14.06: Section Handout

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Today we will cover the basic idea of the model introduced by Bernanke and Gertler in their paper in the AER, 1989 [1].

Summary

This paper introduces a friction (or imperfection) in the financial market into an otherwise "relatively standard" neoclassical model. This friction arises because heterogeneous entrepreneurs (investors) have private information and the financial contract then incorporates additional characteristics that guarantee the entrepreneurs actually reveal the private information. The new addition to the model will give us some very interesting insights about investment and will also shed light on some persistence and amplification mechanisms.

An important part of the paper is devoted to the analysis of the microfoundations of the problem. I will skip that discussion here, and will focus mostly on the macroeconomic implications of the imperfections in the financial markets. In particular, the model will provide us with a simple rationale for financial constraints on the firms and the sensitivity of firm level investment to the availability of internal funds.

I will first describe the model and it assumptions. Then we will see how the no-friction (flexible) equilibrium looks like, and finally we will be able to compare the equilibrium when there is an imperfection in the financial market.

The Model

Bernanke and Gertler (1989)'s model is a relatively standard neoclassical model of investment. The feature that will allow the authors to introduce a twist later is the fact that the production of capital has an stochastic output.

The main ingredients of the model are:

- This is an infinite horizon, overlapping generations model (OLG).[2]

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[1] Bernanke and Gertler (1989).

[2] The main intuition behind the results in this model can still be explained without making explicit reference to this part; but this does not mean that it is not an important element for the particular solution presented in the paper.

- There are two types of agents: lenders and entrepreneurs. There is a fraction η of entrepreneurs. Every agent owns an initial stock of wealth.

  There are two differences: first, lenders are risk averse and entrepreneurs have linear preferences; second, entrepreneurs are the only ones that can start a "project".

- There are two goods: capital (k) and output (final) good. Capital can be transformed into output good within the same period, in particular,

$$y_t = \widetilde{\theta}_t f\left(k_t\right)$$

  where $\widetilde{\theta}$ will play the role of a demand shock in the market for capital.

  Capital can be produced with output goods, but its production takes one period. Production is such that entrepreneurs need to invest an amount ω of the output good today and will have a return κ in the next period, which is stochastic; assume for simplicity that κ takes only two values: κ^H and κ^L, with $\kappa^H > \kappa^L$.

  Entrepreneurs will differ in their abilities, which will be reflected in the amount they need to invest in the first period. In this way, entrepreneurs can be indexed according to ω, with a lower ω for a more productive entrepreneur.

- Agents have also access to a third technology, an storage technology, where agents get a payment r in the next period for each unit of the output good they "invest" today.

Equilibrium without Frictions

I will not provide a thorough revision of the microeconomics of the problem, but instead I will explain the intuition behind the solution.

The storage technology is very useful as it provides a constant alternative return to all investors. Think of the problem a lender faces, she has two options, she can either invest her wealth in the storage technology or she can lend it to an entrepreneur(s) who will use it to create capital.[3] Of course, she will choose the second alternative if and only if the expected return is higher than r.[4] Heterogeneity kicks in here, because there will be a marginal entrepreneur $\overline{\omega}$ such that the expected return on his project is exactly r. There is one more detail left in here, entrepreneurs have projects that require investment in output goods and give a return in capital goods, so the profitability of the projects also depends on the expected (as of time t) price of capital in $t+1$, $\widehat{q}_{t+1}$. in fact, a higher expected price makes additional projects profitable and so $\overline{\omega}$ is an increasing function of $\widehat{q}_{t+1}$, thus k_{t+1} is an increasing function of $\widehat{q}_{t+1}$.

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[3]The model feature perfect competition, so we can think of a single lender as facing a constant return rate.

[4]The authors assume that lenders and borrowers are risk-neutral in the second period, so we can focus on expected returns.
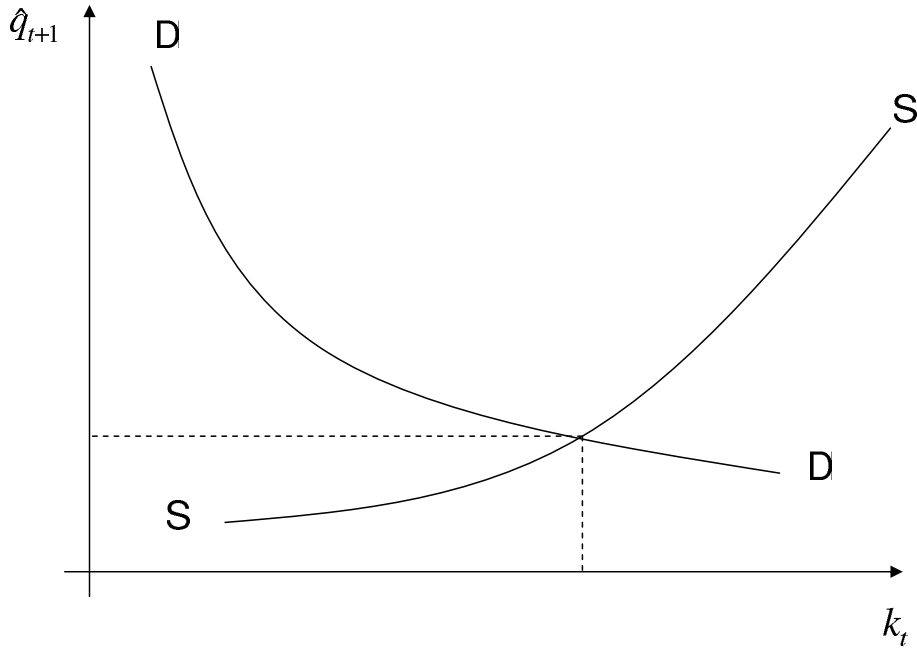
Figure 1: Equilibrium without Frictions.

Producers of the final good need capital for production. Under the assumption of perfect competition in the market for capital goods, demand is implicitly given by the first order condition of the firms:

$$\widehat{q}_{t+1} = \widetilde{\theta}_t f'\left(k_t\right). \tag{1}$$

Equation (1) determines a downward sloping curve, which we will call DD curve. Both curves determine the equilibrium in period t, see Figure 1.[5]

Equilibrium with Frictions

We now relax an assumption that was implicit in the previous section. The return to the investment in capital goods is stochastic, but we haven't made a bid deal out of it. In fact, we have implicitly assumed that the lenders know the realization of this stochastic process: the actual value of κ is observed by all the agents. Let us relax that assumption now and work under the assumption that κ is private info to the entrepreneur. Does this change anything?

Yes! The contract in the previous case specified a fixed payment in the next period. Suppose that we keep the same contract in this case and the entrepreneur gets the high realization κ^H. Given that he is the only one observing the realization he can cheat and say that the actual return was κ^L. For some entrepreneurs it will be

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[5]The equilibrium in period t is defined in terms of variables in $t+1$ because of the "time-to-build" assumption.

optimal to do so, either because they are not very productive or because they were not very wealthy in t and borrowed more.[6]

The authors assume that the lenders have access to a monitoring technology that reveals the actual realization of κ to everyone but it has a cost γ units of the capital good.[7] It can be shown then that the optimal contract specifies a probability $p > 0$ of monitoring if the entrepreneur reports κ^L, while there is no monitoring if κ^H is reported. The main element in this case is the fact that the contract has the "net worth property", that expected agency costs are decreasing in the amount of entrepreneurial savings contributed to the project. This means that a wealthier entrepreneur finds it easier to finance his own project because it has less incentives to cheat in the next period.

We can put the same argument in slightly different words. An entrepreneur who plans to invest has two sources of funds: internal funds (own savings) and external funds (borrowing from the lenders). In the model without frictions the entrepreneur is indifferent between both sources of funds; in the case with private information, he is not indifferent because internal funds are not subjected to this "agency costs" and so it is more convenient to invest using them.[8]

For our macro analysis the main point here is that net worth affects how much entrepreneurs can invest, and so there will be an additional factor to consider in the investment decision. Bernanke and Gertler (1989) show that the new supply curve S'S' lies to the left of the SS curve. Also, as you would expect, the imperfection in this case affects the supply of capital goods, so the demand for capital goods DD is the same as in the previous case. With this, the new equilibrium can be seen in Figure 2; now we have a lower k_{t+1} and a higher $\widehat{q}_{t+1}$.

We can now move and see what other implications of this model. Imagine that for some reason the economy is in an equilibrium like the one described by the intersection of S'S' and DD. Now, assume that in t there was a very high productivity shock (high $\widetilde{\theta}_t$). There will be more internal funds available to entrepreneurs and so the agency costs will play a smaller role in equilibrium. The equilibrium will then be given by a new curve S'S' to the right of the previous one (it cannot go further than the SS curve). If the same shock happens in the frictionless economy, then besides from the effect on the actual price of capital goods, the investment decision is NOT affected at all by the extra internal resources. This is basically a *persistence* mechanism as we have developed a model that makes the effects of the shocks more persistent in time.

The same idea is valid for the case of an *amplification* mechanism. Think of the same shock. In the frictionless economy the shock has no effects on investment in t; in the model with the friction in the financial market, there is an effect in t (even if there were no persistence effect), which was not there before. The same shock gets amplified effects because of this imperfect credit markets. A rough interpretation would be that for the same volatility in the shocks you would get a much volatile

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[6]For a more detailed discussion of the different regimes, see sections III.A and III.B in Bernanke and Gertler (1989).

[7]This is the basic idea introduced by Townsend (1979) and Townsend (1988).

[8]This means that in this model there is an ordering for the sources of funds, with internal funds being preferable to external funds.
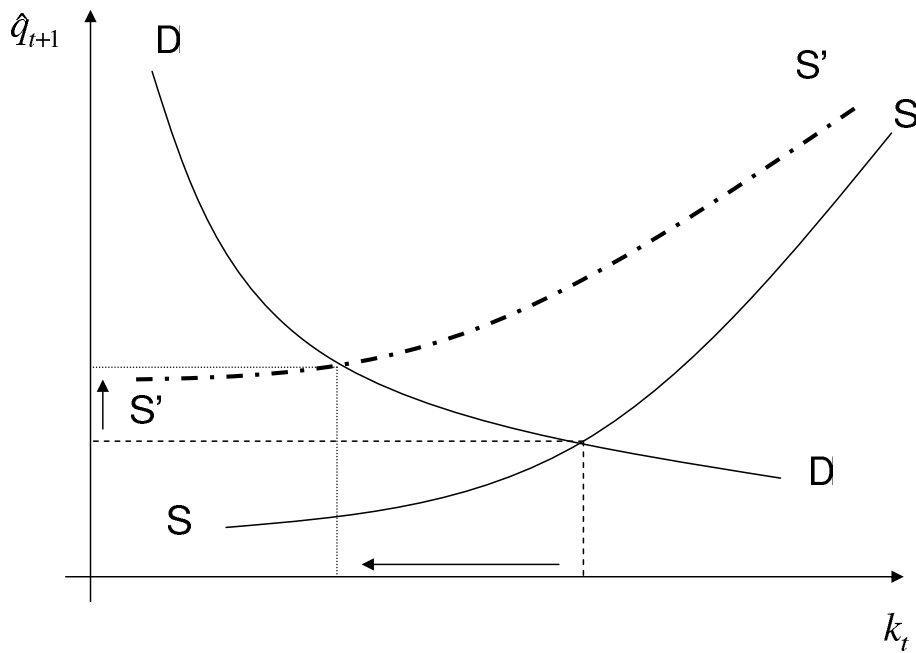
Figure 2: Equilibrium with Frictions.

response in the variable of interest (investment in this case).

References

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