Monetary theory 2

ECON D-406-T0, University of Brussels, 2008-2009

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Chapter 5: The credit channel of monetary policy: theory and evidence

Section 1: the issue

Introduction

- So far 2 possible ways MP can affect the real economy (closed economy)
- If prices are flexible and inflation anticipated, increase in the money supply reduces real balances $\longrightarrow$ directly in the utility function of through a cash in advance model, affects the budgetary constraint.
- If MP is not unanticipated, creates price surprises $\longrightarrow$ affects real wages and labour demand (in the short run)
- If prices and wages are sticky, we have the traditional interest rate channel (IRC): current and future paths of MP affect the interest rate and interest rate affects aggregate demand.

Introduction

- In the open economy case, effects go through changes in the exchange rate .
- Example with sticky prices and wages :
  Mundell-Fleming model : depends of course on the exchange rate regime

Additional effect

- End 70's and 80's, more attention devoted to the role of credit markets in the transmission of MP.
- a couple of new elements have been taken into account
- Distinction between different nonmonetary assets (rather than only bonds like in the IS-LM)
- Distinction between internal and external financing or bank and non bank funding
- heterogeneity of borrowers : different sensitivities to changes in the cost of borrowing
- new economic features : asymmetric or imperfect information, moral hazard, adverse selection, monitoring costs and agency costs
- Recognition of importance : US situation 1989-1992 : Credit Crunch : rationing of credit.

2 broad categories

- 2 categories of channels in the credit channel
- Bank lending channel : emphasize special nature of credit activities and role of banks
- Policy actions that will affect the bank's position (for instance changes in the reserves) will have an effect
- *on the interest rates* $\rightarrow$ traditional IRC channel
- *in the supply of credit* (asset side of the balance sheet) : possible rationing of credit
- If borrowers have no substitute for obtaining funds, effect on investment and aggregate spending
- Crucial role of asymmetric information

2 broad categories

- Financial accelerator channel
- One result : wedge in the cost between internal and external financing.
- If recession weakens the amount available for internal finance (cash flows, net worth), total cost of borrowing increase $\rightarrow$ contractionary effect on spending
- The value of the collateral decreases : value of assets for credit insurance decreases $\rightarrow$ ability to borrow declines and aggregate spending declines.

Credit rationing

- Credit rationing is a sufficient but unnecessary condition for the bank lending channel
- Example : agency costs related to assessment of investment projects raise interest rate
- Accounting for market imperfections in micro approaches
- Application of these micro approaches to macroeconomic analyses

Section 2:Imperfect information in credit markets

Imperfect information

- Key element: information between the parties of the credit contract
- $\rightarrow$ Different roles for different types of lenders (banks and non banks)
- $\rightarrow$ Different roles for different types of borrowers (e.g. small vs large firms)
- Different mechanisms related to imperfect information : adverse selection, moral hazard, monitoring costs.

Section 2.1: Adverse selection

Type of borrowers

- 2 types of borrowers
- honest ones : always repay
- dishonest ones : repay only if the cost of default exceed the cost of repay
- ex ante for the lender, the two types cannot be distinguished
- With adverse selection , heterogeneity of borrowers and inability to identify the type of borrower might result in credit rationing . (Stiglitz and Weiss, 1981, American Economic Review)

Model

- heterogeneity between borrowers in their probability of repayment
- Type G repays with probability q_g (good)
- Type B repays with probability q_b (dishonnest)
- $q_g > q_b$
- in case of perfect information : lenders can discriminate between borrowers and different interest rates for each type : $\frac{r}{q_g}$ for G and $\frac{r}{q_b}$ for B with $\frac{r}{q_g} < \frac{r}{q_b}$
- at the equilibrium, the expected return of lender is equal to r and is equal to his opportunity cost r (zero profit condition because free entry and competitive markets)

Imperfect information

- The lender cannot observe the borrower's type $\Rightarrow$ adverse selection problem
- The changes in the conditions of the contract will affect the proportion of both types of borrowers
- One condition of the loan : interest rate : if the loan interest rate increases (r_l) , decrease in lender's expected return (and profit) and this might lead to credit rationing .
- Assume a fraction g of G type :

$$r_l = gq_g r_l + (1-g)q_b r_l = r$$

$$r_l = \frac{r}{gq_g + (1-g)q_b} \quad (1)$$

- If g is stable , no problem
- If g decreases as a result of the increase in r_l (=adverse selection), then the expected return is lower than r
- $\Rightarrow$ credit rationing

Extension to other elements

- there are other elements than r_l
- Project return of the borrower R
- Loan amount L
- Collateral of the loan : C
- Condition for non default: $L(1 + r_l) \leq (R + C)$
- If not, the borrower can default because in his own interest
- problem : R is not observed perfectly by the lender : R is random $\Rightarrow$ adverse selection through R

Uncertainty on R

- Suppose that R is random:
- $R = R' - x$ with probability 0.5 (bad state)
- $R = R' + x$ with probability 0.5 (good state)
- This means that $E(R) = R$ and $Var(R) = x^2$
- Increase in x means that the distribution of R is more spread out and that the risk in R increases
- What consequences on credit ?

Consequences on credit

- Suppose that $R' - x < L(1 + r_l) - C$: the borrower defaults in the bad state $\rightarrow$ loses C
- Expected profit of the borrower: $E(\pi^B) = \frac{1}{2}[R' + x - L(1 + r_l)] - \frac{1}{2}C$
- We can define the critical cutoff value for x such as $x > x^*$ results in positive expected profits: $x^*(r_l, L, C) \equiv L(1 + r_l) + C - R'$
- The critical cutoff value is increasing in r_l : if r_l increases, x^* increases and some borrowers with less risky projects will find unprofitable to borrow $\rightarrow$ adverse selection: increase in the proportion of borrowers with more risky projects
- Why ? Because they will lose in the bad state C which does not depend on x and r_l

Consequences on credit

- The expected profit of the firm (borrower) is increasing in x
- The expected profit of the bank (lender) is decreasing in x
- $E(\pi^L) = \frac{1}{2}[L(1+r_l)] + \frac{1}{2}[C + R' - x] - [L(1+r)]$
- an increase in r_l will increase x and decrease $E(\pi^L)$
- Why ? In the good state, the lender receives a fixed amount but loses more in the bad state.

Heterogeneity of borrowers

- Suppose 2 groups of borrowers: $x = x_g$ and $x = x_b$ with $x_g < x_b$
- If r_l is relatively low : $x_b > x_g \geq x^*(r_l, L, C)$: both types of borrowers will borrow
- Suppose equal proportion:

$$E(\pi^L) = \frac{1}{4}[L(1+r_l)+C+R'-x_g]+\frac{1}{4}[L(1+r_l)+C+R'-x_b]-[L(1$$

$$E(\pi^L) = \frac{1}{2}[L(1+r_l)+C+R'] - \frac{1}{4}[x_g + x_b] - [L(1+r)]$$

- which is increasing in r_l.

Heterogeneity of borrowers

- if r_l is relatively high : $x_g = x^*(r_l, L, C)$
- a further increase in r_l will cause type G to stop borrowing $\Rightarrow$ adverse selection .

$$E(\pi^L) = \frac{1}{2}[L(1+r_l) + C + R' - x_g] - [L(1+r)]$$

with $x_g \leq x^*(r_l, L, C) \leq x_b$

Credit rationing

- The expected profit of lender is lower ; the profit is increasing in the loan rate for $x^*(r_l, L, C) \leq x_g$ but falls as low-risk borrowers exit the market.
- See figure Non monotonic profit function.
- The profit is not continuous in r_l ; the presence of a local maximum raises the possibility of credit rationing: lenders will not find profitable to raise r_l even in the presence of an excess demand for loans because of adverse selection.

Section 2.2: Moral Hazard

Moral hazard

- With adverse selection, R is exogeneous
- Now suppose that the borrower can choose between projects.
- A higher loan interest rate will induce the borrower to choose riskier projects $\Rightarrow$ moral hasard
- Same result : higher loan rate $\Rightarrow$ riskier projects $\Rightarrow$ expected return of the lender decreases $\Rightarrow$ credit rationing
- This occurs because the lender cannot monitor the choice of the project (asymmetric information)

Moral hazard

- Suppose the borrower can choose between project A and project B
- project A: R^a in good state with proba p^a and 0 in bad state
- project B: R^b in good state with proba p^b and 0 in bad state
- $R^a < R^b$ and $p^a > p^b$ with $p^a R^a > p^b R^b$: project B is the riskier project

moral hazard

- Compares the expected return of the borrower

$$E(\pi^A) = p^a[R^a - L(1 + r_l)] - (1 - p^a)C$$

$$E(\pi^B) = p^b[R^b - L(1 + r_l)] - (1 - p^b)C$$

- One gets

$$E(\pi^A) > E(\pi^B)$$

iff

$$\frac{p^a R^a - p^b R^b}{p^a - p^b} > L(1 + r_l) - C$$

$\rightarrow$ the right hand side increases with r_l

Moral hazard

- Find the value of r_l denoted r_l^* for which $E(\pi^A) = E(\pi^B)$:

$$L(1+r_l^*) - C = \frac{p^a R^a - p^b R^b}{p^a - p^b} > 0$$

- if $r_l < r_l^*$, the borrower chooses project A and the expected payment to the lender is $p^a(L(1+r_l) + (1-p^a)C)$
- if $r_l > r_l^*$, the borrower chooses project B and the expected payment to the lender is $p^b(L(1+r_l) + (1-p^b)C)$
- The expected return is non monotonic in r_l : $p^a(L(1+r_l^*) + (1-p^a)C) > p^b(L(1+r_l^*) + (1-p^b)C)$
- With moral hazard, the equilibrium of the loan market can be characterized with credit rationing .

Section 2.3: Monitoring costs

mMoral hazard

- Adverse selection and/or moral hazard are not necessary for non monotonic profit functions and credit rationing
- Another reason with imperfect information : monitoring costs that the lender must incur to identify the true project outcome
- Idea : asymmetric information wrt to the project's outcome : the borrower knows but the lender must incur costs to know the true outcome
- Why important ? because the borrower has an incentive to underreport the success of the project in order to repay less, for instance by defaulting.
- This results in a non monotonic expected profit function

Assumptions

- 2 type of agents : lenders (risk neutral) and borrowers
- Opportunity costs for lenders : r; competitive markets and free entry : expected return of the lender equal to r
- 2 periods : first period : loan to a borrower with a risky project.
- Payoff of the project in period 2 : $x \in [0, \overline{x}]$; distribution known to lender and borrower
- Actual realization observed directly by borrower but observed by borrower provided he (she) pays a monitoring cost $c \longrightarrow$ borrowers have better information than lenders : presence of asymmetric information .

Report of the borrower

- In period 2, borrower report x^s
- $x^s \in [0, \overline{x}]$ but $x^s \neq x$ because borrower has an incentive to misreport
- Monitoring costs occur only when $x^s \in S \subset [0, \overline{x}]$
- If $x^s \in S$, payment of the borrower to the lender is $R(x)$ and return of the lender is $R(x) - c$
- If x^s not $\in S$, payment of the borrower reports the smallest value : $\overline{K}$
- Normalization assumption : Loan size: 1$\longrightarrow$ interest rate on the loan :$\overline{K} - 1$ if x^s not $\in S$

Incentive compatible behavior

- The reporting procedure of the borrower must be incentive compatible
- If borrower report $x^s \in S$, the return must exceed the return if not reporting $x^s \in S$:

$$x - R(x) > x - \overline{K}$$

or otherwise

$$\overline{K} > R(x)$$

- If $\overline{K} \leq R(x)$, report x^s not in S and no monitoring costs occur.

Optimal contract

- The optimal contract: find $R(x)$ and $\overline{K}$ such as the borrower max his return subject to the constraint that lender's return is at least equal to opportunity cost r
- Expected return of the borrower:
  $$E(R^b) = \underbrace{E[x - R(x)|\overline{K} > R(x)]Pr[\overline{K} > R(x)]}_{A} +$$
  $$\underbrace{E[x - \overline{K}|\overline{K} \leq R(x)]Pr[\overline{K} \leq R(x)]}_{B}$$
- A:expected return with monitoring costs; B:expected return without monitoring costs
- Constraint of the lender:
  $$E[R(x) - c|\overline{K} > R(x)]Pr[\overline{K} > R(x)] + \overline{K}Pr[\overline{K} \leq R(x)] \geq r$$

Optimal contract

- Solution: $R(x) = x$: If the borrower reports a signal which leads the lender to monitor, the lender takes over the entire project and gains $R(x) - c$
- If $R(x) = x > \overline{K}$, the borrower pays $\overline{K}$
- In equilibrium, the constraint of the lender holds: $E[R(x) - c|\overline{K} > R(x)]Pr[\overline{K} > R(x)] + \overline{K}Pr[\overline{K} \leq R(x)] = r$
- Any contract with $R(x) < x$ can be replaced by another contract which increases repayments under monitoring $R(x)$ but lowers $\overline{K}$: the lender's expected profit remains unchanged.

Optimal contract

- Expected return of the borrower:
  $$E[R^b] = E[x] - \underbrace{cPr[R(x) < \overline{K}]}_{A} - r$$
- A: Probability that monitoring occurs
- $E[R^b]$ is decreasing in $\overline{K} \rightarrow$ if $R(x) < x$, the borrower will prefer a contract that reduces $\overline{K}$ and reduces the probability of monitoring.

Example

- Suppose that $x \sim U[0, \overline{x}]$
- $E[R^l] = \underbrace{\int_0^{\overline{K}} (x - c)\frac{1}{x}dx}_{A} + \underbrace{\int_{\overline{K}}^{\overline{K}} \overline{x}\frac{1}{x}dx}_{B}$
- A: expected return if borrower defaults ($x < \overline{K}$) with proba $\frac{\overline{K}}{\overline{x}}$
- B: fixed payment received when ($x \geq \overline{K}$) with proba $\frac{\overline{x}-\overline{K}}{\overline{x}}$
- One needs to compute that and equates that with r:

$$(\frac{1}{2}\frac{\overline{K}^2}{\overline{x}} - c\frac{\overline{K}}{\overline{x}}) + \overline{K}(1 - \frac{\overline{K}}{\overline{x}}) = r$$

Example

- 2 real solutions to this quadratic equation
- The impact of $\overline{K}$ on the lender's expected return is $1 - \frac{c+\overline{K}}{\overline{x}}$ which is negative for $\overline{K} > \overline{x} - c$.
- When the loan repayment $\overline{K}$ is large, further increases in $\overline{K}$ will lower $E[R^l] \Rightarrow \overline{K} > \overline{x} - c$ cannot occur in equilibrium since both the lender and the borrower prefer lower $\overline{K}$
- The gross interest rate on loan $\overline{K}$ will not be above $\overline{x} - c$ $\Rightarrow$ possibility of credit rationing : unsatisfied borrowers willing loans and prepared to pay interest rate above the market rate will not be met.
- Here : Credit rationing only because monitoring costs and without adverse selection and/or moral hazard.

Agency costs

- Other types of costs : agency costs : costs incurred by the lender to monitor the borrower.
- Agency costs external funding more costly than internal funding
- In recessions, internal resources less available $\Rightarrow$ external funding
- If balance sheet of the firm deteriorates, agency costs rise and cost wedge between external and internal funding increase
- $\rightarrow$ Further contraction in investment and spending $\rightarrow$ amplifies effect of initial adverse shock.

Section 3: Macroeconomic Implications

Introduction

- Before: microeconomic analysis suggesting that banks' behavior matter
- It is necessary to use these micro approaches in a macroeconomic perspective
- 2 approaches
- Extending the IS LM approach (Bernanke and Blinder, 1988): analysed here because in line with previous chapters : shows the previous mechanisms capturing the impact of interest rates are supplemented by a bank lending channel
- General equilibrium models with representative agents: difficulties here because lenders and borrowers are by nature not homogeneous $\rightarrow$ not considered here

IS-LM with Bank loans

- 3 assets rather than 2 : money, bonds and loans
- 3 equations : equilibrium in the money market, equilibrium in the goods market and equilibrium in the loans market
- 3 endogenous variables : interest rate on bonds, interest rate on loans and output
- Short to medium-run analysis : ignore the supply side and fixed price

Financial assets

- Banks collect deposits (D) and can invest in bonds (B), loans (L) and Reserves (R) with a system of reserve requirements : $R^d = \sigma D$ with σ the reserve ratio
- Equilibrium :

$$B + L + R = D \qquad (2)$$

- This means that $B + L = (1 - \sigma)D$
- need to specify bank's demand for bonds and loans

Bank's demand

- Demand for bonds are assumed to be positively related to return on bonds (I_b) and negatively related to to return on loans:

$$\frac{B}{(1-\sigma)D} = b(I_b, I_l) \tag{3}$$

with $b_b = \frac{\partial b}{\partial b} \geq 0$;$b_l = \frac{\partial b}{\partial l} \leq 0$

- Fraction of assets devoted to loans assumed to be negatively related to return on bonds (I_b) and positively related to to return on loans:

$$\frac{L}{(1-\sigma)D} = 1 - b(I_b, I_l) \equiv l^s(I_b, I_l) \tag{4}$$

with $l_b^s \leq 0$;$l_l^s \geq 0$

Equilibrium in the Reserves market

- In equilibrium, $R^d = R^s$
- R^d is determined by the level of deposits D which are supposed to be positively determined by output (y_t) and negatively determined by interest rates on bonds (i_b)
- R^s is the way monetary policy might be conducted by the central bank
- Equilibrium:

$$R^s = y_t - ci_b + \nu \tag{5}$$

- Everything is expressed in terms of deviations to steady state
- ν capture money demand shocks or more exactly deposit-demand shocks

Equilibrium in the loan market

- Supply of loans determined by the bank as a function of deposits: $l^s(I_b, I_l)(1-\sigma)D = l^s(I_b, I_l)(\frac{1-\sigma}{\sigma})R^s$
- Demand for loans (by the public) supposed to be positively determined by output and negatively determined by interest rates on loans $L^d \equiv l^d(I_l, Y)$ with $l_l^d \leq 0$;$l_y^d \geq 0$
- In equilibrium,$L^d = L^s$, which can lead to (using total differential): $l_l^d i_l + l_y^d y = l_l^s i_l + r^s + \omega'$
- This can be reexpressed as :

$$i_l = h_1 i_b + h_2 y - h_3 r^s + \omega \quad (6)$$

with $h_1 = \frac{l_b^s}{(l_l^s - l_l^s)}$, $h_2 = -\frac{l_y^d}{(l_l^d - l_l^s)}$ and $h_3 = \frac{-1}{(l_l^d - l_l^s)}$

Equilibrium in the loan market

- h_1, h_2 and h_3 are all positive
- $\omega = \frac{\omega'}{(l_l^d - l_l^s)}$ is a shock, which is a mix of credit-supply and credit-demand shock.
- Negative credit-supply shock or a positive credit-demand shock $\rightarrow \omega > 0 \rightarrow$ increases the interest rate on loans.

Equilibrium in the goods market

- Like in the traditional IS-LM model, IS curve

$$y = -c_1 i_l - c_2 i_b + u \tag{7}$$

Macro equilibrium

- We have three equilibrium conditions $\rightarrow$ three endogeneous variables
- Using partial equilibrium conditions, one can express y as a function of i_b (just as the traditional IS-LM framework) but in a modified way where the role of the bank lending channel is emphasized :

$$y = \frac{c_1 h_3 r^s - (c_2 + c_1 h_1) i_b + u - c_1 \omega}{1 + c_1 h_2} \qquad (8)$$

The bank lending channel

- The model solution reveals the bank lending channel
- Monetary policy affects activity through the traditional interest channel ($c_2 + c_1 h_1$): $r^s \uparrow \rightarrow i_b \downarrow \rightarrow y \uparrow$
- Monetary policy also affects activity through an additional bank lending channel ($c_1 h_3$): $r^s \uparrow \rightarrow D \uparrow \rightarrow L^s \uparrow \rightarrow i_l \downarrow \rightarrow y \uparrow$

Conditions for a bank lending channel

- Bank loans must be essential for private investment : $c_1 \neq 0$ If firms have alternatives to bank lending (intermediate credit, own resources), the channel is weak because firms can substitute
- Elasticity of loan demand (l^d) or/and loan supply (l^s) to interest rate is relatively weak: $h_3 = \frac{-1}{(l_l^d - l_l^s)} \neq 0$
- Elasticity of loan demand will be high if alternative credit sources close to bank lending (perfect substitutes) are easily available
- The value of the loan supply elasticity is directly related to the interaction of costs between loans and bonds faced by the bank (not seen here)

Section 4: The bank lending channel in practice

2 types of channel and Euro issues

- Distinction between
- the basic bank lending channel (see IS-LM) where the behavior of banks in terms of offsetting the decline of reserves
- The broad bank lending channel in which credit-market imperfections such as asymmetric information and agency costs play an important role
- Also some investigation to see if a bank lending channel is important in the Euro area and if there are differences across European countries

Direct banking channel

- In general mixed evidence in favor of a direct channel
- Problem related to identification: does monetary contraction cause a decrease in bank lending which increases the effects of a slowdown in economic activity or the other way around (slowdown in economic activity $\rightarrow$ banks close
- In general, no evidence of a specific bank lending channel in the US apart during some specific subperiods
- In the 30's maybe where a lot of banks stop doing credit
- end of 80's and early 90's in New England (anecdotical evdidence)

Broad credit channel

- More evidence in favor of a broad channel
- Agency costs create discrepancies between internal finance and external finance (more expensive) $\rightarrow$ agency costs should lead in context of recessions to a decrease in bank lending for high costs borrowers $\rightarrow$ small firms more affected than large firms : supportive of theories
- The value of collateral matters: in case of monetary contraction, value of small firms decrease much more $\rightarrow$ stresses the role of financial factors in the transmission of MP
- In recessions, evidence of a flight to quality : shift for high-costs borrowers to low-costs borrowers

Policy implications

- Heterogeneity of borrowers matter: small firms are likely to be more affected by a monetary contraction than large firms
- The initial financial situation of firms (value of net worth, cash flow, ...) is going to be important for the impact of MP: different initial situations $\rightarrow$ different impact
- Central banks should look at firms' situation before making decisions with respect to MP