Lecture 8

Technological Progress

6/16

Goals

- Today, we introduce technological progress into the model of Pissarides.
- With this new component, we can ask whether a faster technological progress reduces the unemployment rate in the long run.
- We shall also study a model of Creative Destruction, in which a higher rate of technological progress causes a shorter duration of jobs.

Technological Progress and Job Creation

Review of the DMP Model

- Consider (1.6), which is
$$rV = -pc + q(\theta)(J - V)$$
- Now consider (1.33), which is
$$rV = -pc + q(\theta)(J - V) + \dot{V}$$
- Let us introduce $V(t)$ to consider the possibility that V itself grows over time.

Review of the DMP Model

- Consider:

$$V(t) = -pc\delta t + \frac{1}{1 + r\delta t}\{q(\theta)\delta t J(t + \delta t) + [1 - q(\theta)\delta t]V(t + \delta t)\}$$

- Multiply both sides by $1 + r\delta t$ to obtain

$$(1 + r\delta t)V(t)$$
$$= -(1 + r\delta t)pc\delta t + \{q(\theta)\delta t J(t + \delta t) + [1 - q(\theta)\delta t]V(t + \delta t)\}$$

- Arrange terms to obtain

$$r\delta t V(t) = -(1 + r\delta t)pc\delta t + q(\theta)\delta t[J(t + \delta t) - V(t + \delta t)] +$$
$$V(t + \delta t) - V(t)$$

- Divide both sides by δt to obtain

$$rV(t) = -(1 + r\delta t)pc + q(\theta)[J(t + \delta t) - V(t + \delta t)] + \frac{V(t+\delta t) - V(t)}{\delta t}$$

Review of the DMP Model

- Note that

$$\lim_{\delta t \to \infty} \frac{V(t+\delta t) - V(t)}{\delta t} = \frac{dV(t)}{dt} = \dot{V}$$

- Take the limit as $\delta t \to 0$ to obtain (1.33) as

$$rV = -pc + q(\theta)(J - V) + \dot{V}$$

- Similarly, we derived (1.34), (1.37) and (1.38) as follows.

$$rJ = p - w + \lambda(V - J) + \dot{J}$$
$$rU = z + \theta q(\theta)(W - U) + \dot{U}$$
$$rW = w + \lambda(U - W) + \dot{W}$$

Technological Progress

- The new ingredient is that we are going to assume that p grows over time.
- In particular,

$$p(t) = p(0)e^{gt}$$

- This implies

$$\frac{\dot{p}}{p} = g$$

- Thus, the growth rate of technology is g.
  - We assume g is constant and satisfies $g < r$.

Balanced Growth Equilibrium

- Because p grows over time, we cannot find a steady state in the usual sense.
- Instead, we look for a **balanced-growth equilibrium (BGE)**, in which all values grow at the same rate.
- Thus, we shall now impose

$$\frac{\dot{V}}{V} = \frac{\dot{J}}{J} = \frac{\dot{U}}{U} = \frac{\dot{W}}{W} = \frac{\dot{p}}{p} = g$$

Balanced Growth Equilibrium

- Consider

$$\frac{\dot{V}}{V} = \frac{\dot{J}}{J} = \frac{\dot{U}}{U} = \frac{\dot{W}}{W} = g$$

- Interestingly, this implies

$$\dot{V} = gV$$
$$\dot{J} = gJ$$
$$\dot{U} = gU$$
$$\dot{W} = gW$$

- We substitute them into the Bellman equations.

Balanced Growth Equilibrium

- In any balanced-growth equilibrium,

$$rV = -pc + q(\theta)(J - V) + gV$$
$$rJ = p - w + \lambda(V - J) + gJ$$
$$rU = z + \theta q(\theta)(W - U) + gU$$
$$rW = w + \lambda(U - W) + gW$$

- For a technical reason (to be explained), we shall assume that the unemployment benefit z is proportional to p. Thus, we assume

$$z = pb,$$

where $b > 0$ is constant.

Balanced Growth Equilibrium

- Thus, we rewrite the equations as

$$(r-g)V = -pc + q(\theta)(J - V)$$
$$(r-g)J = p - w + \lambda(V - J)$$
$$(r-g)U = pb + \theta q(\theta)(W - U)$$
$$(r-g)W = w + \lambda(U - W)$$

- Sometimes we call $r-g$ as the **effective discount rate**.
  - I hope you now understand why we imposed the assumption $g < r$.
  - We want the effective discount rate to be positive.

Balanced Growth Equilibrium

- Notice that once we redefine $r - g$ as ρ, say, our model looks nearly the same as the original model:

$$\rho V = -pc + q(\theta)(J - V)$$
$$\rho J = p - w + \lambda(V - J)$$
$$\rho U = pb + \theta q(\theta)(W - U)$$
$$\rho W = w + \lambda(U - W)$$

- We can now derive the job-creation condition and the wage equation from the model.

Balanced Growth Equilibrium

- As in the model without technological progress, we can determine a balanced-growth equilibrium by the set of (θ, w, u) satisfying

$$u = \frac{\lambda}{\lambda + \theta q(\theta)}$$

$$(r - g + \lambda)\frac{pc}{q(\theta)} = p - w$$

$$w = \beta p + (1 - \beta)pb + \beta pc\theta$$

Balanced Growth Equilibrium

- First, observe that the wage equation implies that the wage rate is proportional to p. To see this,

$$w = \beta p + (1 - \beta)pb + \beta pc\theta$$
$$= [\beta + (1 - \beta)b + \beta c\theta]p$$

- In other words, the wage rate grows at rate g.
  - This result is derived, not assumed.
  - For this to be true, the unemployment benefit and the vacancy cost are both proportional to p. Remember our additional assumption $z = pb$.

Balanced Growth Equilibrium

- Substitute the wage equation into the job-creation condition to obtain

$$(r-g+\lambda)\frac{pc}{q(\theta)} = p - [\beta + (1-\beta)b + \beta c\theta]p$$

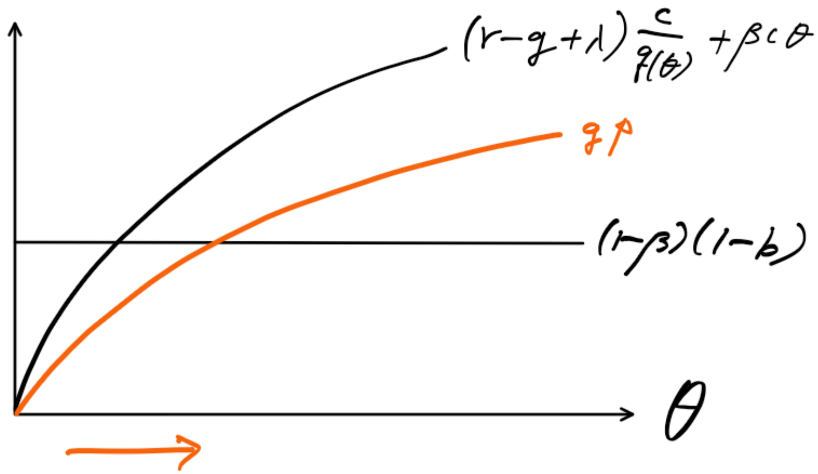
- Both sides are proportional to p.
- <u>For this to be true, the vacancy cost must be proportional to pc, as in Pissarides</u>.
  - In other words, without technological progress, it is OK to assume the vacancy cost to be c not pc.

Balanced Growth Equilibrium

- Divide both sides by p to obtain
$$(r-g+\lambda)\frac{c}{q(\theta)}+\beta c\theta=(1-\beta)(1-b)$$
- Because p is dropped, all variables in this expression can be constant over time.
    - We can safely find a balanced-growth equilibrium.
- The left-hand side is increasing in θ.
- The right-hand side is constant. The sign is positive if and only if $b<1$ (i.e., $z<p$).

Balanced Growth Equilibrium

- There is a unique BGE, as shown in the diagram.
- An increase in g will increase θ in BGE.
- Because $u = \frac{\lambda}{\lambda+\theta q(\theta)}$ implies a negative relationship between θ and u, an increase in g will decrease u.



Capitalization Effect

- We have now shown that a faster technological progress will create more jobs and reduce the unemployment rate in the long run.
- This result is referred to as the **capitalization effect**.

Capitalization Effect

- To fully understand the capitalization effect, consider the job-creation condition:

$$\frac{(r-g+\lambda)pc}{q(\theta)} = p - w$$

- Let $r - g + \lambda = \tilde{r}$ be the effective discount rate.
- Then we rewrite it as

$$\underbrace{\underbrace{\frac{1}{q(\theta)}}_{\text{Expected duration}} \times \underbrace{pc}_{\text{Vacancy cost}}}_{\text{Expected Total Vacancy Costs}} = \underbrace{\frac{p-w}{\tilde{r}}}_{\text{Discounted Infinite Sum of Profits}}$$

Capitalization Effect

- It is now clear that the job-creation condition balances the cost and benefit of creating a vacancy.
- The effective discount rate $\tilde{r} = r - g + \lambda$ captures two things:
  - Technological progress
  - Separations.
- Suppose that you must borrow money to finance the vacancy cost. Then, $\frac{p-w}{\tilde{r}}$ is the maximum amount of money you can repay in the future.
  - A lower interest rate expands this amount.

Technological Progress and Job Destruction

Mortensen, Dale T., and Christopher A. Pissarides. "Technological progress, job creation, and job destruction." Review of Economic dynamics (1998): 733-753.

Goals

- An implicit assumption was made in the previous model that technological progress improves the labor productivity for all jobs.
  - Often referred to as **disembodied** technological progress.
- We now consider the polar opposite in which only the newly created job can enjoy the cutting-edge technology.
  - After a job is created, there are newer, better technology outside, causing the job obsolete.

Vintage

- Consider (1.33) in Pissarides, which is
$$rV = -pc + q(\theta)(J - V) + \dot{V}$$
- This is the value of creating a vacancy.
- We shall introduce the idea of **job vintage**.
- Let $J(\tau)$ denote the value of job filled in period τ, evaluated in period t.
  - τ is the **vintage** of a particular job.
  - t is the actual time.
  - For brevity, we denote $J(\tau)$ instead of $J(\tau, t)$.

Vintage

- We shall extend this expression as

$$rV = -pc + q(\theta)(J(t) - V - pK) + \dot{V}$$

  - $J(t)$ is the value of a job of vintage t.
  - pK is the cost of starting a new job. Training cost.
- As always, we assume free entry of jobs: $V = 0$
- Thus, this Bellman equation implies

$$\frac{c}{q(\theta)} + K = \frac{J(t)}{p}$$

- This is (3) in MP.
  - For simplicity, we will assume $K = 0$.

Vintage

- In Pissarides: $rJ = p - w + \lambda(V - J) + \dot{J}$
- The value of a job of vintage τ satisfies
$$rJ(\tau) = p(\tau) - w(\tau) + \lambda\big(V - J(\tau)\big) + \dot{J}(\tau)$$
- This is (4) in MP (when $V = 0$).
  - We drop x by assuming $x = 1$.
  - Imagine an extreme example where you stop learning on the date you are hired.

Vintage

- In Pissarides,

$$rW = w + \lambda(U - W) + \dot{W}$$

- The value of employment of vintage τ is

$$rW(\tau) = w(\tau) + \lambda\big(U - W(\tau)\big) + \dot{W}(\tau)$$

- This is (5) in MP.

Vintage

- In Pissarides,
$$rU = z + \theta q(\theta)(W - U) + \dot{U}$$
- The value of unemployment in MP is
$$rU = pb + \theta q(\theta)(W(t) - U) + \dot{U}$$
- $W(t)$ means that at the time you are hired, your job vintage is $\tau = t$ because the date you are hired is indexed by t.
- Your job vintage is fixed at τ while t increases over time. Thus, $t > \tau$ and $t - \tau$ is job **tenure**.
- As $t - \tau$ expands, the job becomes **obsolete**.

Wage Bargaining

- (1.17) in Pissarides:

$$W_i - U = \beta(J_i + W_i - V - U)$$

- With vintage,

$$W(\tau) - U = \beta(J(\tau) + W(\tau) - V - U)$$

- Or,

$$\beta[J(\tau) - V] = (1 - \beta)[W(\tau) - U]$$

- This is (7) in MP.
- Differentiate it by t to obtain

$$\beta\left[\dot{J}(\tau) - \dot{V}\right] = (1 - \beta)\left[\dot{W}(\tau) - \dot{U}\right]$$

Wage Bargaining

- Rewrite the values as
$$(r+\lambda)[J(\tau)-V]=p(\tau)-w(\tau)-rV+\dot{J}(\tau)$$
- Similarly,
$$(r+\lambda)[W(\tau)-U]=w(\tau)-rU+\dot{W}(\tau)$$
- Substitute these expressions into the bargaining outcome to obtain
$$\beta\left[p(\tau)-w(\tau)-rV+\dot{J}(\tau)\right]$$
$$=(1-\beta)\left[w(\tau)-rU+\dot{W}(\tau)\right]$$
- Thus,
$$w(\tau)=\beta p(\tau)+(1-\beta)rU$$
$$+\beta\dot{J}(\tau)-(1-\beta)\dot{W}(\tau)$$

Wage Bargaining

- The bargaining outcome implies

$$[W(\tau) - U] = \frac{\beta}{1-\beta}[J(\tau) - V]$$

- Substitute the equations on page 24 into above:

$$[W(\tau) - U] = \frac{\beta}{1-\beta}\frac{pc}{q(\theta)}$$

- Thus, rU (on page 27) satisfies

$$rU = pb + \frac{\beta}{1-\beta}pc\theta + \dot{U}$$

Wage Bargaining

- Substitute rU into $w(\tau)$ to obtain

$$w(\tau) = \beta p(\tau) + (1-\beta)\left\{pb + \frac{\beta}{1-\beta}pc\theta\right\}$$
$$+\beta\dot{J}(\tau) - (1-\beta)\left[\dot{W}(\tau) - \dot{U}\right]$$

- Because $\beta\left[\dot{J}(\tau) - \dot{V}\right] = (1-\beta)\left[\dot{W}(\tau) - \dot{U}\right]$ and $V = \dot{V} = 0$, we obtain

$$w(\tau) = \beta p(\tau) + (1-\beta)\left\{pb + \frac{\beta}{1-\beta}pc\theta\right\}$$

Wage Bargaining

- Consider
$$w(\tau) = \beta p(\tau) + (1-\beta)\left\{pb + \frac{\beta}{1-\beta}pc\theta\right\}$$
- Collect the terms independent of τ to define
$$\omega(\theta) = b + \frac{\beta}{1-\beta}c\theta$$
- This is (9) in MP. Thus, the wage equation is
$$w(\tau) = \beta p(\tau) + (1-\beta)p\omega(\theta)$$
- This is (8).
    - We are assuming $x = 1$.

Wage Bargaining

- Consider the wage equation

$$w(\tau) = \beta p(\tau) + (1-\beta) p\omega(\theta)$$

- Observe:
  - $p(\tau)$ is constant.
  - $p = p(0)e^{gt}$ is growing over time.
- The key here is that the wage rate for a job of vintage τ grows over time even though the productivity of the worker-firm pair is <u>not growing</u>.
  - $w(\tau)$ is growing because the worker's reservation wage rU is growing because of economic growth.

Obsolescence and Job Destruction

- The value of a job of vintage τ in period t satisfies
$$rJ(\tau,t) = p(\tau) - w(\tau,t) + \lambda\big(V - J(\tau,t)\big) + \dot{J}(\tau,t)$$
- With $w(\tau,t)$ and $V = 0$, rewrite above as
$$(r+\lambda)J(\tau,t) = (1-\beta)[p(\tau) - p(t)\omega(\theta)] + \dot{J}(\tau,t)$$
- Multiply both sides by $e^{-(r+\lambda)t}$ to obtain
$$(r+\lambda)J(\tau,t)e^{-(r+\lambda)t} - \dot{J}(\tau,t)e^{-(r+\lambda)t}$$
$$= (1-\beta)[p(\tau) - p(t)\omega(\theta)]e^{-(r+\lambda)t}$$
- Observe that the left-hand side is
$$\frac{d\big[J(\tau,t)e^{-(r+\lambda)t}\big]}{dt} = -(r+\lambda)J(\tau,t)e^{-(r+\lambda)t} + \dot{J}(\tau,t)e^{-(r+\lambda)t}$$

Obsolescence and Job Destruction

- Thus,
$$-\frac{d\left[J(\tau,t)e^{-(r+\lambda)t}\right]}{dt}=(1-\beta)[p(\tau)-p(t)\omega(\theta)]e^{-(r+\lambda)t}$$
- Integrate both sides from t to $\tau+T$ to obtain
$$e^{-(r+\lambda)t}J(\tau,t)-e^{-(r+\lambda)(\tau+T)}J(\tau,\tau+T)$$
$$=\int_t^{\tau+T}(1-\beta)[p(\tau)-p(s)\omega(\theta)]e^{-(r+\lambda)s}ds$$
- Multiply both sides by $e^{(r+\lambda)t}$ to obtain
$$J(\tau,t)=\int_t^{\tau+T}(1-\beta)[p(\tau)-p(s)\omega(\theta)]e^{-(r+\lambda)(s-t)}ds$$
$$+e^{-(r+\lambda)(\tau+T-t)}J(\tau,\tau+T)$$

Obsolescence and Job Destruction

- Consider

$$J(\tau, t) = \int_t^{\tau+T} (1-\beta)[p(\tau) - p(s)\omega(\theta)]e^{-(r+\lambda)(s-t)}ds$$
$$+e^{-(r+\lambda)(\tau+T-t)}J(\tau, \tau+T)$$

- Let $\tau + T$ be the date at which the job must be destroyed. Then, the terminal value of the job must satisfy (by definition)

$$J(\tau, \tau+T) = 0$$

- Thus,

$$J(\tau, t) = \int_t^{\tau+T} (1-\beta)[p(\tau) - p(s)\omega(\theta)]e^{-(r+\lambda)(s-t)}ds$$

Obsolescence and Job Destruction

- Let the firm choose T:
  $$J(\tau, t) = \max_T \int_t^{\tau+T} (1-\beta)[p(\tau) - p(s)\omega(\theta)]e^{-(r+\lambda)(s-t)} ds$$
- This is (10) in MP.
- The first-order condition with respect to T is
  $$(1-\beta)[p(\tau) - p(\tau+T)\omega(\theta)]e^{-(r+\lambda)(\tau+T-t)} = 0$$
- Equivalently,
  $$p(\tau) - p(\tau+T)\omega(\theta) = 0$$

Obsolescence and Job Destruction

- Consider $p(\tau) - p(\tau + T)\omega(\theta) = 0$
- Because $p(\tau + T) = p(\tau)e^{gT}$,
$$p(\tau) = p(\tau)e^{gT}\omega(\theta)$$
- Thus,
$$\begin{aligned} 1 &= e^{gT}\omega(\theta) \\ &= e^{gT}\left(b + \frac{\beta}{1-\beta}c\theta\right) \end{aligned}$$
- This is (13) in MP.
- This defines the relationship between θ and T.

Obsolescence and Job Destruction

- Consider

$$1 = e^{gT}\omega(\theta) = e^{gT}\left(b + \frac{\beta}{1-\beta}c\theta\right)$$

- This implies a <u>negative</u> relationship between θ & T.
- From page 24,

$$\frac{c}{q(\theta)}p(t) = J(t,t)$$

- The right-hand side is

$$J(t,t) = \int_t^{t+T} (1-\beta)[p(t) - p(s)\omega(\theta)]e^{-(r+\lambda)(s-t)}ds$$

Obsolescence and Job Destruction

- Rewrite the previous equation as

$$J(t,t) = (1-\beta)p(t)\int_t^{t+T}\left[1-e^{g(s-t)}\omega(\theta)\right]e^{-(r+\lambda)(s-t)}ds = (1-\beta)p(t)\int_0^T[1-e^{gs}\omega(\theta)]e^{-(r+\lambda)s}ds$$

- Thus,

$$\frac{c}{q(\theta)} = (1-\beta)\int_0^T[1-e^{gs}\omega(\theta)]e^{-(r+\lambda)s}ds$$

Obsolescence and Job Destruction

- Consider
$$\frac{c}{(1-\beta)q(\theta)} = \int_0^T [1 - e^{gs}\omega(\theta)]e^{-(r+\lambda)s}ds$$
- The derivative of the right-hand side with respect to T is
$$[1 - e^{gT}\omega(\theta)]e^{-(r+\lambda)T} = 0$$
- This is because $1 = e^{gT}\omega(\theta)$.
- This implies that this equation is independent of T.

Obsolescence and Job Destruction

- Equilibrium is determined by a pair $\{\theta, T\}$ satisfying

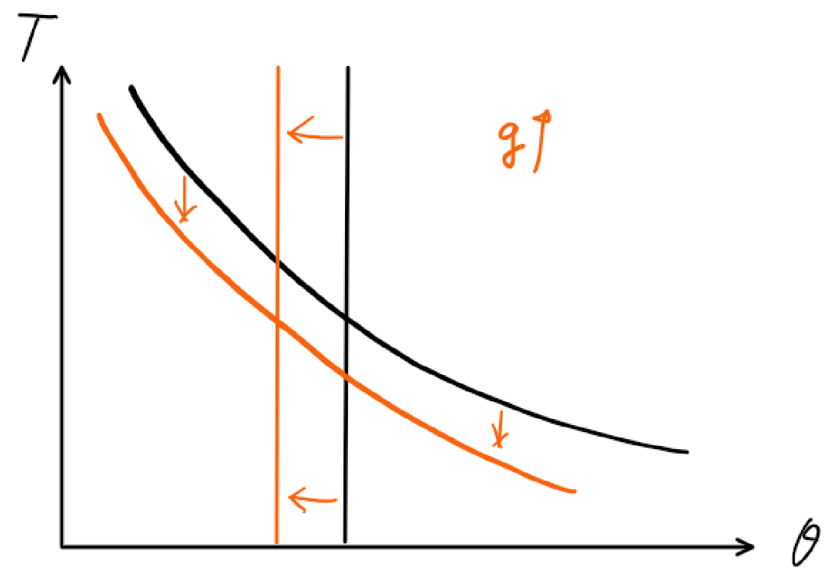
$$1 = e^{gT}\left\{b + \frac{\beta c}{1-\beta}\theta\right\} = e^{gT}\omega(\theta)$$

$$\frac{c}{(1-\beta)q(\theta)} = \int_0^T [1 - e^{gs}\omega(\theta)]e^{-(r+\lambda)s} ds$$

- The first equation implies a negative relationship, while the second implies a unique θ for each T.

Obsolescence and Job Destruction

- An increase in g decreases both θ and T.
- Thus, when technology is **embodied**, a faster technological progress makes the life of each job shorter.
- This is called **creative destruction** of jobs.



Obsolescence and Worker Flows

- Let us consider worker flows. In the basic Pissarides model, total job creation is $\theta q(\theta)u_t$ and total job destruction is $\lambda(1-u_t)$.
- With obsolescence, total job creation at t is
$$C_t = \theta q(\theta)u_t$$
- Because jobs are destroyed exogenously at rate λ, C satisfies the following differential equation:
$$\dot{C} = -\lambda C$$
- To solve it, multiply by integration factor $e^{\lambda t}$ to get
$$\dot{C}e^{\lambda t} + \lambda C e^{\lambda t} = 0$$

Obsolescence and Worker Flows

- Consider $\dot{C}e^{\lambda t} + \lambda C e^{\lambda t} = 0.$
- Note that $\left(Ce^{\lambda t}\right)' = \dot{C}e^{\lambda t} + \lambda C e^{\lambda t}$
- Thus,

$$\left(Ce^{\lambda t}\right)' = 0$$

- Integrate this from $t - T$ to t:

$$\left[Ce^{\lambda s}\right]_{t-T}^{t} = C_t e^{\lambda t} - C_{t-T} e^{\lambda(t-T)} = 0$$

- Thus,

$$C_t = C_{t-T} e^{-\lambda T}$$

Obsolescence and Worker Flows

- Consider

$$C_t = C_{t-T} e^{-\lambda T}$$

- This is a solution to the differential equation.
- Instead of the usual initial condition at C_0, the initial condition is set at C_{t-T}.
- The expression tells us the number of jobs created at $t - T$ that survived after T periods.
- Because the optimal tenure length is T, $C_{t-T} e^{-\lambda T}$ is the number of jobs destroyed because of obsolescence (not by separation shock).

Obsolescence and Worker Flows

- Total job creation at t is
$$C_t = \theta q(\theta) u_t$$
- Total job destruction at t is
$$D_t = \lambda(1 - u_t) + C_{t-T} e^{-\lambda T}$$
- In any steady state, two flows must be the same:
$$\theta q(\theta) u = \lambda(1 - u) + \theta q(\theta) u e^{-\lambda T}$$
- Solve it to obtain
$$u = \frac{\lambda}{\lambda + [1 - e^{-\lambda T}]\theta q(\theta)}$$

Creative Destruction

- Consider

$$u = \frac{\lambda}{\lambda + [1 - e^{-\lambda T}]\theta q(\theta)}$$

- We have shown that an increase in g decreases both θ and T.
- Because $\left[1 - e^{-\lambda T}\right]\theta q(\theta)$ is increasing in both θ and T, an increase in g decreases u.
- Thus, <u>embodied technological progress increases unemployment</u>.

Creative Destruction

- Equilibrium is determined by a set of $\{\theta, T, u\}$ satisfying

$$1 = e^{gT}\left\{b + \frac{\beta c}{1-\beta}\theta\right\} = e^{gT}\omega(\theta)$$

$$\frac{c}{q(\theta)} = (1-\beta)\int_0^T [1 - e^{gs}\omega(\theta)]e^{-(r+\lambda)s}ds$$

$$u = \frac{\lambda}{\lambda + [1 - e^{-\lambda T}]\theta q(\theta)}$$

- The second equation is still too complicated as it includes integration.

Creative Destruction

- Let us simplify the second equation.

$$\frac{c}{(1-\beta)q(\theta)} = \int_0^T [1 - e^{gs}\omega(\theta)]e^{-(r+\lambda)s} ds$$

$$= \int_0^T e^{-(r+\lambda)s} ds - \omega(\theta) \int_0^T e^{-(r-g+\lambda)s} ds$$

$$= \left[-\frac{1}{r+\lambda} e^{-(r+\lambda)s}\right]_0^T$$

$$-\omega(\theta) \left[-\frac{1}{r-g+\lambda} e^{-(r-g+\lambda)s}\right]_0^T$$

Creative Destruction

- Thus, we obtain

$$\frac{c}{(1-\beta)q(\theta)} = \frac{1}{r+\lambda}\left[1-e^{-(r+\lambda)T}\right] - \frac{\omega(\theta)}{r-g+\lambda}\left[1-e^{-(r-g+\lambda)T}\right]$$

- This equation does not contain integration.

Creative Destruction

- Equilibrium is determined by a set of $\{\theta, T, u\}$ satisfying

$$1 = e^{gT}\left\{b + \frac{\beta c}{1-\beta}\theta\right\} = e^{gT}\omega(\theta)$$

$$\frac{c}{(1-\beta)q(\theta)} = \frac{1}{r+\lambda}\left[1 - e^{-(r+\lambda)T}\right] - \frac{\omega(\theta)}{r-g+\lambda}\left[1 - e^{-(r-g+\lambda)T}\right]$$

$$u = \frac{\lambda}{\lambda + [1 - e^{-\lambda T}]\theta q(\theta)}$$

Further Readings

- Chapter 3 in Pissarides (2000).
- Mortensen, Dale T., and Christopher A. Pissarides. "Technological progress, job creation, and job destruction." *Review of Economic dynamics* (1998) 733-753.

Reading Assignment

- Acemoglu. “Good Jobs versus Bad Jobs.” *Journal of Labor Economics*, 2001.
- Downloadable from UNCT.
- Read Section I (Introduction), and Section II (The Basic Model).
- Due is on 6/23.
- 6/23 class will focus on this paper.