

Moral Hazard

Definition: Moral hazard is a situation in which one agent decides on how much risk to take, while another agent bears (parts of) the negative consequences of risky choices.

Typical case: insurance. The person who buys an insurance is protected against monetary damages. Therefore, he may engage in more risky behavior than if he has to bear the risk himself.

A moral hazard problem requires that there is asymmetric information after signing the contract, so that contracted payments cannot be conditioned on events that are only known to one of the parties. Asymmetric information may concern

- (i) the actions of the party who is insured. These actions cannot be fully observed or verified by the insurance (hidden action).
- (ii) the state of the world, that influences the outcome of the actions of the insured person. The insured could respond to such events in order to minimize risk, but may lack an incentive to do so.

Example: Insurance against theft of a bicycle without deductible.

- (i) The insured person buys a cheap lock that can be broken easily and, thus, raises the risk of the bicycle being stolen.
- (ii) The insured person knows that in certain street bicycles get stolen quite frequently, but leaves his bike there anyway.

Examples from macroeconomics: Unemployment insurance with full payment of the former wage. Insured person has lower incentive to provide effort in his job or to find a new job, after becoming unemployed.

Solutions of moral-hazard problems in insurance industry:

- some risks cannot be insured.
- Deductible: if the insured person must cover a part of the damage himself, he has higher incentive to avoid risk.
- Deductible + risk aversion: if the insured person is risk averse, even a small co-payment may be sufficient to eliminate moral hazard problems.

Consider the following example: a good bike lock costs x Euro more than a cheap lock. With a good lock, the probability of theft is reduced by 10%. The bike is worth 200 Euro.

In expected terms, buying a good lock pays off if $x < 20$ (10% of 200). If the cyclist has no insurance he would buy the good lock if $x < 20$.

If he is insured without co-payment, he has no incentive to spend more money on a better lock. He would not buy it if $x > 0$.

Deductable of 10%: If the bike gets stolen, the insured person has a loss of 20 Euro. A better lock reduces the probability of the loss by 10%. If he is risk neutral, he will buy the lock, if $x < 2$.

Suppose, instead, that the biker is risk averse. Buying a safe lock is like an additional insurance that reduces the likelihood of losing 20 Euros by 10%. The certainty equivalent is (depending on the degree of risk aversion) between 2 and 20 €.

A sufficiently risk averse person would be willing to spend e.g. 10 € on a lock that saves him a loss of 20€ with probability 10%.

Why do we have moral hazard in the banking sector?

Example

amount for investment 100 €, time horizon 1 year

2 possible assets:

asset S pays with probability $\frac{1}{2}$: 105 € (state 1)

 with probability $\frac{1}{2}$: 115 € (state 2)

⇒ expected return 110

⇒ standard deviation $\sigma = \sqrt{\frac{(115-110)^2 + (105-110)^2}{2}} = 5$

asset R pays with probability $\frac{1}{2}$: 60 € (state 1)

 with probability $\frac{1}{2}$: 130 € (state 2)

⇒ expected return 95

⇒ standard deviation $\sigma = \sqrt{\frac{(60-95)^2 + (130-95)^2}{2}} = 35$

Efficient: Asset S

Consider a bank, who decides in which assets it should invest. The bank is financed with 100% by deposits (no equity) and can choose only one asset.

The deposit interest rate is 4%.

Asset S => Profit of the bank in state 1: $105 - 104 \text{ €} = 1 \text{ €}$

Profit of the bank in state 2: $115 - 104 \text{ €} = 11 \text{ €}$

⇒ expected profit = 6 €

Asset R => In state 1 returns are not sufficient to cover the costs:

$$60 - 104 \text{ €} < 0$$

⇒ Bank is bankrupt. Bank owners get 0.

Loss is borne by depositors.

Profit of the bank in state 2: $130 - 104 \text{ €} = 26 \text{ €}$

⇒ expected profit = 13 €

Asset R promises a higher expected profit than asset S, although S has a higher expected return and lower variance than R.

⇒ Bank will choose asset R.

Promised repayment to depositors: 104 €

Depositors can foresee that the bank will invest in asset R. They know that in state 1 the Bank is insolvent and can repay only 60 €.

In state 2 the bank pays back 104 €

⇒ expected return to depositors = 82 € < 100 €

⇒ Depositors will not deposit their funds in the bank. market is inactive (lemons market).

A **deposit insurance** may solve the problem that depositors do not provide their funds. But, then the deposit insurance would face a loss of 44 € with probability $\frac{1}{2}$. This would need to be covered by premia or taxes.

The result of an inefficient investment by the bank would not be altered.

Minimum equity requirement : the bank must finance at least a fraction x of her assets by equity.
(analog to a deductible in insurance contracts).

Minimum equity requirement: How big must the share of equity be for incentivising the bank to choose Asset S?

A fraction $1-x$ is financed by deposits. Deposit interest rate 4%

Asset S pays with probability $\frac{1}{2}$: 105 € (state 1)

 with probability $\frac{1}{2}$: 115 € (state 2)

Profit of the bank in state 1: $105 - (1 - x) 104 \text{ €} = 1 + 104 x$

Profit of the bank in state 2: $115 - (1 - x) 104 \text{ €} = 11 + 104 x$

\Rightarrow expected profit = $6 + 104 x$

Asset R pays with probability $\frac{1}{2}$: 60 € (state 1)

 with probability $\frac{1}{2}$: 130 € (state 2)

Profit of the bank in state 1: $60 - (1 - x) 104 \text{ €} = 104 x - 44$

If $x < 44/104 = 42.3\%$, the bank is bankrupt.

Profit of the bank in state 2: $130 - (1 - x) 104 \text{ €} = 104 x + 26$

\Rightarrow expected profit =
$$\begin{cases} 104x - 9 & \text{if } x \geq 0.423 \\ 52x + 13 & \text{if } x < 0.423 \end{cases}$$

Is an equity quota of $x < 42,3\%$ sufficient?

Expected profit from S: $104x + 6$

Expected profit from R: $52x + 13$

When is the expected profit of asset S larger than expected profit from R?

$$104x + 6 > 52x + 13 \Leftrightarrow 52x > 7 \Leftrightarrow x > 13.46\%$$

If the bank invests at least 13.46% equity, it has an incentive to choose Asset S instead of R.

Problem here is **limited liability**. In case of losses, owners cannot lose more than their equity. Losses exceeding equity are borne by depositors and not by those who make decisions (external effect). Excess profits of a risky investment (in case of success), however, are fully distributed to owners of the bank. Hence, the owners are interested in risky investments.

This problem is immanent in any firm.

But: small companies have a manager who is also a major owner. Those who decide have a lot to lose. Depending on the corporation type owners may be obliged to cover parts of the losses from private wealth or they have to pledge private wealth to get a credit for their firm. If, in addition, the owner is risk averse, he has almost no incentive anymore to engage in risky actions.

1. The higher the equity ratio, the smaller is the moral hazard problem.
2. The larger risk aversion, the smaller is the moral hazard problem.

Institutional investors are more or less risk neutral.

- ⇒ The larger the share of institutional investors among shareholders, the lower is the effect of a minimum equity ratio and the less can it this ratio compensate moral hazard incentives.
 - This concerns anonymous stock companies more than privately run firms.
 - Hedge funds and investment banks are almost exclusively owned by institutional investors (usually other banks or investment funds)
- ⇒ The moral hazard problem is most severe for hedge funds and other bank-owned financial institutions.

All firms have an incentive to get financed by credits, in order to raise the „leverage“. Maximizing profit per unit of equity demands a low equity ratio. In banks these leverages are larger than in other industries, because banks are „only“ intermediaries.

- ⇒ Banks are financed by some 90% deposits.
- ⇒ The lower the equity ratio, the larger the moral hazard problem.

To reduce the moral hazard problem, banks are regulated.

→ **Basel I und II**

Basel I (1988 signed, 1992 validated): Loans to private borrowers must be financed by at least 8% equity.

⇒ The average equity ratio of banks in G-10 countries rose from 1988 to 1992 from 9.3% to 11.2%.
German bank had equity ratios of 10% – 14% (2007).

⇒ Why do banks hold more equity than required? Is the quota redundant?

Main reason is to create a buffer: If losses arise, equity is reduced. A bank that has only 8% equity would in case of a loss, reduce its engagement in other investments in order to restore the minimum equity ratio.

⇒ Example: original situation

A		P	
Credit to private	100 Mio	Deposits	92 Mio
		Equity	8 Mio

Suppose, the asset value is reduced by 1 Mio, because some important debtor could not pay back his loan.

⇒ Loss of 1 Mio reduces equity

A		P	
Credit to private	99 Mio	Deposits	92 Mio
		Equity	7 Mio

⇒ Equity ratio dropped to $7/99 = 7.07\%$.

To restore a ratio of 8%, the bank must either raise fresh equity or sell some of its remaining assets or liquidate some credit.

Here: bank sells 11.5 Mio. of credits to private parties in exchange for government bonds that do not require an equity ratio.

A		P	
Credit to private	87.5 Mio	Deposits	92 Mio
Govt. bonds	11.5 Mio	Equity	7 Mio

⇒ Equity ratio of 8% is restored: $7/87.5 = 8\%$.

Premature liquidation of claims is usually associated with losses.

Example: Suppose a premature liquidation credits to private parties is associated with a loss of 5%. Liquidating credits of 11.5 Mio (as above) yields a return of only $0.95 * 11.5 = 10.925$ Mio. There is an additional loss that affects the equity ratio.

A		P	
Credit to private		Deposits	92 Mio
	87.5 Mio		
Govt. bonds	10.925 Mio	Equity	6.425 Mio

=> Equity ratio is only $6.425/87.5 = 7.34\%$.

If liquidation of assets results in additional losses, even more claims must be liquidated to restore the equity ratio.

Calculus: How many claims to private parties need to be liquidated to restore an equity ratio of 8%?

A		P	
Credit	$99 - x$	Deposits	92
Bonds	$0.95 x$	Equity	$7 - 0.05 x$

=> Equity ratio:

$$\frac{7 - 0.05x}{99 - x} \geq 8\% \Leftrightarrow 7 - 0.05x \geq 0.08(99 - x)$$

$$\Leftrightarrow 0.03x \geq 0.08 \cdot 99 - 7 \Leftrightarrow x \geq \frac{0.08 \cdot 99 - 7}{0.03} = 30.667$$

=> The bank must liquidate credits with a volume of some 30.7 Mio

A		P	
Credit	68.3 Mio	Deposits	92 Mio
Bonds	29.165 Mio	Equity	5.465 Mio

=> Equity ratio = $5.465 / 68.3 = 8\%$

For avoiding the inefficient liquidation of claims in response to unexpected losses, banks try holding more equity than required.

Critique to Basel I

1. Equity requirement is independent of risk.

- ⇒ This invites for risk arbitrage which is another form of moral hazard: banks are more interested in risky assets, if they promise a higher ratio of expected profits to regulatory capital.
- ⇒ No incentives for an efficient risk allocation and risk evaluation.

2. The market does not get information about the riskiness of a bank. Private depositors should know how risky a bank is, if different banks offer different interest rates. If depositors can distinguish banks' positions, deposit rates are informative prices.

- ⇒ Banks, who engage in risky investments, can promise higher deposit rates. Since depositors cannot distinguish the risk (asymmetric information), they deposit their funds in those banks that offer the highest rates and make the most risky investments.
- ⇒ Safe banks will be crowded out of the market.

To address these problems was the task of **Basel II**. (effective since 2008)

- 3 pillars:
1. Minimum capital requirement
 2. Supervision
 3. Market discipline

ad 1. Minimum capital requirement

New: risk weighted capital requirements, inclusion of operative risk

(i) standardized approach,

quota depend on external ratings of individual assets

1 Einzelne Forderungen

Forderung an	AAA bis AA-	A+ bis A-	BBB+ bis BBB-	BB+ bis BB-	B+ bis B-	Unter B-	Nicht beurteilt
Staaten/Zentralbanken	0 %	20 %	50 %	100 %		150 % oder höher	100 %
Banken (Option 1)	20 %	50 %	100 %	100 %		150 % oder höher	100 %
Banken (Option 2)	20 %	50 %	50 %	100 %		150 % oder höher	50 %
Banken (Option 2) kurzfristige Forderungen ²	20 %	20 %	20 %	50 %		150 % oder höher	20 %
Unternehmen	20 %	50 %	100 %	100 %	150 % oder höher		100 %
Retail (ohne Zahlungsverzug)	75 % (Gliederungspunkt 1.7)						
Durch Wohnimmobilien besicherte Forderungen	35 % (Gliederungspunkt 1.8)						
Durch gewerbliche Immobilien besicherte Forderungen	grundsätzlich 100 % / Reduzierung auf 50 % möglich (Gliederungspunkt 1.9)						
Unbesicherter Teil von Forderungen über 90 Tage im Verzug /. EWB	100 % oder 150 % / unter bestimmten Umständen 50 % (Gliederungspunkt 1.10)						
Verbriefungen (ab Tz. 566)	20 %	50 %	100 %	350 %	1.250 % (= Kapitalabzug)		

- Option 1 – Risikogewichtung einer Bank um eine Stufe höher als diejenige des Sitzstaates, wobei eine Begrenzung auf 100 % festgelegt wird.
- Option 2 – Risikogewichtung entsprechend dem externen Rating der einzelnen Bank

(ii) Internal Ratings (IRB) / „value-at-risk“ models

allow banks to construct their own models evaluating risk. The models also include correlations of returns from different asset classes.

ad 2. Supervision

- Eventually higher equity ratios for additional risks (interest rate risk, strategic risks, market risk in the business cycle)
- Supervision of risk management

ad 3. Market discipline

aim: motivate prudent management by enhancing the degree of transparency in banks' public reporting to shareholders and customers

Banks must publish their equity, risk position, and risk measurement procedures every six months.

Intention of Basel II:

1. higher equity and more efficient risk management, lower probability of banking crises.
2. reduced moral-hazard effects, reduced risk arbitrage.
3. enable markets to aggregate information. Prices for capital and deposits should become signals of the risk evaluation by markets
4. Restrict competition, avoid a race to the bottom of the lowest standard allowed.
5. Transparency should allow depositors to evaluate the riskiness of deposits => risky banks must pay a higher risk premium, which provides another disincentive to take risk.

Downside: capital ratios seem inefficiently high

Market effects of Banking regulation:

Reconsider the example of a bank that must sell assets to fulfil the minimum equity requirement:

A loss of 1 Mio forces the bank to sell assets in value of 30 Mio. How does this affect asset markets?

If our bank is a small institution and if the original losses occur only at this bank (singular banking crisis), it has no impact on market prices.

If large institutions or many small banks sell assets at the same time, they affect market prices.

=> Prices decline

=> The value of remaining assets in the banks' balance sheets drops and so does the banks' equity.

=> Banks must sell even more assets to restore the minimum equity ratio.

Feedback effect („vicious circle“): Falling asset prices force banks to sell assets, which causes further drops in asset prices.

=> negative bubbles may arise!

Who can break the vicious circle?

Investors who are not regulated and who are not liquidity constrained

- Private investors (households)
- Private equity funds
- Foreign investors, e.g. pension funds
- Domestic central bank (but direct interventions by the central bank in asset markets raise other concerns)

Reforms of Basel II

Main problems:

1. Ratings depend on the business cycle.
2. Minimum capital ratio is procyclical: during recessions banks lose equity. To fulfil the quota, they reduce lending => credit crunch.
3. Minimum capital ratio should provide incentives for efficient risk allocation and a buffer to insolvency. But, if banks can never undercut 8%, they are forced to downsize their balance sheet in case of losses. This is a partial liquidation of the bank – and it is not efficient if the bank is solvent.

Possible solutions:

1. Higher voluntary capital ratio (buffer)
2. Let the minimum capital ratio depend on business cycle (high quota in booms, lower quota in recessions)
3. Minimum capital ratio and other regulatory instruments can be used to stabilize financial markets.

Basel III

Higher equity requirements (until 2019 rising to 10.5%),
additional 2.5% counter-cyclical buffer in countries with high credit growth.

Liquidity requirements in addition

See Hanson, Kashyap, Stein (JEP 2011)

Enhancing stability by automated countercyclical responses

Banking Union - order of liabilities:

1. equity

minimum equity ratio reduces moral hazard incentives.

2. liabilities that can be transformed into equity under pre-specified conditions

If losses trigger a threshold, bail-in instruments allow transforming debt into equity to fulfil the minimum equity ratio.

3. unsecured debt

holders of unsecured debt and bail-in instruments should monitor the bank.

4. deposit insurance provided by banks

requires minimum equity for containing moral hazard, insurance is cheaper, if banks are monitored by unsecured debtors.

5. European stability mechanism (taxpayer)