Liquidity and Crises in Financial Markets

Risk Management III

U of Basel, HS 2012

What is CCP Clearing?

When trade is centralized, risk management tends to be delegated to clearinghouses.

Clearinghouse assume all counterparty risk in exchange for collateral.

With such *novation*, the clearinghouse becomes the seller to every buyer and the buyer to every seller.

This is often interpreted as guaranteeing the obligations from trades.

Full transfer of counterparty/replacement cost risk requires solid risk management.

- membership requirements
- margins
- default fund
- capital
- shortfall contribution from clearing members

Benefits of Central Clearing

Standard:

- Diversification
- Novation and Multilateral Netting
- Mutual Insurance (mutualized losses)

Not that obvious:

- better information about overall positions
- better risk allocation
- can better take into account social benefits

Outline

1. What are the key benefits of CCP clearing?
2. What is different in OTC markets?

Key distinction: contract view vs. counterparty view

Contract vs. Counterparty

Contract view:

- Can we price a contract continuously and assess its price risk?
- Risk management involves securing the underlying contract.
- One looks – possibly after netting – at contracts in isolation.
- Bottomline: Cannot clear customized OTC contracts!

Counterparty view:

- Can we assess the current risk position of counterparties?
- Risk management involves controlling the incentives to take risk.
- One needs to look at the overall position of counterparties.
- Bottomline: Clear all OTC trades for certain counterparties/markets!

We will follow the latter.

Koeppl and Monnet (2011)

Measure 1 of Farmers: $-q + E[\log x]$

- produce wheat q in $t = 1$
- consume cash x in $t = 2$

Measure $\frac{1}{1-\delta}$ of Bakers: $-\mu x_1 + (1-\delta)\, E\left[\theta_i \log y - x_2\right]$

- produce cash

  x_1 at cost $\mu > 1$ in $t = 1$

  x_2 at cost 1 in $t = 2$

- consume wheat y with probability $1 - \delta$

Three Shocks:

- default shock δ
- individual demand shock $\theta_i = \theta + \epsilon$, $(E(\epsilon) = 0)$
- aggregate demand shock θ, $(E(\theta) = 1)$

First-Best

- Farmer's allocation is independent of θ:

$$\begin{aligned} q^* &= 1 \\ x(\theta) &= 1 \end{aligned}$$

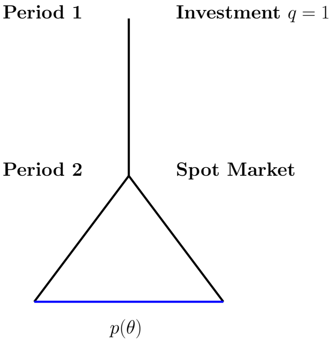
- Production of cash takes place only in $t = 2$ and

$$y^*(\theta_i; \theta) = \theta_i / \theta$$

Conclusion: All risk is borne by Bakers.

Idea: Clearing arrangements help to achieve the first-best.

Spot Market



Result: Farmers bear all the risk.

Demand for wheat at $t = 2$:

$$\max_y \theta_i \log y_i - p(\theta) y_i$$

Hence: $y_i = \theta_i / p(\theta)$ and aggregate demand is $\int_i y_i(\theta_i) di = \theta / p(\theta)$

Farmers produce in $t = 1$:

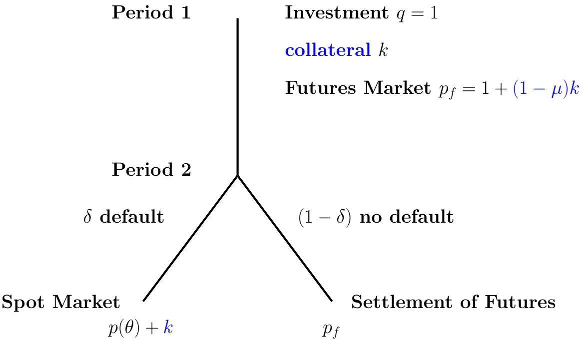
$$\max_q -q + \int \log\left(p(\theta) q\right) dF(\theta)$$

Aggregate supply is given by $q = 1$.

In the spot market equilibrium, prices reflect the aggregate demand shock and

$$p(\theta) = \theta$$

Futures Market



Consider now a futures contract (p_f, k):

- obligation for farmer to deliver wheat at fixed price p_f at $t = 2$
- obligation for baker to pay p_f at $t = 2$
- collateral ("margin") k placed by baker at $t = 1$

Bakers maximize their expected financial wealth:

$$\max_q -\mu k q + \int (p(\theta) - p_f + k) q dF(\theta)$$

They need to be indifferent between spot trades and trading futures:

$$p_f = \int p(\theta) dF(\theta) - \left(\frac{\mu}{1-\delta} - 1\right) k$$

Farmers solve:

$$\max_q -q + (1-\delta)\log(p_f q) + \delta \int \log((p(\theta) + k)q) dF(\theta)$$

Equilibrium:

- $q = 1$
- $p_f = 1 + \left(1 - \frac{\mu}{1-\delta}\right) k$
- $k > 0$ iff μ close enough to 1

Result: Futures contract insures against aggregate risk with collateral (partially) insuring against counterparty risk.

CCP Clearing

CCP pools all payments and pays them out to farmers.

1) Revenue (payout to farmers):

$$R(\theta) = \underbrace{p(\theta)\delta q}_{\text{default trades}} + \underbrace{\left(p_f^n - k\right)(1-\delta)q}_{\text{settled trades}} + \underbrace{kq}_{\text{collateral}} + \underbrace{(1-\delta)\phi(\theta)}_{\text{add. payments}}$$

2) Price (reflects costs of clearing for bakers)

$$p_f = 1 + \underbrace{\left(1 - \frac{\mu}{(1-\delta)}\right)k}_{\text{collateral cost}} - \underbrace{\int \phi(\theta) dF(\theta)}_{\text{add. cost}}.$$

3) Additional payments schedule $\phi(\theta)$ acts like a tax.

Remark: Quantity of wheat produced by farmers is again independent of risk, $q = 1$.

Novation

Set $\phi(\theta) = 0$.

It is optimal to set $k = 0$. Why? No idiosyncratic default risk left.

Then:

$$\begin{aligned} \phi(\theta) &= 0 \text{ for all } \theta \\ p_f^n &= 1 \\ R(\theta) &= (1-\delta)p_f^n + \delta\theta = 1 + \delta(\theta - 1) \end{aligned}$$

Farmers receive their *expected payment* from the futures contract.

They are *not insured* against aggregate price risk.

Result: Novation is a perfect substitute for diversification of counterparty risk.

Mutualization

"Survivor-pays-rule":

$$\phi(\theta) = \frac{\delta\,(1-\theta)}{1-\delta}$$

Given the aggregate state, θ, total losses are split equally among surviving bakers.

Additional payment $\phi > 0$ if and only if $\theta < 1$, but zero in expected terms.

It is again optimal to set $k = 0$.

Hence, we have

$$\begin{aligned} \int \phi(\theta) dF(\theta) &= 0 \\ p_f^m &= 1 \\ R(\theta) &= 1 \text{ for all } \theta \end{aligned}$$

Result: Perfect insurance of aggregate price risk at the fair price.

Model with OTC Trades

Farmers produce a specific type of wheat (exotic wheat)

$$-s_i + E[\log x]$$

Bakers only like a particular tpye of special wheat

$$-\mu x_1 + (1 - \delta)\left[\sigma_i v(s_i) - x_2\right]$$

where v is strictly concave and σ_i varies across bakers.

Bakers are heterogeneous in both, the type and the valuation of exotic wheat.

Wheat is not fungible, i.e., cannot be retraded (extreme price or replacement cost risk).

Farmers make take-it-or-leave-it offer of a contract (s_i, p_i, k_i)

Inefficient Allocation of Risk

Efficiency requires:

1. MV of wheat = MC of purchasing it

$$(1-\delta)\sigma_i v'(s_i) = p_i$$

2. MV of gold consumption = MC of wheat production

$$\frac{1}{p_i} = 1$$

3. Pooling of default risk

Hence:

- payments are fixed across trades
- quantity is increasing in σ ...
- ... thus counterparty risk should be increasing in σ

Farmer's offer solves:

$$\max_{(s,p,k)} -s + (1-\delta)\log p + \delta \log k$$
$$\text{subject to}$$
$$-\mu k + (1-\delta)\left(\sigma v(s) - p + k\right) \geq 0$$

FOC:

$$\begin{aligned} v'(s) &= v(s) \\ p &= (1-\delta)\sigma v'(s) \\ k &= \frac{\delta p}{\mu - (1-\delta)} \end{aligned}$$

Novation works the same, since pooling yields $k = 0$ and, thus, higher expected pay-offs for farmers.

But counterparty risk is constant, while farmers extract surplus through (inefficiently) large prices.

Improving Efficiency

CCP offers novation, i.e., it promises a payout equal to $(1-\delta)p_i$.

It also announces an ex-post "tax" schedule $\phi(\sigma)$ on bakers.

Farmers problem:

$$\max_{(s,p)} -s + \log\left((1-\delta)p\right)$$
$$\text{subject to}$$
$$(1-\delta)\left(\sigma v(s) - p - \phi(\sigma)\right) \geq 0$$

FOC:

$$\begin{aligned} \sigma v'(s) &= p \\ \sigma v(s) - \phi(\sigma) &= p \end{aligned}$$

Hence, $\phi(\sigma)$ drives a wedge into the choice of the contract size *without affecting the pricing* of the contract.

Why does ϕ improve efficiency?

It is a tax/subsidy that makes it harder/easier to extract surplus.

Define the wedge by

$$\phi(\sigma) = \sigma v(s^*(\sigma)) - \sigma v'(s^*(\sigma)) \text{ for all } \sigma$$

where s^* is the optimal size of the contract.

Then, bargaining yields

$$\begin{aligned} \sigma v'(s) &= \sigma v(s) - \phi(\sigma) \\ &= \sigma v(s) - \sigma v(s^*(\sigma)) + \sigma v'(s^*(\sigma)) \end{aligned}$$

which has a unique solution at s^*.

Note that this implies precisely the price

$$\sigma v'(s^*(\sigma)) = \frac{1}{1-\delta}$$

so that the total payment is given by 1 *independent* of σ.

What are the limits on CCP clearing?

1) We did not impose revenue neutrality on the CCP, i.e., we have not required that $\int \phi(\sigma) di = 0$.

2) We have not imposed the bargaining friction on the efficient allocation.

One can show that combining the two, the schedule ϕ^* is revenue neutral.

Why? The bargaining restriction implies that $\sigma v(s^*(\sigma)) - p = 0$ for all σ.

Hence: $\int \phi^* dH(\sigma) = \int \sigma v(s^*(\sigma)) - p dH(\sigma) = 0$.

3) Preferences of bakers might only be known by the contracting parties, but not the CCP.

There is an incentive for farmers to mispresent the value of the trade and claim lower σ.

Why?

- the payment is independent of σ
- but the production of wheat is increasing in σ

Need to design a “tax” schedule $\phi(\sigma)$ that is incentive compatible.

4) There could be moral hazard with CCP clearing that leads to more risk taking.