University of Warsaw
Faculty of Economic Sciences

Fiscal & monetary policy interactions
Introduction to financial frictions

Advanced Macroeconomics: Lecture 11

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Fiscal & monetary policy interactions

Government and central bank budget constraints

Government's budget constraint

$$P_t G_t + (1 + i_{t-1}) B_{t-1}^T = P_t T_t + B_t^T + RCB_t$$

where B^T is total debt and RCB is revenue of the central bank

Central bank "budget constraint"

$$RCB_t = (1 + i_{t-1}) B_{t-1}^M - B_t^M + H_t - H_{t-1}$$

where B^M is government debt held by central bank and H is monetary base

Consolidated public sector budget constraint

$$\begin{aligned} P_t G_t + (1 + i_{t-1}) B_{t-1}^T &= P_t T_t + B_t^T + (1 + i_{t-1}) B_{t-1}^M - B_t^M + H_t - H_{t-1} \\ P_t G_t + (1 + i_{t-1}) B_{t-1} &= P_t T_t + B_t + H_t - H_{t-1} \end{aligned}$$

where $B \equiv B^T - B^M$ is privately held public debt

For simplicity assume $H \equiv M$

Public debt dynamics

Public debt dynamics

$$P_t G_t + (1 + i_{t-1}) B_{t-1} = P_t T_t + B_t + M_t - M_{t-1}$$

$$B_t = P_t (G_t - T_t) + (1 + i_{t-1}) B_{t-1} - (M_t - M_{t-1})$$

In real terms

$$B_t^r \equiv \frac{B_t}{P_t} = G_t - T_t + (1 + i_{t-1}) \frac{P_{t-1}}{P_t} \frac{B_{t-1}}{P_{t-1}} - \frac{M_t - M_{t-1}}{P_t} \equiv D_t^r + \frac{1 + i_{t-1}}{1 + \pi_t} B_{t-1}^r - S_t^r$$

where B^r is the real debt, D^r is primary deficit
and S^r is the real income from seignorage (money production)

Unlike private agents, government can additionally “print” money and benefit from seignorage or induce surprise inflation that devalues real debt

In many countries there is is explicitly legally forbidden for the central bank to directly purchase government debt: $B^M > 0$ results from transactions with commercial banks via open market operations (or quantitative easing)

Seignorage

Real income from seignorage (inflation tax)

$$S_t^r = \frac{M_t - M_{t-1}}{P_t} = \frac{\Delta M_t}{M_{t-1}} \cdot \frac{M_{t-1}}{P_t}$$

Money demand

$$\frac{M_{t-1}}{P_t} = L\left(Y_t,\, i_{t-1}\right)$$

where $L_Y > 0$ and $L_i < 0$. If real interest rate does not depend on policy, then

$$S_t^r = \frac{\Delta M_t}{M_{t-1}} \cdot L\left(Y_t,\, r + \pi_t^e\right)$$

Increase in inflation expectations leads to decrease in money demand and increase in nominal interest rate

Seignorage

Assuming constant rate of growth of money supply μ and (for simplicity) constant Y, expected and actual inflation in the long-run is

$$\pi^e = \pi = \mu$$

Real seignorage is then

$$S^r = \mu \cdot L\left(Y, r + \mu\right)$$

And reaches maximum value for some $\mu^* > 0$

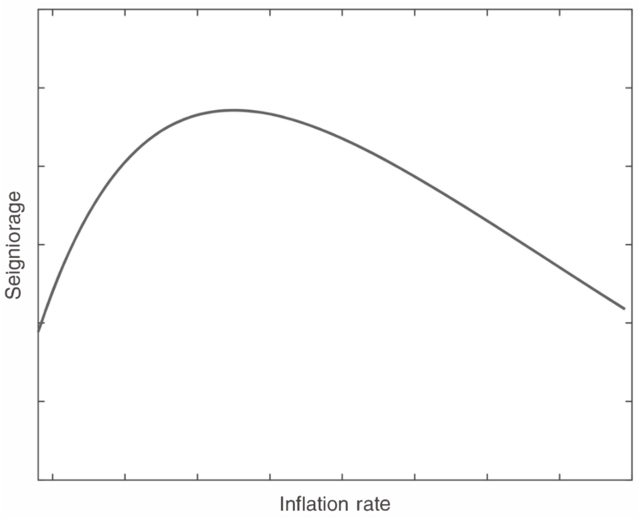
$$\frac{\partial S^r}{\partial \mu} = L\left(\cdot\right) + \mu L_i = 0 \quad \rightarrow \quad \mu^* = -\frac{L\left(\cdot\right)}{L_i} > 0$$

It means then that for $\mu > \mu^*$

$$\frac{\partial S^r}{\partial \mu} < 0$$

Overly high inflation is not beneficial for the government, but once this region is reached, disinflation requires painful reforms

Seignorage



Walsh (2017), Figure 4.1

Policy mix and coordination

We already know (see IRFs in previous lectures) that

- Expansionary fiscal policy ($G \uparrow$) leads to:
  short-run increase in GDP ($Y \uparrow$), increase in price level ($P \uparrow$ / $\pi \uparrow$)
  and increase in level of (real) public debt ($B^{(r)} \uparrow$)
- Expansionary monetary policy ($M \uparrow$ / $i \downarrow$) leads to:
  short-run increase in GDP ($Y \uparrow$), increase in price level ($P \uparrow$ / $\pi \uparrow$)
  and decrease in level of (real) public debt ($B^{(r)} \uparrow$)

Which of the two policies are useful for macroeconomic stabilization?

Both, but monetary policy can act “faster” and has shorter lags in transmission mechanism (exceptions: automatic stabilizers and ELB situation)

Additionally, it is easier to set up a formal economic goals mandate for monetary policy, while fiscal is bogged down by redistribution debates

Fiscal dominance

Models studied so far assumed monetary dominance: monetary policy sets M or i and fiscal policy adjusts to satisfy long-run public debt stability

Under monetary dominance central bank can anchor inflation at mandated target in the long run

Under fiscal dominance the government sets primary deficit path D^r, regardless of central bank actions

Sargent and Wallace (1981): in this case the central bank can lose control over inflation

1. Tighter monetary policy may lead to higher future inflation
2. Tighter monetary policy may even lead to higher current inflation!

Fiscal dominance: higher future inflation

Assumptions:

- Rate of growth of aggregate real GDP γ does not depend on policy
- Real interest rate $r > \gamma$ does not depend on policy
- There exists and upper bound on debt to GDP level, as a result of e.g. private demand for public debt. For notational convenience set for all $t > T$:

$$\frac{B_t}{P_t Y_t} = \frac{B_t^r}{Y_t} = \bar{b}$$

- Price level is given by the quantity theory of money with constant V:

$$M_t V = P_t Y_t \quad \rightarrow \quad P_t = \frac{M_t V}{Y_t} \quad \rightarrow \quad \pi \simeq \mu - \gamma$$

- For $t \leq T$ monetary policy sets (constant) rate of growth of money supply μ:

$$M_t = (1 + \mu) M_{t-1}$$

$$\frac{S_t^r}{Y_t} = \frac{M_t - M_{t-1}}{P_t Y_t} = \frac{M_t - M_t / (1 + \mu)}{M_t V} = \frac{1}{V}\left(1 - \frac{1}{1 + \mu}\right) = \frac{1}{V}\frac{\mu}{1 + \mu} \simeq \frac{\mu}{V}$$

Fiscal dominance: higher future inflation

Step 1: Inflation after T increases with $\bar{b}$

$$\begin{aligned} B_t^r &= D_t^r + (1+r)\, B_{t-1}^r - S_t^r \quad \Big| \quad : Y_t \\ \frac{B_t^r}{Y_t} &= \frac{D_t^r}{Y_t} + (1+r)\,\frac{Y_{t-1}}{Y_t}\,\frac{B_{t-1}^r}{Y_{t-1}} - \frac{S_t^r}{Y_t} \\ b_t &= d_t + \frac{1+r}{1+\gamma} b_{t-1} - s_t \end{aligned}$$

For $t > T$:

$$\bar{b} = d_t + \frac{1+r}{1+\gamma}\bar{b} - s_t \quad \rightarrow \quad s_t = d_t + \frac{r-\gamma}{1+\gamma}\bar{b}$$

If only $r > \gamma$ and fiscal policy does not adjust d, central bank is forced to cover the deficit with seignorage

$$\frac{\partial s_{t>T}}{\partial \bar{b}} > 0 \quad \rightarrow \quad \frac{\partial \mu}{\partial \bar{b}} > 0 \quad \rightarrow \quad \frac{\partial \pi}{\partial \bar{b}} > 0$$

Fiscal dominance: higher future inflation

Step 2: $\bar{b}$ decreases with μ

$$b_t = \frac{1+r}{1+\gamma} b_{t-1} + d_t - \frac{1}{V}\frac{\mu}{1+\mu} = \frac{1+r}{1+\gamma}\left[\frac{1+r}{1+\gamma} b_{t-2} + d_{t-1} - \frac{1}{V}\frac{\mu}{1+\mu}\right] + d_t - \frac{1}{V}\frac{\mu}{1+\mu}$$

$$= \left(\frac{1+r}{1+\gamma}\right)^2 b_{t-2} + \left(\frac{1+r}{1+\gamma}\right) d_{t-1} + d_t - \left(1 + \frac{1+r}{1+\gamma}\right)\frac{1}{V}\frac{\mu}{1+\mu}$$

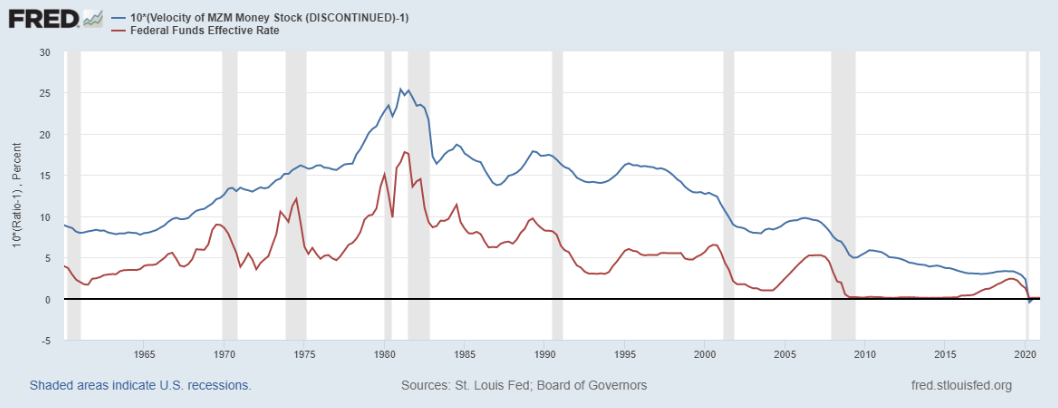
$$= \left(\frac{1+r}{1+\gamma}\right)^t b_0 + \sum_{i=0}^{t}\left(\frac{1+r}{1+\gamma}\right)^i d_{t-i} - \frac{1}{V}\frac{\mu}{1+\mu}\sum_{i=0}^{t}\left(\frac{1+r}{1+\gamma}\right)^i$$

$$\bar{b} \equiv b_T = \left(\frac{1+r}{1+\gamma}\right)^T b_0 + \sum_{i=0}^{T}\left(\frac{1+r}{1+\gamma}\right)^i d_{t-i} - \frac{1}{V}\frac{\mu}{1+\mu}\sum_{i=0}^{T}\left(\frac{1+r}{1+\gamma}\right)^i \quad \rightarrow \quad \frac{\partial \bar{b}}{\partial \mu} < 0$$

Tighter monetary policy (lower μ) generates lower seignorage income

With given d it leads to higher debt issuance, and the central bank will have to provide more seignorage in the future!

Money velocity and nominal interest rate



Federal Reserve Economic Database

Fiscal dominance: possible higher current inflation

Assume now that money velocity V depends positively on nominal interest rate i (and expected inflation π^e)

$$V(i) = V(r + \pi^e) \quad \rightarrow \quad \frac{\partial V}{\partial \pi^e} > 0$$

Price path before T depends now not only on μ,
but also on expectations for periods beyond T:

- Tighter monetary policy (lower μ) alone would reduce inflation
- But under fiscal dominance that leads to higher expected inflation beyond T and via backward induction increases current inflation expectations

Net effect is ambiguous: in some cases the second effect dominates and $\frac{\partial \pi_t}{\partial \mu} > 0$!

Fiscal theory of price level

In the previous discussion we assumed that if only monetary policy dominates, it will be able to pin down inflation rate / price level in the long run

According to the fiscal theory of price level even a fully independent central bank may not guarantee price stability, since reckless fiscal policy can cause jumps in the price level

Fiscal theory of price level: multiple equilibria

Equation of exchange suggests that money supply "sets" the price level

$$MV = PY \quad \rightarrow \quad P = \frac{MV}{Y}$$

However, if money velocity V (nominal interest rate i) are endogenous, and not constant, the above equation can be consistent with more than a single combination of current price level P and inflation expectations path

In such cases fiscal policy stance provides an additional equation pinning down the current level of P

Fiscal theory of price level: households

For simplicity assume no uncertainty and stationary GDP

Household budget constraint

$$M_{t-1} + (1 + i_{t-1})\, B_{t-1} + P_t\,(Y_t - T_t) \geq P_t C_t + B_t^d + M_t^d$$

Define $\mathcal{A}_t$ as the level of nominal assets at the beginning of period t

$$\mathcal{A}_t \equiv M_{t-1} + (1 + i_{t-1})\, B_{t-1}$$

$$\begin{aligned}
\mathcal{A}_t + P_t\,(Y_t - T_t) &\geq P_t C_t + B_t^d + M_t^d = P_t C_t + \frac{i_t}{1+i_t} M_t^d + \frac{1}{1+i_t}\left(M_t^d + (1+i_t)\, B_t\right) \\
&\geq P_t C_t + \frac{i_t}{1+i_t} M_t^d + \frac{1}{1+i_t} \mathcal{A}_{t+1}
\end{aligned}$$

In real terms ($\mathcal{A}_t^r \equiv \mathcal{A}_t / P_t$, $M_t^r \equiv M_t^d / P_t$)

$$\begin{aligned}
\mathcal{A}_t^r + Y_t - T_t &\geq C_t + \frac{i_t}{1+i_t} M_t^r + \frac{1}{1+i_t} \frac{P_{t+1}}{P_t} \frac{\mathcal{A}_{t+1}}{P_{t+1}} = C_t + \frac{i_t}{1+i_t} M_t^r + \frac{1+\pi_{t+1}}{1+i_t} \mathcal{A}_{t+1}^r \\
&\geq C_t + \frac{i_t}{1+i_t} M_t^r + \frac{1}{1+r_{t+1}} \mathcal{A}_{t+1}^r
\end{aligned}$$

Fiscal theory of price level: households

Denote with $\bar{r}_{t,t+j}$ the product of real interest rates between t and $t+j$

$$1+\bar{r}_{t,t+j} = (1+r_t)(1+r_{t+1})\cdot\ldots\cdot(1+r_{t+j})$$

Lifetime budget constraint can then be expressed as

$$\mathcal{A}_t^r + Y_t - T_t \geq C_t + \frac{i_t}{1+i_t}M_t^r + \frac{1}{1+r_{t+1}}\mathcal{A}_{t+1}^r$$

$$\mathcal{A}_t^r + \sum_{j=0}^{\infty}\frac{1}{1+\bar{r}_{t,t+j}}\left[Y_{t+j} - T_{t+j}\right] \geq \sum_{j=0}^{\infty}\frac{1}{1+\bar{r}_{t,t+j}}\left[C_{t+j} + \frac{i_{t+j}}{1+i_{t+j}}M_{t+j}^r\right]$$

PDV path of consumption expenditures (+ cost of holding money)
cannot exceed PDV path of disposable income (+ initial assets)

In equilibrium the equation holds with equality

Fiscal theory of price level: public sector

Consolidated budget constraint of government and central bank

$$P_t G_t + (1 + i_{t-1}) B_{t-1} + M_{t-1} = P_t T_t + B_t + M_t$$

$$G_t + \mathcal{A}_t^r = T_t + \frac{i_t}{1 + i_t} M_t^r + \frac{1}{1 + r_{t+1}} \mathcal{A}_{t+1}^r$$

We can also produce its “lifetime” version

$$\mathcal{A}_t^r = T_t - G_t + \frac{i_t}{1 + i_t} M_t^r + \frac{1}{1 + r_{t+1}} \mathcal{A}_{t+1}^r$$

$$\mathcal{A}_t^r = \sum_{j=0}^{\infty} \frac{1}{1 + \bar{r}_{t,t+j}} \left[T_{t+j} - G_{t+j} + \frac{i_{t+j}}{1 + i_{t+j}} M_{t+j}^r \right] + \lim_{j \to \infty} \frac{\mathcal{A}_{t+j}^r}{1 + \bar{r}_{t,t+j}}$$

Until now we have assumed that for any price level path $\{P_{t+j}\}$
the government satisfies $\lim_{j\to\infty} \left[\mathcal{A}_{t+j}^r / (1 + \bar{r}_{t,t+j})\right] = 0$ (Ricardian policy)

What happens if $\lim_{j\to\infty} \left[\mathcal{A}_{t+j}^r / (1 + \bar{r}_{t,t+j})\right] \neq 0$? (non-Ricardian policy)

Fiscal theory of price level: non-Ricardian policy

Even if $\lim_{j\to\infty}\left[\mathcal{A}^r_{t+j}/\left(1+\bar{r}_{t,t+j}\right)\right]\neq 0$, in equilibrium $Y_t = C_t + G_t$ and $M_t = M^d_t$

From households' lifetime budget constraint we get

$$\mathcal{A}^r_t + \sum_{j=0}^{\infty}\frac{1}{1+\bar{r}_{t,t+j}}\left[C_{t+j}+G_{t+j}-T_{t+j}\right] = \sum_{j=0}^{\infty}\frac{1}{1+\bar{r}_{t,t+j}}\left[C_{t+j}+\frac{i_{t+j}}{1+i_{t+j}}M^r_{t+j}\right]$$

$$\mathcal{A}^r_t + \sum_{j=0}^{\infty}\frac{1}{1+\bar{r}_{t,t+j}}\left[G_{t+j}-T_{t+j}+\frac{i_{t+j}}{1+i_{t+j}}M^r_{t+j}\right] = 0$$

$$\frac{\mathcal{A}_t}{P_t} = \sum_{j=0}^{\infty}\frac{1}{1+\bar{r}_{t,t+j}}\left[T_{t+j}-G_{t+j}+S^r_{t+j}\right]$$

where we use the fact that inflation tax is equal to seignorage revenue

Under an "inherited" level of nominal assets $\mathcal{A}_t$ and a given PDV path of future surpluses (fiscal and monetary) the only endogenous variable in the equation is the current price level P_t

Fiscal theory of price level: general equilibrium

In equilibrium two equations need to hold: the "budget constraint"

$$\frac{\mathcal{A}_t}{P_t} = \sum_{j=0}^{\infty} \frac{1}{1+\bar{r}_{t,t+j}} \left[T_{t+j} - G_{t+j} + S^r_{t+j}\right]$$

And demand for money

$$M_t^d = \mathrm{E}_t \left[P_{t+1} Y_{t+1}\right] \cdot h\left(i_t\right)$$

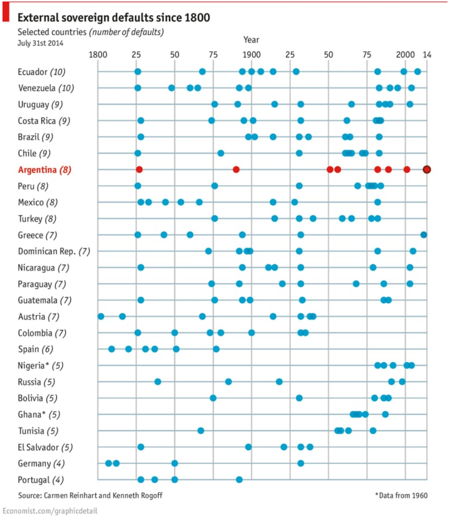
Which variables are endogenous depends on the policy framework

If the fiscal policy sets independently $\{T_{t+j}, G_{t+j}\}$, and monetary policy sets independently $\{i_{t+j}\}$, then the solution of the system is the price level path (including current level) and endogenous path of money supply $\{M_{t+j}\}$

In this equilibrium changes in fiscal policy stance (e.g. permanent tax cut) can directly impact the price level, even if there are no changes to the seignorage levels

Bianchi and Melosi (2022): post-COVID inflation results largely due to shift in perceived fiscal policy toward non-Ricardian

Sovereign default



Economist

Sovereign default

Why countries default if they can “print their way out of debt”?

We need to distinguish defaults between “external” (on foreign debt) and “internal” (on domestic debt)

Default can be preferable to alternatives (draconian taxes, hyperinflation)

If the debt is denominated in foreign currency, “money printing” leads to exchange rate depreciation which makes debt repayment harder (or even impossible)

Sovereign default: simple two-period model

A country can borrow on international markets at interest rate $r \geq r^*$

In the first period country sells bonds B_1 at price $Q_1 = 1/\left(1+r\right)$ and receives $Q_1 B_1$

In the second the country decides whether to repay debt

If it defaults, it loses a part x of its GDP

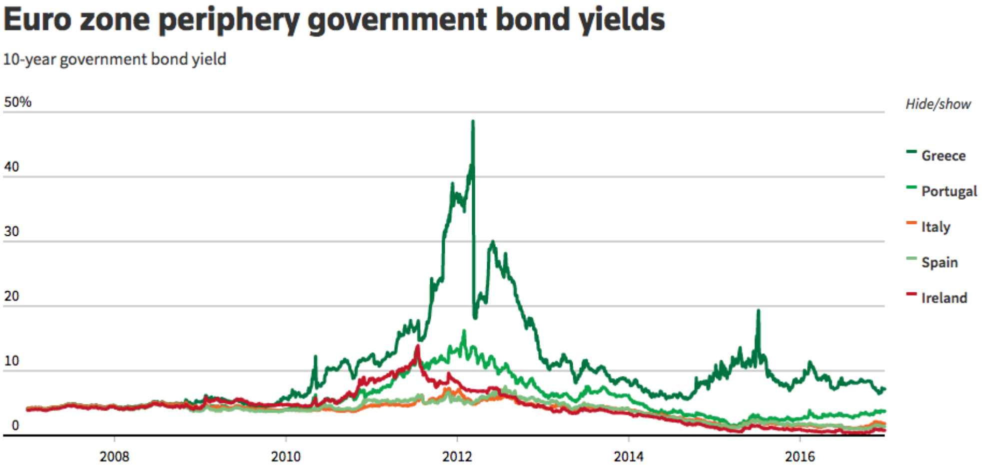
GDP is stochastic and its level depends on realization of shocks

The country defaults if $Y_2 < \bar{Y}$:

$$Y_2 - B_1 < Y_2\left(1-x\right) \quad \rightarrow \quad \bar{Y} = B_1/x$$

$\bar{Y}$ is higher (default more probable), the higher is B_1
and the higher is r (need to issue more bonds to finance spending in period 1)

Bond yields during eurozone sovereign debt crisis



Reuters

Sovereign default: simple two-period model

Interest on debt depends on repayment probability

$$1 + r = \frac{1 + r^*}{\Pr\left[Y_2 - B_1 > Y_2\left(1 - x\right)\right]} \quad \rightarrow \quad r = r\left(B/Y\right), \quad r' > 0$$

In a multi-period variant we can model effects of non-fundamental shocks

An increase in perceived risk of default increases interest on debt and makes rolling over the debt more costly, indeed increasing default probability (self-fulfilling expectations)

Alternative modeling approach: with a certain probability the country becomes excluded from financial markets and cannot roll-over its debt

Whether it defaults on debt depends on whether it is able to cover the deficit with emergency tax increase

This is again a self-fulfilling expectations equilibrium

Introduction to financial frictions

Diamond and Dybvig (1983), Nobel 2022

Banks perform liquidity transformation: have short-term liabilities (deposits) and long-term assets (loans)

This is an efficient situation that allows for risk-sharing:
an investor that is uncertain on when they will need liquidity may put a deposit at a bank that can be converted into cash on demand

Banks are then vulnerable to runs: if the customers want to withdraw more funds than expected, a solvent bank becomes temporarily illiquid and can go into default

The central bank as a lender of last resort can eliminate bank runs equilibria

Consumer / investor

Three time periods: 0, 1 i 2

Each consumer / investor has a unit of consumption good to invest in period 0

Each of the draws in period 1 their "type":

- With probability p they become impatient and will need to consume in period 1
- With probability $1 - p$ they can wait to consume until period 2

Preferences can be assumed to be e.g. CRRA, with no discounting

Available assets

Assets are not risky, but have differing liquidity

The liquid asset has a payoff of 1 in both time periods

The illiquid asset has payoffs: $\ell < 1$ in period 1 and $R > 1$ in period 2

Autarkic equilibrium

Consumer / investor sets the share ω of illiquid asset in the portfolio

If they receive the “impatience” shock, they will consume in period 1

$$c_1^A = (1 - \omega) + \omega\ell = \omega\,(\ell - 1) + 1 \leq 1$$

Otherwise they will consume in period 2

$$c_2^A = (1 - \omega) + \omega R = \omega\,(R - 1) + 1 \leq R$$

There exists no ω for which jointly $c_1 = 1$ and $c_2 = R$

Insurance contract

Consumer / investor receives either $c_1^O = 1$ or $c_2^O = R$

Is such allocation feasible? Yes, for $\omega = 1 - p$

Fraction p of assets are held in liquid instrument and can satisfy the demand from "impatient" investors for liquidity in period 1

For the remaining investors it pays to wait until period R when they will receive $R > 1$

Naturally $U\left(1,\, R\right) \succ U\left(c_1^A,\, c_2^A\right)$

This allocation can be further improved upon

Optimal deposit contract

Consumer / investor receives either $c_1^D = r_1 \geq 1$ or $c_2^D = r_2 \in (r_1,\, R)$

The bank stores $x \equiv pc_1^D$ liquid assets and invests remaining $1 - x$

The optimal contract solves

$$\begin{aligned} \max \quad & U = pu\left(c_1\right) + \left(1-p\right)u\left(c_2\right) \\ \text{s. t.} \quad & pc_1 + \frac{\left(1-p\right)c_2}{R} = 1 \end{aligned}$$

For $u\left(c\right) = c^{1-\sigma} / \left(1-\sigma\right)$ where additionally $\sigma \geq 1$ we get that

$$\begin{aligned} c_1^D &= \frac{1}{p + \left(1-p\right)R^{(1-\sigma)/\sigma}} \geq 1 \\ c_D^2 &= \frac{R}{pR^{(\sigma-1)/\sigma} + \left(1-p\right)} \leq R \end{aligned}$$

It can be shown that $c_1^D < c_2^D$ and that $U\left(c_1^D,\, c_2^D\right) \succ U\left(1,\, R\right) \succ U\left(c_1^A,\, c_2^A\right)$

Bank run

While the “patient” investor has incentive to wait until period 2, the situation changes under perceptions that other “patient” investors will withdraw their funds in period 1

The bank will have to liquidate (a part of) investment with payoff $\ell < 1$

Then not only $c_2^R < c_2^D$, but for a large enough share of period 1 withdrawals $c_2^R < 1$

Even the “patient” investor prefers then to withdraw in period 1!

A run on bank occurs, which is a “bad” self-fulfilling expectations equilibrium

The central bank can step in and provide liquidity in period 1,
preventing the run outcome (but can incentivize moral hazard)

Asymmetric Information

Generally refers to a situation in which different parties to a transaction are not equally informed about characteristics or actions of the other parties to the transaction

Two main kinds of asymmetric information:

1. Adverse Selection occurs before a transaction takes place
2. Moral Hazard occurs after a transaction takes place

Both can help us understand the kind of financial structure we observe in the real world – in particular, why indirect finance is so important (and why financial intermediation is important)

Adverse Selection

The buyer of a product (e.g. a car, a stock) doesn't know the true "type" of the product (e.g. good or bad, risky or safe)

Buyer a priori knows only the average type

Hence, buyer will only be willing to pay the average valuation, which is more than the bad type but less than the good type

This tends to drive sellers of products that are a good type away and attract sellers of products that are a bad type

But then buyer knows this, and entire market can fall apart

Classic example in Akerlof (1970): "lemons" in the market for used cars

Financing firms

Two types of firms who need 1 unit to undertake a project

Project succeeds or fails with a given probability

Firm types and payoffs are:

	Safe Firm	Risky Firm
Payoff in “good” state	4	8
Payoff in “bad” state	0	0
Prob. of “good” state	1/2	1/4

Expected return the same for both firms,
but lender would prefer to loan to safe firm since it is less risky

Simple debt contract

Only one kind of debt contract: bank lends firm one unit, firm promises to repay R (gross) units if project succeeds, 0 otherwise (it can't pay back in event low state occurs)

Borrower only has to pay back in the good state

Borrower's expected payoffs are:

$$\text{Safe} = \frac{1}{2}(4 - R)$$
$$\text{Risky} = \frac{1}{4}(8 - R)$$

Borrower takes a loan only if her expected payoff is non-negative

If $R > 4$, safe firms won't take the loan

If $R > 8$, both firms won't take the loan

Lender's problem

Lender's opportunity cost of funds is 1 $\rightarrow$ needs to earn at least 1 in expectation

If lender charges $R > 8$, she makes no loan and "earns" 1 (i.e. keeps its money)

If she charges $R \leq 4$, both types of firms will take the loan

If it charges $R > 4$,only risky firms will take the loan

Suppose fraction q of firms are risky, and $1 - q$ are safe

Expected lender payoff:

$$\begin{aligned} R \leq 4 \quad &: \quad \mathrm{E}\left[\text{payoff}\right] = (1-q) \cdot \frac{1}{2}R + q \cdot \frac{1}{4}R \\ 4 < R \leq 8 \quad &: \quad \mathrm{E}\left[\text{payoff}\right] = \frac{1}{4}R \end{aligned}$$

Pooling vs. separating equilibrium

A pooling equilibrium emerges for such R in which both types of firms take a loan

A separating equilibrium emerges for such R in which only one type of firms gets a loan

Look first for a pooling equilibrium to see if one exists

Can write lender's expected payoff as:

$$\mathrm{E}\left[\text{payoff}\right] = \left(\frac{1}{2} - \frac{1}{4}q\right) R$$

Suppose $q = 0.8$, so most firms are risky

Expected payoff must be bigger or equal to 1

Solve for the "break-even" R:

$$R \geq 1/\left(0.5 - 0.2\right) = 3\frac{1}{3}$$

So $3\frac{1}{3} \leq R \leq 4$ would be a pooling equilibrium,
while $4 < R \leq 8$ would be a separating equilibrium

Equilibrium

A pooling equilibrium exists for $3\frac{1}{3} \leq R \leq 4$

A separating equilibrium exists for $4 < R \leq 8$

Don't know which equilibria we'll end up at

But if it's separating equilibrium, safe firm doesn't get a loan, which is a bad outcome relative to symmetric information case

If it's pooling equilibrium, interest rate charged to safe firm may be "too high" relative to symmetric information case and interest rate charged to risky firm is "too low"

This will tend to over-attract risky firms and deter safe firms from getting loans

Adverse selection and collateral

Collateral is an important feature of many debt contracts

A firm receiving funds pledges some collateral
that can be seized in the event that the firm defaults

Banks can offer different kinds of contracts:

- Some require posting more collateral
- Some require less collateral but charge higher interest rates

This offering different kinds of contracts can get firms to voluntarily reveal their type

In mortgage finance: the more you put down (more collateral),
the better the terms on the loan typically

Collateral can be a useful way for financial contracts
to deal with information asymmetry

But when collateral loses value (“bubble bursting”)
this can exacerbate information asymmetry problems

Loan contracts with collateral

Lender requires borrower to post collateral C,
which borrower has to pay in the event of project failure

Borrower's expected payoffs are:

$$\text{Safe} = \frac{1}{2}(4 - R) - \frac{1}{2}C$$
$$\text{Risky} = \frac{1}{4}(8 - R) - \frac{3}{4}C$$

R "hurts" the safe firm more, but C "hurts" the risky firm more

Suppose that the lender posts two contracts,
one without collateral (R, $C = 0$) and the other with collateral ($R_C < R$, $C > 0$)

Safe firm chooses to post collateral and reveals itself as safe

Requirements

If lender seizes collateral, a fraction d goes bad, so lender only recovers $(1-d)\,C$

Think of this as a "bankruptcy cost"

For this to work, we must have the following hold:

1. Risky firm prefers no collateral contract
2. Safe firm prefers posting collateral
3. Lender breaks even (or better) on both contracts

Firms' choices

Risky firm prefers no collateral

$$\frac{1}{4}(8 - R_C) - \frac{3}{4}C \leq \frac{1}{4}(8 - R)$$
$$R - R_C \leq 3C$$

1. $R > R_C$ (you get a lower interest rate if you post collateral)
2. Collateral must be big enough to induce risky firm to take R, $C = 0$

Safe firm prefers posting collateral

$$\frac{1}{2}(4 - R_C) - \frac{1}{2}C \geq \frac{1}{2}(4 - R)$$
$$R - R_C \geq C$$

1. $R > R_C$ again
2. Collateral can't be too big, otherwise safe firm won't post it

All conditions

Lender must at least break even on both contracts

$$\frac{1}{4}R \geq 1$$

$$\frac{1}{2}R_C + \frac{1}{2}(1-d)\,C \geq 1$$

Everything together

$$R - R_C \leq 3C$$

$$R - R_C \geq C$$

$$R \geq 4$$

$$R_C + (1-d)\,C \geq 2$$

Multiple equilibria (possibly depending on bargaining power)

One possibility: lender just breaks even on both contracts (perfect competition)
and risky firm is indifferent between contracts (weakly prefers the no-collateral contract)

Solution (perfect competition among lenders)

Lender just breaks even

$$R = 4 \quad \text{and} \quad R_C + (1 - d)\, C = 2$$

Let $d = 1/4$

$$3C = 8 - 4R_C$$

Risky firm just breaks even

$$4 - R_C = 3C = 8 - 4R_C$$

Resulting in

$$R_C = \frac{4}{3} \quad \text{and} \quad C = \frac{8}{9}$$

Firms voluntarily separate into different loan contracts

Financial accelerator and business cycles

Posting of collateral allows safe firms to reveal their type

Allows them to get loans (depending on market structure)
and results in more efficient allocation

Since collateral consists of assets,
asset price fluctuations can affect ability of firms to get loans

Financial accelerator:

1. Decline in economic activity (e.g. a recession) causes assets to lose value
2. Declining asset values makes it harder for firms to post collateral
3. Inability to post collateral $\rightarrow$ stronger adverse selection problem $\rightarrow$ less investment and/or a worse allocation of investment between safe and risky firms
4. Less investment causes more declines in economic activity, and further falls in collateral values
5. An adverse feedback loop! (although not without end)

Moral hazard

Information asymmetry occurring after a transaction takes place

For example, someone lends you money,
but then can't perfectly monitor what you do with the money

Because of limited liability, you have an incentive to "gamble"
with someone else's money

Moral hazard can encourage excessive risk taking

Can be applied to insurance markets too: once you have insurance,
you have less incentive to behave safely

Insurers know that, and may not sell you insurance in first place

Just like in case of adverse selection, markets can break down

Moral hazard and collateral

Collateral also plays a role in mitigating moral hazard

Requiring firms to post collateral gives them some “skin in the game” and encourages good behavior

Without collateral, lenders may be reluctant to lend because they can’t perfectly control what borrowers do

Similarly to adverse selection, this importance of collateral can give rise to a financial accelerator mechanism

Assets decline in value $\rightarrow$ harder to post collateral $\rightarrow$ harder for firms to get loans

Costly state verification

Townsend (1979), Bernanke and Gertler (1989),
Carlstrom and Fuerst (1997), Bernanke, Gertler and Gilchrist (1999),
Christiano, Motto and Rostagno (2004, 2014)

Entrepreneurs borrow funds to finance risky projects

Project outcome is known ex post to the entrepreneur only $\rightarrow$ information asymmetry

If the project outcome is low entrepreneur defaults on the loan

But successful entrepreneurs are temped to default as well $\rightarrow$ moral hazard

Verification of the project success by outsiders is costly

Optimal contract: fixed rate loan, verification in case of default

Endogenous premium on loans

Bernanke, Gertler and Gilchrist (1999) model

Bernanke, Gertler and Gilchrist (1999)

New Keynesian model with entrepreneurial sector
which requires external funding to invest in new projects

Entrepreneurs identical up to an idiosyncratic productivity shock

Funds provided by intermediary sector financed from household deposits

Asymmetric information, costly state verification (Townsend, 1979)

External finance premium (credit premium) is a decreasing function
of the share of project financed by net worth (equity)

Net worth equals retained profits by surviving entrepreneurs

Gives rise to a financial accelerator mechanism