ECON 5110 Class Notes
Coordination Failures

1 Introduction

We have discussed three different models of the business cycle.

1. Business-cycle models driven by supply-side factors including imperfect information (e.g., RBC and Lucas' model).

2. Business-cycle models driven by sunspots (e.g., Farmer's IR model).

3. Business-cycle models driven by wage/price rigidities (e.g., Taylor's overlapping contracts model, menu cost model).

One could argue that there is a fourth class that does not rely on any of these mechanisms. One example is Cooper and John's (1988) game theoretic model where strategic complementarities lead to coordination failures. Another example is Diamond's (1982) model of coordination failures that arise due to search and trading externalities.

2 Diamond's (1982) Search Model

2.1 Island Metaphor

Diamond uses an island metaphor to describe the basic idea of the model.

- Islanders are employed by searching for palm trees with coconuts.

- All trees have nuts but they vary in their height.

- There is a taboo against eating the nuts you have picked and so you must trade.

- If many are employed, picking nuts (i.e., production) is attractive.

- If few are employed, picking nuts (i.e., production) is unattractive.

- Trading externality: my employment affects others' likelihood of making a trade.

- Multiple equilibria.

– If everyone thinks few are picking (pessimistic), it is best not to pick.

– If everyone thinks picking is high (optimistic), it is best to pick.

- Expectations can be self-fulfilling.

2.2 Basic Model

All individuals are identical, risk-neutral and maximize expected lifetime utility, given by

$$E[V] = E[\sum_{i=1}^{\infty} e^{-rt_i} U_{t_i}]$$

by choosing consumption (y) and the cost of production (c). Instantaneous utility is given by

$$U = y - c.$$

Production opportunities (x) follow a Poisson process and arrive at exogenous rate a. Recall, the Poisson distribution is

$$p(x, at) = \frac{e^{-at}(at)^x}{x!}.$$

Each opportunity produces y and costs c, with (cumulative) probability distribution $G(c)$. Costs are seen before the production decision and production is instantaneous. Individuals cannot consume their own output and cannot produce until all inventories are exhausted. There are two types of individuals

- Unemployed. Individuals with 0 units looking for production opportunities.

- Employed. Individuals with y units looking for a trade.

The arrival of a trading partner also follows a Poisson process with arrival rate $b(e)$, where e is the fraction employed. It is assumed that $b'(e) > 0$. The law of motion for aggregate employment is

$$\dot{e} = a(1-e)G(c^*) - eb(e)$$

where c^* is the cost ceiling. Note that as expected, the steady-state employment rate $(\dot{e} = 0)$ rises with c^*. This can be found by setting $\dot{e} = 0$ and totally differentiating the resulting equation to get

$$\frac{de}{dc^*} = \frac{a(1-e)G'(c^*)}{b(e) + eb'(e) + aG(c^*)} > 0.$$

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Note also that $d^2e/d(c^*)^2 < 0$, when evaluated at $\dot{e} = 0$.

2.3   Individual Choice

Begin by denoting W_e and W_u as the discounted expected lifetime utility from employment and unemployment, respectively. Standard dynamic programming arguments give

$$rW_e = b(y - W_e + W_u)$$

$$rW_u = a \int_0^{c^*} (W_e - W_u - c)dG(c).$$

These equations are in the form "interest rate x asset = expected contemporaneous benefit + expected capital gain." [*Similar conditions can be found in Shapiro and Stiglitz's (1984) AER efficiency-wage paper.*] Unemployed persons accept production if $W_e - W_u > c^*$. This produces an expression for c^*

$$c^* = W_e - W_u = \frac{\left(by + a \int_0^{c^*} cdG\right)}{r + b + aG(c^*)}.$$

Differentiating with respect to e gives

$$\frac{dc^*}{de} = \frac{b'y(r + b + aG(c^*)) - \left(by + a \int_0^{c^*} cdG\right)b'}{(r + b + aG(c^*))^2} = \frac{b'(y - c^*)}{r + b + aG(c^*)} > 0.$$

Note also that $d^2c^*/de^2 < 0$.

2.4   Steady-State Equilibrium

Figure 1 shows three possible steady-state rational expectation equilibria – zero, low and high employment. The economy will always be on the $c = c^*(e)$ curve but will only be on the $\dot{e} = 0$ curve in the steady state. The zero and high employment steady states are stable. The low employment steady state is unstable.

2.5   Static Model

To highlight the possible inefficiencies associated with the trading externality, consider a simple static version of the model. Agents produce output with cost function $c = f(y)$ and take the probability of making a sale $p(y)$ as given. However, in aggregate, p depends positively on y as more agents will be trading. Expected

utility follows

$$E[U] = yp(y) - f(y).$$

The decentralized equilibrium has all agents maximizing utility according to

$$p(y) = f'(y).$$

In making private decisions, agents will fail to recognize that by increasing their production, it increases the likelihood that others can successfully make trades. Therefore, the decentralized equilibrium will result in too little production.

A social planner, however, will internalize the trading externality and choose y according to

$$p(y) + yp'(y) = f'(y),$$

which will lead to higher production. By subsidizing the cost of production (via lump-sum taxes), the decentralized economy can realize the socially efficient level of production.

2.6 Policy in the Dynamic Model

Consider an increase in c^* (via a production cost subsidy). Diamond shows that

$$\frac{\partial(Welfare)}{\partial c^*} > 0$$

so that as in the static example, private decisions in the dynamic model (without the subsidy) result in an equilibrium with too little production. The intuition is as follows

- Intuition. By increasing the maximum cost at which individuals are willing to produce, more people will produce, trade will be easier, which will in turn induce people to produce more. That is, the production subsidy partially offsets the trading externality.

2.7 Conclusion

Diamond's model is a highly abstract model of coordination failures. However, the basic concept applies to large and complex modern economies, where there is not a Walrasian auctioneer to make sure all mutually beneficial trades are exhausted. Search is still an important feature of our economy. In the presence of

search costs, an unsubsidized, decentralized economy is likely to underproduce due to trading externalities. This is one possible explanation of business cycles, whereby shocks bounce us between inefficient equilibria. In this type of environment, reaching the socially efficient equilibrium will almost surely require government intervention to induce agents to internalize the trading externality and increase production.