Transmission mechanism of monetary policy

Lecture 7

Readings

- Mishkin, Chapter 26, 10th edition (or Chapter 23, 9th edition)

Plan

- Describe several transmission mechanisms of monetary policy
- Develop the (simpler) specification of the transmission mechanism that is embedded in state of the art models used to study monetary policy effects on economic activity

Transmission mechanisms of monetary policy

- Channels through which changes in monetary policy influence output, employment and inflation
- Series of links between monetary policy change and real economic activity can be broken into two elements:
    1. Impact of monetary policy changes on aggregate demand, Y^{ad}
    2. Effect of changes in aggregate demand on output, Y, employment, N, and prices, P
- Here we look at the first step in channel and we call it the transmission mechanism of monetary policy as it is done in the literature

Interest rate channel

- Traditional monetary transmission mechanism
- Key monetary transmission mechanism in textbook analysis based on IS/LM and AS/AD models
- How it works:

$$\text{expansionary monetary policy} \uparrow \Rightarrow \ r \downarrow \Rightarrow \ \text{cost of borrowing} \downarrow \Rightarrow \ I \uparrow \ \Rightarrow Y^{ad} \uparrow$$

- Initial focus on businesses decisions about investment spending
- Later focus also on consumers decisions about housing and consumer durable expenditures
- Thus I includes business investment, residential housing and consumer durables expenditures

Interest rate channel, cont.

- What matters for consumer and business investment decisions is the long term real interest rate
- The monetary authority controls the short term nominal interest rate
- How can CB control longer real rates by controlling short nominal rates?
- Two phenomena explain the link:

1. Sticky prices: since the aggregate price level adjusts slowly over time, an expansionary monetary policy lowering the nominal short term rate also lowers the real short term rate

$$r_t = i_t - \pi^e_{t+1}$$

2. Expectation hypothesis of the terms structure: since the long term interest rate is an average of the expected future short term interest rates, a lower real short term interest rate that persists for some time leads to a fall in the real long term interest rate

$$i_{nt} = \frac{i_{1t} + i^e_{1,t+1} + i^e_{1,t+2} + \ldots + i^e_{n,t+n-1}}{n}$$

Implications: expectations about future monetary policy matter!

Exchange rate channel

- Increasing importance with growing internationalization
- Recently included in textbook analysis based on IS/LM and AS/AD models
- How it works:

expansionary monetary policy $\uparrow \Rightarrow$ r $\downarrow \Rightarrow$ E $\downarrow$ (national currency depreciation) $\Rightarrow$ NX $\uparrow$ $\Rightarrow Y^{ad}\uparrow$

- Also involves interest rate effects

Other asset prices effects

- In particular stock prices, but also housing and land prices
- First step: how monetary policy affects assets prices
- Second step: how asset prices affect aggregate demand
    1. Tobin's q theory → Investment
    2. Wealth channel → Consumption

Other asset prices effects, cont.

Effect of monetary policy on asset prices

- One mechanism:

  expansionary monetary policy $\Rightarrow$ interest rates or return on bonds $\downarrow \Rightarrow$ equities or housing more attractive relative to bonds $\Rightarrow$ stocks or housing demand $\uparrow \Rightarrow$ prices of stocks $\uparrow$

  put it differently, return on bonds $\downarrow \Rightarrow$ required return on stocks and housing$\downarrow \Rightarrow$ stock and housing prices $\uparrow$

- A second mechanism for stock prices:

  expansionary monetary policy $\Rightarrow$ aggregate demand $\uparrow \Rightarrow$ dividends $\uparrow \Rightarrow$ stock prices $\uparrow$

$$P_t = \frac{D_{t+1}}{1+r_e} + \frac{D_{t+1}}{(1+r_e)^2} + \ldots + \frac{D_{t+n}}{(1+r_e)^n} + \frac{P_{t+n}}{(1+r_e)^n}$$

Other asset prices effects, cont.

Tobin's q theory of investment

- Focuses on stocks, but also applies to housing and properties
- Tobin's q = (market value of firms) / (replacement cost of capital)

  Replacement cost = cost of repurchasing all firm's plants and equipments at market prices

  Market value reflects also intellectual capital or market sentiment about firm prospects

  q = firm value on financial markets relative to its value on capital good markets

  If q is high, new plant and equipment capital is cheap relative to the market value of firms

  That is, companies can issue equity and get a high price for it relative to the cost of the plant and equipment they are buying

- How the mechanism works:

$$\text{expansionary monetary policy} \Rightarrow P_a \uparrow \Rightarrow q \uparrow \Rightarrow I \uparrow \Rightarrow Y^{ad} \uparrow$$

Other asset prices effects, cont.

Wealth channel on consumption

- Wealth effects on consumption
- Consumers smooth out their consumption over time (consumption smoothing) so that consumption spending is determined by lifetime resources of consumers
- Modigliani life-cycle model and Friedman permanent income hypothesis
- Lifetime resources include human, real and financial wealth
- Financial wealth includes stocks, real wealth includes housing and land
- How the mechanism works:

$$\text{expansionary monetary policy} \uparrow \Rightarrow P_a \uparrow \Rightarrow \text{wealth} \uparrow \Rightarrow C \uparrow \Rightarrow Y^{ad} \uparrow$$

Credit view

Main idea:

- Frictions in the functioning of financial markets
- Monetary policy changes aggregate demand by changing borrowing conditions of borrowers
- Not an alternative channel to the interest rate channel, but enhances the interest rate channel (called financial accelerator)

Credit view, cont.

Sources of financial frictions

- Asymmetric information: Borrowers know about return of their projects more than lenders
- Limited commitment: Borrowers cannot commit to repaying debt (default)

Two types of problems

- Adverse selection: problem created by asymmetric information before a financial transaction occurs: the potential borrowers who are the most likely to produce an undesirable (adverse) outcome – the bad credit risks - are the ones that most actively seek out a loan and are thus most likely to be selected

  Big risk takers are most eager to take out a loan since they are less likely to pay it back

- Moral hazard: problem created by asymmetric information after a financial transaction occurs: risk (hazard) that the borrower might engage in behavior that is undesirable (immoral) from the lender's point of view because they make it less likely that the loan will be repaid

  Borrowers have incentives to take on big risks with high expected return but high risk of default

Credit view, cont.

Adverse selection example

Consider 2 projects both require $1 Million investment:

Project 1 pays: $0 with 50% Prob. and $3 M with 50% Prob. i.e. an Expected Payoff of $1.5 M

Project 2 pays: $0 with 75% Prob. and $5 M with 25% Prob. i.e. an EP of $1.25 M

Assume the bank is risk-neutral provides 100% of the funds and the interest rate is zero.

With complete information:
In Project 1 the bank gets $2 M in the case of a success and the entrepreneur gets $1 M
In Project 2 the bank gets $4 M in the case of success and the entrepreneur gets $1 M

With complete information, if the entrepreneur can only pursue one project, then he chooses project 1

Assuming risk neutrality (to simplify) with incomplete information (the bank cannot distinguish the projects) the entrepreneur says he/she will take project 1 but chooses project 2

In this case, Project 1 gives the entrepreneur an EP of $0.5 M and project 2 an EP of $0.75 M

Credit view, cont.

Moral hazard example

Consider a project that requires $1000 investment:

The Project pays with entrepreneur's effort (equivalent to $100): $0 with 1% Prob. and $1120 with 99% Prob. The EP is $(1108.8-100)=$1008.8

The Project pays without effort: $0 with 10% Prob. and $1030 with 0.9 Prob. The EP is $927

Assume risk neutrality, the bank provides 100% of the funds and the interest rate is zero.

With complete information:
The bank finances the project, (gets 1010 in the event of success) and the entrepreneur puts effort, obtaining EP $8.8

Assuming (to simplify) with incomplete information (the bank cannot observe effort) the entrepreneur chooses to do no effort. In this case, the Project gives the entrepreneur an EP of $0.9*(1030-1010)=$18

Credit view, cont.

Consequences

- Borrowing conditions depend on collateral/net worth of borrowers (think about mortgages)
  - Collateral – property promised to lender if borrower defaults – reduces the negative consequences of adverse selection since the lender can sell the collateral and use the receipts to make up for the losses on the loan if the borrower defaults. Firm's net worth (difference between assets and liabilities) performs a similar role as collateral since the lender can take title to the firm's net worth and sell it.
  - Collateral or net worth reduces the risk of moral hazard since borrowers engaging in risky behavior may lose their valuable collateral and net worth. High net worth or collateral means that borrowers have more at stake, or more to lose. Incentives of the borrower become aligned with those of the lender.
- Borrowing limited by the collateral value: lenders are more willing to make loans secured by collateral/net worth

Credit view, cont.

Monetary policy affects borrowing conditions through

- Bank lending channel
- Net worth channel

Credit view, cont.

Bank lending channel

- Banks play a special role in financial markets
- Borrowers more subject to information problems (especially small firms) do not have access to credit markets unless they borrow from banks
- Large firms instead can directly access credit markets through stocks and bond markets
- How the mechanism works:

  expansionary monetary policy $\uparrow \Rightarrow$ bank deposits $\uparrow \Rightarrow$ bank loans $\uparrow \Rightarrow I \uparrow \Rightarrow Y^{ad} \uparrow$

- Also applies to consumer spending C in durables and housing

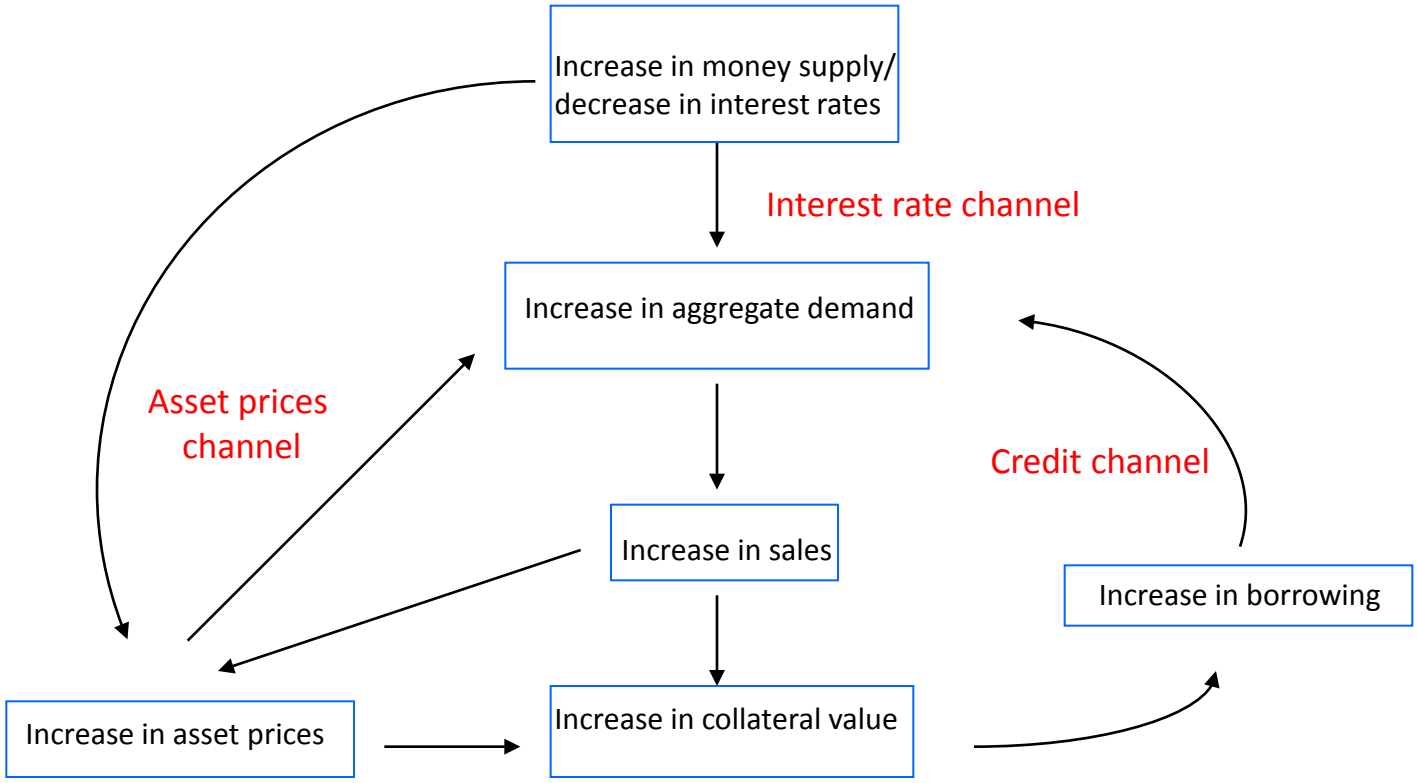
Credit view, cont.

Net worth or balance-sheet channel

- The lower the net worth of firms, the more severe are adverse selection and moral hazard problems
  - Adverse selection: lower net worth means lenders have less collateral for their loans, and so losses from adverse selection are higher
  - Moral hazard: lower net worth means borrowers have a lower equity stake in their firms, giving them more incentives to engage in risky activity
- How the mechanism works:

  expansionary monetary policy $\uparrow \Rightarrow P_a \uparrow \Rightarrow$ net worth $\uparrow \Rightarrow$ adverse selection & moral hazard $\downarrow \Rightarrow$ lending $\uparrow \Rightarrow I \uparrow \Rightarrow Y^{ad} \uparrow$
- Also applies to consumer spending C in durables and housing

Summing up


Increase in money supply/ decrease in interest rates
Interest rate channel
Increase in aggregate demand
Asset prices channel
Credit channel
Increase in sales
Increase in borrowing
Increase in asset prices
Increase in collateral value

A simple model of the transmission mechanism: the new dynamic IS curve

- Focus on consumption component of aggregate demand, ignore investment and net exports
- Focus on a specific transmission mechanism: intertemporal substitution in consumption
- Model has predictions representing well most of the transmission mechanisms we have described
- Simpler description of transmission mechanism in state of the art models used to study monetary policy (more sophisticated versions build on this)

New dynamic IS curve, cont.

- Two-period model: today (current period) and tomorrow (future period)
- Agents live for two periods
- Agents obtain utility from consuming goods
- Asset: nominal bond

Lifetime utility

- Consumer lifetime utility is

$$U = \log C_1 + \beta \log C_2$$

where $0 < \beta < 1$ is the intertemporal discount factor and C_1 and C_2 is consumption in real terms today and tomorrow, respectively

Consumer budget constraint

- Budget constraint at time 1

$$P_1 C_1 + B_1 = W_1 + P_1 Y_1$$

where P_1 is the price level at time 1, B_1 is holding of nominal bonds at time 1, Y_1 is income at time 1 and $W_1 = (1 + i_0) B_0$ is initial wealth at the beginning of period 1

- Wealth at the beginning of period 2

$$W_2 = (1 + i_1) B_1$$

where i_1 is the nominal interest rate at time 1

- Budget constraint at time 2

$$P_2 C_2 = W_2 + P_2 Y_2$$

Intertemporal budget constraint

- From the three equations above:

$$P_1 C_1 + \frac{P_2 C_2}{1+i_1} = W_1 + P_1 Y_1 + \frac{P_2 Y_2}{1+i_1}$$

1. Left hand side: present discounted value of consumption

1. Right hand side: wealth + present discounted value of income

- Over the lifetime the value of consumption must be equal to the value of available resources

Maximization problem

Consumer choose C_1 and C_2 to maximize the lifetime utility

$$U = \log C_1 + \beta \log C_2$$

subject to the intertemporal budget constraint

$$P_1 C_1 + \frac{P_2 C_2}{1 + i_1} = W_1 + P_1 Y_1 + \frac{P_2 Y_2}{1 + i_1}$$

Solving the maximization problem

- From the intertemporal budget constraint write

$$C_2 = -(1+i_1)\frac{P_1}{P_2}C_1 + d$$

where d is exogenous to the consumer

$$d = (1+i_1)\left[\frac{W_1}{P_2} + \frac{P_1 Y_1}{P_2} + \frac{Y_2}{1+i_1}\right]$$

- Substitute in the lifetime utility

$$U = \log C_1 + \beta \log\left[-(1+i_1)\frac{P_1}{P_2}C_1 + d\right]$$

- The FOC relative to C_1 implies

$$\frac{1}{C_1} - \beta\frac{1}{C_2}(1+i_1)\frac{P_1}{P_2} = 0$$

Euler equation

The FOC can be rewritten as

$$\frac{1}{C_1} = \beta(1+r_1)\frac{1}{C_2}$$

where r_1 is the real interest rate at time 1

$$1+r_1 = (1+i_1)\frac{P_1}{P_2}$$

Economic intuition

$$\frac{1}{C_1} = \beta(1+r_1)\frac{1}{C_2}$$

Equate marginal cost and marginal benefit of postponing consumption by 1 unit from today to tomorrow

- Marginal cost:

  Give up consumption by 1 unit at time 1 $\rightarrow$ utility at time 1 decreases by $1/C_1$

- Marginal benefit:

  Save $\rightarrow$ raise consumption at time 2 by $(1 + r_1)$ $\rightarrow$ raise discounted utility at time 2 by $(1 + r_1)$ β $1/C_2$

Economic intuition, cont.

- The FOC can be written as

$$C_1 = \frac{C_2}{\beta(1+r_1)}$$

- What matters for consumption is the real interest rate
- Intertemporal substitution of demand: increases in r_1 cause a decrease in C_1 relative to C_2
- Monetary policy has effects on consumption if it changes the real interest rate
- Expectations about the future matter for current aggregate demand: given r_1, C_1 increases if C_2 increases

Economic intuition, cont.

- Combine the FOC with the intertemporal budget constraint and solve for C_1 (and C_2) to obtain

$$C_1 = \frac{1}{1+\beta}\left[\frac{W_1}{P_1} + Y_1 + \frac{Y_2}{1+r_1}\right]$$

$$C_2 = \frac{\beta}{1+\beta}(1+r_1)\left[\frac{W_1}{P_1} + Y_1 + \frac{Y_2}{1+r_1}\right]$$

- C_1 (and C_2) raises with real wealth W_1/P_1, current income Y_1 and present value of future income $Y_2/(1+r_1)$
- C_1 decreases with r_1, while C_2 increases with r_1, other things being equal
- Expectations about future events (including future monetary policy) matter for aggregate demand

Log linear Euler equation

- Consider now a logarithmic version of the dynamic IS curve

$$c_1 = c_2 - (r_1 - \rho)$$

where c = log C, r = log (1+r) and ρ = - log β

- Take now any generic pair of periods

$$c = c^e - (r - \rho)$$

where c^e is (log) consumption expected for next period

Log linear dynamic IS curve

- Assume now equilibrium in the goods market: $c = y$
- Then

$$y = y^e - (r - \rho)$$

Log linear dynamic IS curve

- Two main differences with the traditional IS curve where y only depend negatively on r:

1. A higher level of future expected output y^e increases current output y

   Due to consumption smoothing implicit in the FOC: a consumer prefers to smooth out consumption over time (with $\beta (1+r) = 1$, $C_1 = C_2$); thus, when he expects that income will be higher in the future, he consumes more starting from today

2. The negative effect of r on y reflects the intertemporal substitution effect

   When r is higher, the consumer prefers to save and invest savings in financial activities that appear today particularly attractive; thus, the consumer prefers to postpone consumption to tomorrow when maturing interests rates will generate a higher income; the consumer substitutes consumption today with consumption tomorrow; r represents the relative price of current consumption relative to future consumption