edmond

1st Semester 2019

This class and next

- Two topics of recent interest
  - competition and market power (today)
  - automation (next class)

Competition and market power

- In many countries, measures of competitiveness have been declining
  - e.g., increasing concentration as measured by share of sales, employment etc accounted for by top firms
- In many countries, aggregate labor share has been falling (after having been stable for many decades)
- How might these facts be related?

Declining labor share

- Aggregate labor share

$$s_L \equiv \frac{WL}{Y}$$

- Aggregate labor share is stable when real wage growth keeps up with labor productivity growth

$$d\log W \approx d\log Y/L$$

- What can account for *wedge* between real wage growth and labor productivity growth?

Competition and market power

- As we will see, market power can drive a wedge between real wage and labor productivity

- To get *declining* labor share will need market power to be *rising* over time (declining competitiveness)

- Will illustrate using simple model of imperfect competition

  [Automation will provide a complementary explanation of declining labor share, not reliant on imperfect competition]

Imperfect competition

- Final good produced by perfectly competitive firms using a range of differentiated intermediate inputs

- Intermediate inputs are *imperfect substitutes*, producers of intermediate inputs have some *market power*

- Intermediate input producers engage in *monopolistic competition*

  [Ethier (1982) version of Dixit-Stiglitz (1977)]

Final good producers

- Produce final good Y using a range of differentiated intermediate inputs $y(i)$ for $i \in [0, N]$

- Production function is

$$Y = \left(\int_0^N y(i)^{\frac{\theta-1}{\theta}} \, di \right)^{\frac{\theta}{\theta-1}}, \qquad \theta > 1$$

- This is an example of a *constant elasticity of substitution* (CES) production function

- Taking prices $p(i)$ as given, final good producers choose $y(i)$ to maximize profits

$$Y - \int_0^N p(i) y(i) \, di$$

subject to the CES production function above

Final good producers

- Choose $y(i)$ to maximize profits

$$\left(\int_0^N y(i)^{\frac{\theta-1}{\theta}}\,di\right)^{\frac{\theta}{\theta-1}} - \int_0^N p(i)y(i)\,di$$

- For each $y(i)$ we have the first order condition

$$\left(\int_0^N y(i)^{\frac{\theta-1}{\theta}}\,di\right)^{\frac{1}{\theta-1}} y(i)^{-\frac{1}{\theta}} = p(i)$$

- This can be written

$$y(i) = p(i)^{-\theta}\,Y$$

Elasticity of substitution

- Note that for any two intermediates

$$\frac{y(i)}{y(j)} = \left(\frac{p(i)}{p(j)}\right)^{-\theta}$$

- Hence for this production function the elasticity of substitution between any two varieties is constant

$$\frac{d\log\frac{y(i)}{y(j)}}{d\log\frac{p(i)}{p(j)}} = -\theta$$

- If the relative price $p(i)/p(j)$ increases by 1%, the final good producers substitute from i to j reducing $y(i)/y(j)$ by $\theta\%$

Intermediate producers

- Constant marginal cost $c > 0$ [will derive this shortly]

- Choose their quantity $y(i)$ to maximize profits

$$\pi(i) = p(i)y(i) - c\,y(i)$$

subject to the downward-sloping demand curve for their product

$$y(i) = p(i)^{-\theta}Y$$

- Intermediate producers choose price $p(i)$ internalizing the effect on demand (i.e., recognizing their market power)

Intermediate producers

- Equivalently, choose $p(i)$ to maximize

$$\pi(i) = \left[p(i)^{1-\theta} - c\,p(i)^{-\theta} \right] Y$$

- Solution is price that is a *markup* over marginal cost

$$p(i) = \frac{\theta}{\theta - 1}\, c$$

- Perfect competition is the limit $\theta \to \infty$ (perfectly elastic demand) so that $p(i) \to c$ (marginal cost pricing)

- Restriction $\theta > 1$ needed to ensure marginal revenue is positive

Cost function

- How should we interpret this constant marginal cost?

- Suppose intermediates have Cobb-Douglas production function

$$y = Ak^{\alpha}l^{1-\alpha}$$

and hire capital and labor at competitive factor prices R and W

- Cost function is then

$$C(y) = \min_{k,l} \left[Rk + Wl \;\middle|\; Ak^{\alpha}l^{1-\alpha} = y \right]$$

- First order conditions for this problem

$$R = \lambda\alpha Ak^{\alpha-1}l^{1-\alpha} = \lambda\alpha\frac{y}{k}$$

$$W = \lambda(1-\alpha)Ak^{\alpha}l^{-\alpha} = \lambda(1-\alpha)\frac{y}{l}$$

where λ is the multiplier on the production function

Cost function

- So at the optimum we have

$$Rk + Wl = \lambda y$$

- In other words cost function is linear in y

$$C(y) = Rk + Wl = \lambda y$$

and multiplier λ *is* the constant marginal cost c

- Solving for the multiplier gives

$$\lambda = \left(\frac{R}{\alpha}\right)^{\alpha}\left(\frac{W}{1-\alpha}\right)^{1-\alpha}\frac{1}{A} \equiv c$$

Factor shares

- Labor and capital shares for each producer

$$\frac{Wl(i)}{p(i)y(i)}, \qquad \frac{Rk(i)}{p(i)y(i)}$$

- Under perfect competition $p(i) = c$ we would have

$$\frac{Wl(i)}{p(i)y(i)} = 1 - \alpha, \qquad \frac{Rk(i)}{p(i)y(i)} = \alpha$$

and hence we would have the aggregate factor income shares

$$s_L \equiv \frac{WL}{Y} = 1 - \alpha, \qquad s_K \equiv \frac{RK}{Y} = \alpha$$

where $L \equiv \int l(i)\, di$ and $K \equiv \int k(i)\, di$

Factor shares and markups

- But with monopolistic competition, price is a markup over marginal cost

$$p(i) = \frac{\theta}{\theta - 1}\, c$$

- So now factor shares are

$$s_L \equiv \frac{WL}{Y} = \frac{1-\alpha}{\frac{\theta}{\theta-1}} < 1 - \alpha$$

and

$$s_K \equiv \frac{RK}{Y} = \frac{\alpha}{\frac{\theta}{\theta-1}} < \alpha$$

- So indeed markup (monopoly power) drives a wedge between real wage W and labor productivity Y/L

Profits

- These factor income payments no longer exhaust aggregate output. What's left?

- Residual is monopoly (economic) profits

$$\frac{\Pi}{Y} = 1 - \frac{WL}{Y} - \frac{RK}{Y} = \frac{1}{\theta}$$

where $\Pi \equiv \int \pi(i)\, di$

- Suppose θ is falling over time (demand is becoming less elastic for some reason), then markups rise, there is a larger wedge between real wage and labor productivity, and economic profits rise

Next class

- Automation
  - what are the economic consequences of automation?
  - will automation increase or decrease wages?
  - does automation differ from factor-augmenting technical change?