Mandatory Central Clearing and Financial Risk Exposure

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Definition and Research Agenda

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- Assesses the overall impact on financial risk.

Results:

- Smaller buyers and sellers exit the market (increased market risk), while larger sellers insure more and become safer (decreased credit risk).
- Model calibration and policy evaluation show increase in market risk to dominate.

Overview

Over-The-Counter (OTC) Derivatives

Market Risk:

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Counterparty Default Insurance:

- Central Counterparties (CCPs) provide counterparty default insurance.
- Ex ante, they collect collateral to lower default risk.
- Upon default they manage and ensure contracted payments.

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Higher Market Risk Exposure $\Longleftrightarrow$ Lower Credit Risk Exposure

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1. Discussing competition in the markets of OTC derivatives and their insurance.
2. Analyze a monopolistic CCP's ability to influence the market outcome under both mandatory and voluntary insurance.
3. Study the effect of a regime shift on aggregate financial risk.

Literature & Contribution

OTC Prices and Competition: search frictions (Duffie et al., 2005), random match with Nash bargaining (Koeppl et al., 2012; Huang, 2019), take-it-or-leave-it offer (Biais et al., 2012), horizontal differentiation (Perez Saiz et al., 2012).

- **Heterogeneous** switching cost in the presence of trading-platforms.

Monopolistic for-profit CCPs: Optimal capital choices (Huang, 2019), maximize profit in the absence of price discrimination (Capponi and Cheng, 2018).

- The **spillover effect** of CCP choices on competition in the OTC derivatives market.

Mandatory Insurance and Financial Risk: Netting benefits of CCPs (Ghamami and Glasserman, 2017), systemic risk and for-profit CCPs (Capponi and Cheng, 2018).

- The **interaction** between market structure and micro-prudential policy.
- **Heterogeneous** impact on different buyers, sellers and the CCP.

Overview

Model Environment

Three dates:

- $t = 0$: Risky endowments are received and types decided.
- $t = 1$: All trades take place .
- $t = 2$: Uncertainty resolves and agents decide whether to strategically default.

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Three types of agents:

- Risk-averse buyers. ▸ Buyers
- Risk-neutral sellers: Clearing members and non-clearing members. ▸ Sellers
- For-profit monopolistic CCP. ▸ CCP

Markets and Competition

Derivatives Market (Product *d*):

$t = 0$: Each buyer is matched with one seller and endowed with n_b risky assets.

$t = 1$: Buyers purchase product d, paying costs C when **switching** to another seller.

$\rightarrow$ **Sellers** compete in prices subject to switching cost frictions and discrimination.

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Insurance Market (Product m):

$t = 0$: The monopolistic CCP sets a two-part tariff for insurance.

$t = 1$: Product d counterparties **mutually agree** whether to purchase insurance.

$\rightarrow$ Risk-neutral **sellers** ask a take-it-or-leave it price for their agreement.

$\rightarrow$ **Clearing members** ask for a (competitive) price to intermediate with CCP.

$t = 2$: CCP covers transfers for insured product ds with defaulting sellers.

Sub-game perfect Nash equilibrium with incomplete information.

	Voluntary Insurance	**Mandatory Insurance**
$t = 2$	Transfers given buyer allocation, seller default and **product choices**.	
$t = 1$	Buyers decide whether to additionally purchase insurance **product *m***. Buyers choose whether and from which seller to purchase **product *d***.	Buyers decide whether to purchase **the bundle** of product d and m.
$t = 0$	CCP sets fees and collateral; sellers become clearing members.	

Summary of Theory Results

	Voluntary Insurance	Mandatory Insurance	Implications
Buyers	• All buyers purchase product d. • Only large buyers purchase product m.	• Small buyers exit the market. • Medium and large buyers purchase product m.	• Some buyers remain unhedged. $\rightarrow$ **Higher market risk** • More buyers are insured. $\rightarrow$ **Lower credit risk**

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Sellers	• Small & medium sized sellers sell product d. • Large sellers become clearing members and sell product d & m.	• Small sellers exit the market. • Medium sized & large sellers sell bundle.	• Sellers have more insured and less uninsured sales. • Sellers have lower default risk. $\rightarrow$ **Credit risk externalities.**

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$\longrightarrow$ Ambiguous effects on buyers' risk exposure: **financial risk trade-off**.

$\longrightarrow$ Positive effect on seller credit risk: **credit risk externality**

$\longrightarrow$ Aggregate effect depends on model parameters and buyer size distribution.

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Counterfactual Policy Evaluation

Parameterization: ▸ Param.

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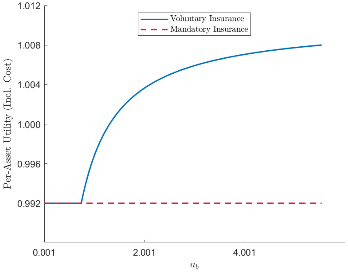
Financial Risk Analysis:

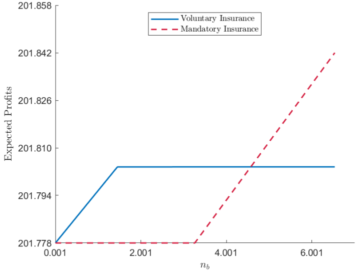
- Compute and compare average **buyer's** exposure to risk.
- Compute and compare average **seller's** credit risk.

Counterfactual Policy Evaluation

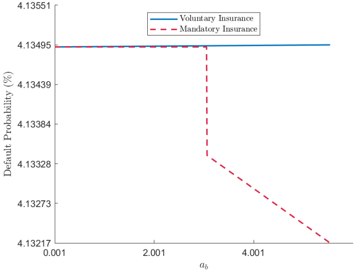
(a) Buyer Utility



(b) Seller Profits



(c) Seller Default Probability



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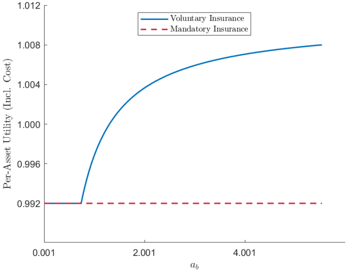

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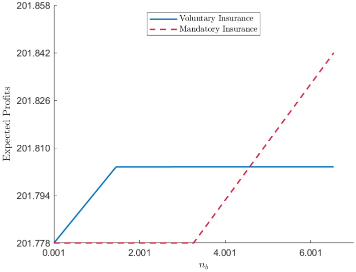

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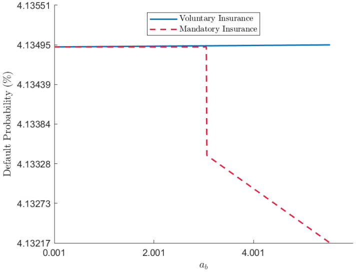

Table: The Effect on Financial Risk Exposure

Credit Risk Exposure	Market Risk Exposure	Risk Exposure Change (%)	Credit Risk Externality
$\Delta CR = -0.00324$	$\Delta MR = 0.05836$	$\Delta R = 1701.45$ %	$\Delta D = -0.00009$ %

Conclusion

Theoretical Analysis:

- Mandatory insurance empowers the monopolistic **for-profit** CCP to set higher prices.
- Therefore, **smaller** buyers and sellers **exit** the market $\rightarrow$ increased market risk.
- **Larger** buyers and sellers insuring more $\rightarrow$ decreased credit risk.

$\Rightarrow$ Buyer size distribution determines the aggregate effect of mandatory insurance.

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Counterfactual Policy Evaluation:

- The EuroDollar FX Market is populated by many small buyers.
- Insurance provides little additional value even to large buyers.

$\Longrightarrow$ Mandatory insurance would result in a significant increase in financial risk exposure.

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- Therefore, **smaller** buyers and sellers **exit** the market.
  $\longrightarrow$ Increased market risk exposure.
- **Larger** buyers and sellers became **safer** by insuring more with higher collateral.
  $\longrightarrow$ Decreased credit risk exposure
- Safer sellers also benefit other financial markets.
  $\longrightarrow$ Credit risk externality

$\Longrightarrow$ Buyer size distribution determines the aggregate effect of mandatory insurance.

Thank You!

References I

Biais, B., Heider, F., and Hoerova, M. (2012). Clearing, Counterparty Risk, and Aggregate Risk. *IMF Economic Review*, 60(2):193–222.

Capponi, A. and Cheng, W. A. (2018). Clearinghouse Margin Requirements. *Operations Research*, 66(6):1542–1558.

Duffie, D., Garleanu, N., and Pedersen, L. H. (2005). Over-the-Counter Markets. *Econometrica*, 73(6):1815–1847.

Ghamami, S. and Glasserman, P. (2017). Does OTC derivatives reform incentivize central clearing? *Journal of Financial Intermediation*, 32:76–87.

Huang, W. (2019). Central counterparty capitalization and misaligned incentives.

Koeppl, T., Monnet, C., and Temzelides, T. (2012). Optimal clearing arrangements for financial trades. *Journal of Financial Economics*, 103(1):189–203.

Perez Saiz, H., Fontaine, J.-S., and Slive, J. (2012). Competition and Strategic Control of a Central Counterparty: When Lower Risk Increases Profit. *SSRN Electronic Journal*.

The Risk-Averse Buyers

▸ Model.Env.

- Finite, but large number B of buyers with mean-variance utility:

$$u(x) = E(x) - \frac{\gamma}{2} Var(x) \quad \text{where} \quad \gamma > 0 \tag{1}$$

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- At $t = 2$ the derivative seller(s) may default on positive transfers with an expected probability $\widehat{D}_s$:

$$u_d = \left(1 - \widehat{D}_s\right)\mu_R + \widehat{D}_s u\left(1 + \tilde{R} \mid \tau > 0\right) - P_d \tag{3}$$

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- Maximize total profits, taking strategic default into account:

$$\mathbb{E}_0 \Pi_s = \max_{P_d} \quad \Pi_s^0 + \mathbb{E}_0 \Pi_s^1 + (1 - D_s)\, \mathbb{E}_0 \left[\Pi_s^2 \middle| \Pi_s^2 > 0 \right] + D_s * 0 \tag{5}$$

The CCP's Profit Function ▸ Model.Env.

- Expected numbers of clearing members and membership fee: M and f_M
- Expected product m sales of a clearing member and clearing fee: Q_m and f
- Clearing members' expected default probability given collateral: $D_M(g_M)$
- CCP's expected losses from a single seller's default: Π^2_{CCP}
- CCP's profit maximization problem:

$$\mathbb{E}_0\Pi_{CCP} = \max_{\{f_m, f, g_M\}} \underbrace{\overline{M} f_M}_{t=0} + \underbrace{\overline{M} Q_M 2f}_{t=1} + \underbrace{\overline{M} D_M(g_M)\Pi^2_{CCP}}_{t=2}(g_m) \tag{6}$$

Model Parameters & Calibration Methods ▸ Simulation

Table 2: Model Parameterization Normalized to €mn

Parameter	Notation	Value	Method	Data Source
Buyer size	$a_b \sim Weibull(\lambda, k)$	$\lambda = 0.686,\ k = 0.689$	SMM	Hau et al. (2021)
Asset Return	$(1+\tilde{r}) \sim N(\mu_r, \sigma_r^2)$	$\mu_r = 1.012,\ \sigma_r = 0.095$	return of US corp. bonds and exchange rate volatility	St. Louis Fed (2021) Bundesbank (2021)
Risk Aversion	γ	$\gamma = 4.37$	-	Eisfeldt et al. (2020)
Seller profits	$L \sim N(\mu_L, \sigma_L)$	$\mu_L = 199.846,\ \sigma_L = 115.169$	avg., std.	S&P Global (2021)
Collateral Cost	δ	$\delta = 0.000636$	avg. EURIBOR	Bundesbank (2021)
Switching Costs	C	$C \in \{\underline{C},\ \overline{C},\ 2\overline{C}\}$	parameter implied	-