Re-use of Collateral: Leverage, Volatility, and Welfare

Johannes Brumm[1] Michael Grill[2]

Felix Kubler[3] Karl Schmedders[4]

[1]Karlsruhe Institute of Technology

[2]European Central Bank [3]University of Zurich

[4]IMD Lausanne & University of Zurich

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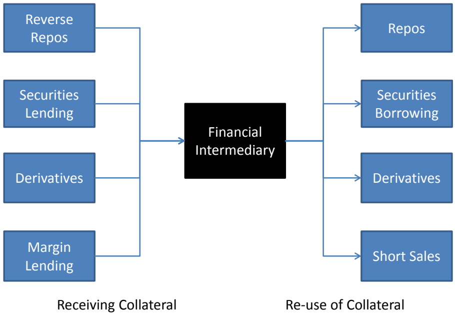
Re-use of Collateral

The Financial Stability Board (FSB) defines collateral re-use as "any use of assets delivered as collateral in a transaction by an intermediary or other collateral taker"



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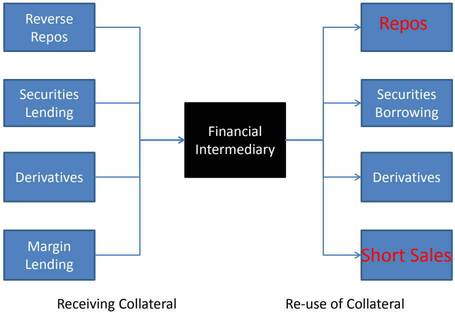
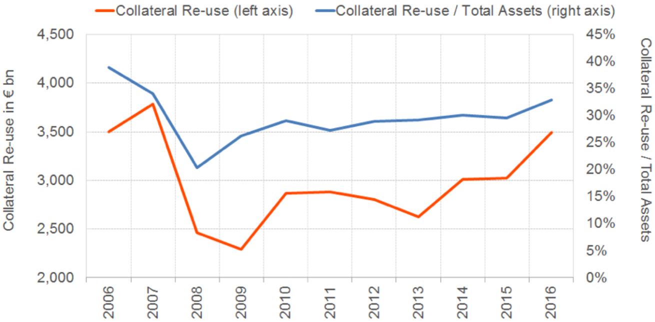


Infante et al. (2018) estimate that repos account for close to 50 % of collateral re-use whereas short sales account for 35 %.

Relevance of Collateral Re-use

Collateral re-use plays a major role in global financial markets



Source: Publicly available data on collateral re-use activity of 11 globally active banks

Re-use: Benefits and Concerns

Re-use of collateral is an important source of funding, reduces balance sheet costs and is beneficial for market liquidity (see e.g. FSB (2017))

FSB (2017) discusses potential financial stability issues related to the contribution of re-use to the build-up of leverage, interconnectedness and procyclicality

Former ECB Vice-President, Vítor Constâncio (Speech, 2014): "activities of re-hypothecation and re-use of securities amplified the creation of [...] higher leverage"

Literature and Contribution

Papers estimating volume of collateral re-use
Singh (2011), Kirk et al. (2014), Infante et al. (2018)

Theoretical models of collateral re-use
Bottazzi et al. (2012), Andolfatto et al. (2017), Maurin (2015), Gottardi et al. (2019)

Funding role of re-use for dealer banks
Eren (2014), Infante (2019), Infante and Vardoulakis (2018)

Our paper: first quantitative analysis of the implications of re-use on aggregate financial market outcomes + normative analysis of re-use limits

General equilibrium infinite-horizon economy with heterogeneous agents, collateral constraints, and re-use of collateral

Physical Economy

- Infinite-horizon exchange economy in discrete time, $t = 0, 1, 2, ..$
- S discrete exogenous shocks, date–event $s^t = (s_0, s_1, \ldots, s_t)$
- $H = 2$ types of agents, $h = 1, 2$
- Agent h receives individual endowment $e^h(s^t)$
- Long-lived asset ("Lucas tree", "stock") with dividends $d(s^t)$ in unit net supply
- Aggregate endowment in the economy

$$\bar{e}(s^t) = d(s^t) + \sum_h e^h(s^t)$$

Beliefs and Preferences

- Exogenous shocks follow a Markov chain with transition matrix π
- Individual beliefs π^h may differ from true transition process
- Agent h has recursive utility (Epstein and Zin, 1989)

$$U^h\left(c^h, s^t\right) = \left\{ \left[c^h(s^t)\right]^{\rho^h} + \beta \left[\sum_{s_{t+1}} \pi^h(s_{t+1}|s_t)\left(U^h(c^h, s^{t+1})\right)^{\alpha^h} \right]^{\frac{\rho^h}{\alpha^h}} \right\}^{\frac{1}{\rho^h}}$$

- Elasticity of intertemporal substitution (EIS) $\frac{1}{1-\rho^h}$
- Risk aversion determined by $1 - \alpha^h$

Financial Markets and Collateral

- Agents trade in stock and one-period bond in zero net supply
- Agent h can buy or sell shares $\theta^h(s^t)$ of stock at price $q(s^t)$, can buy or sell $\phi^h(s^t)$ of short-lived bond at price $p(s^t)$
- Borrowing (i.e. short positions) in bond needs to be backed by long position in stock as collateral and vice versa
  - Default without utility penalties or loss of reputation
  - Agents must back up promised payments with collateral
- Collateral constraints are tight enough to prevent default
  - Brumm et al. (2015 IER): no default as equilibrium outcome in presence of small default cost

Market-determined Margin Constraints

When borrowing (going short) in bond using stock as collateral
Upper bound on negative bond position determined by collateral holding in the stock:

$$-\phi^h(s^t) \leq \theta^h(s^t) \min_{s_{t+1}} \left\{ q(s^{t+1}) + d(s^{t+1}) \right\}$$

When borrowing (going short) in stock using bond as collateral
Upper bound on negative stock position determined by collateral holding in the bond:

$$-\theta^h(s^t) \leq \frac{\phi^h(s^t)}{\max_{s_{t+1}} \left\{ q(s^{t+1}) + d(s^{t+1}) \right\}}$$

Re-use of Collateral

- Agents may re-use received stock collateral
- Naked shorting is ruled out $\rightarrow$ Agents need to obtain the stock as collateral for shorting
- Regulatory agency can set limit $\kappa(s^t) \in [0, 1]$ on the fraction of received collateral permissible for re-use
- Re-use constraint for agent h:

$$\theta^h_{reused}(s^t) \leq \kappa(s^t) \cdot \theta^h_{received}(s^t)$$

- Using margin constraint for long stock position, an upper bound for agent h's negative stock position is obtained:

$$-\theta^h(s^t) = \theta^h_{reused}(s^t) \leq \kappa(s^t) \cdot \frac{\max(0, -\phi^{-h}(s^t))}{\min_{s_{t+1}} \{q(s^{t+1}) + d(s^{t+1})\}}$$

Exogenous Growth Rate

Aggregate endowments grow at a stochastic rate

$$\bar{e}(s^{t+1}) = \bar{e}(s^t)g(s_{t+1})$$

$S = 4$ exogenous i.i.d. shocks:

- shock 1 is a disaster shock, calibrated to match the mean of the distribution of disasters in Barro and Ursúa (2008)
- shocks 2,3,4 are standard business cycle sized shocks that have a standard deviation of 2%

Growth rates and probabilities of exogenous shocks

	Disaster	Recession	Normal Times	Boom
growth rate g	0.72	0.96	1.02	1.08
probability $\pi(g)$	2.2%	5.4%	87.0%	5.4%

Endowments and Utility

- Stock pays dividends $d(s^t) = 0.1 \cdot \bar{e}(s^t)$
- Two agents with total endowment $e^1(s^t) + e^2(s^t) = 0.9 \cdot \bar{e}(s^t)$, with $e^1(s^t) = \tilde{e}^1(s^t) \cdot 0.9 \cdot \bar{e}(s^t)$
- Agents have identical EIS of 0.5 (robustness with 1.5)
- Agent 1 is optimistic, believes probability of disaster is only $(1 - \delta^d)$ times objective probability
- Agent 2 is pessimistic, believes probability of disaster is $(1 + \delta^d)$ times objective probability

Targets and Parameters

Target	Model ($\kappa = 1$)	Data[1]
Mean equity return (in %)	5.8	5.5
Mean risk-free rate (in %)	0.39	0.56
STD risky returns (in %)	19	20
STD risk-free returns (in %)	3.3	2.9
Log price-dividend ratio	3.4	3.4

Parameter	Calibration
risk aversion agent 1, $\frac{1}{1-\alpha^1}$	3
risk aversion agent 2, $\frac{1}{1-\alpha^2}$	7
discount factor of both agents, β	0.94
endowment share agent 1, $\tilde{e}^1$	0.1
disagreement on disaster, δ^d	0.8

[1] US data, from Beeler and Campbell (2012)

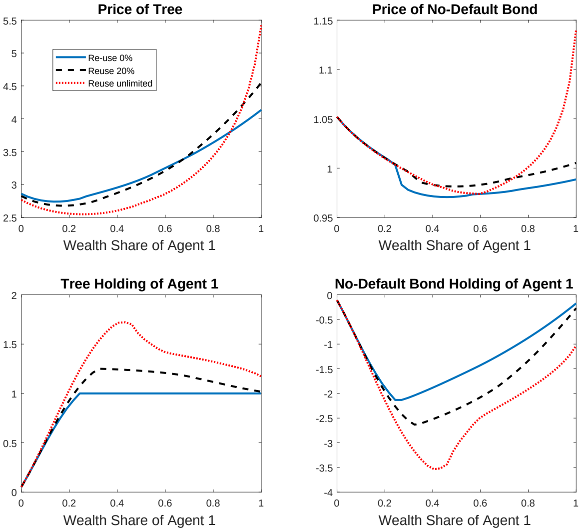
Basic Economic Mechanism

- Agent 1 less risk-averse and optimistic, natural buyer of risky stock, taking up leverage to finance investments
- Agent 2 more risk-averse and pessimistic, natural seller of risky stock, buyer of risk-free bond
- Agent 2 provides financing to agent 1 by lending via the risk-free bond and accepting stock as collateral
- Agent 2 re-uses collateral for short sales of stock to invest even more in risk-free bond

Simulation Statistics for different re-use parameters

	$\kappa = 0$	$\kappa = 0.2$	$\kappa = 1$
mean wealth, agent 1 (in %)	31	44	60
STD wealth, agent 1 (in %)	9.2	13	22
mean re-use rate (in %)	0.0	17	32
mean bond holding, agent 1	-1.9	-2.2	-2.3
mean equity return (in %)	4.9	4.9	5.8
mean risk-free rate (in %)	1.8	1.3	0.39
STD equity returns (in %)	5.5	6.3	19
STD risk-free returns (in %)	1.9	1.4	3.3

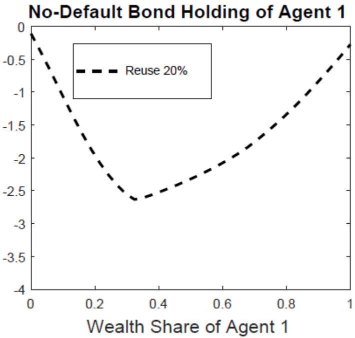
Price and Policy Functions



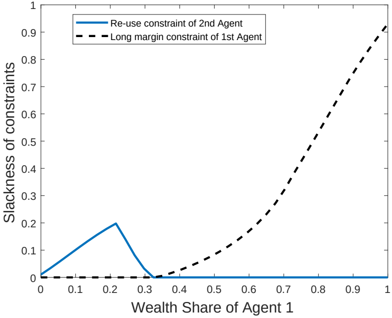
Two Key Constraints

- Two key constraints for agents' equilibrium portfolios:
  - Long margin constraint of agent 1
  - Re-use constraint of agent 2
- Long margin constraint of agent 1 is binding when he is poorer
- Re-use constraint of agent 2 is binding when agent 1 is richer
- Leverage peaks for wealth share of agent 1 when both constraints are binding

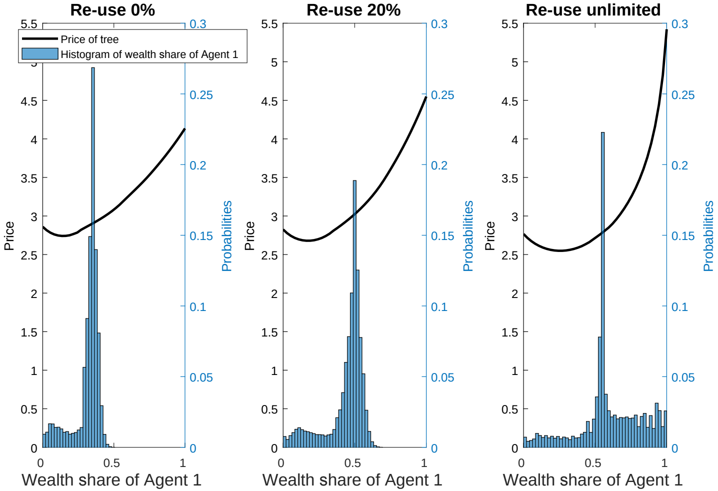
Leverage and Slack in Constraints



$\kappa = 0.2$



Wealth Distribution

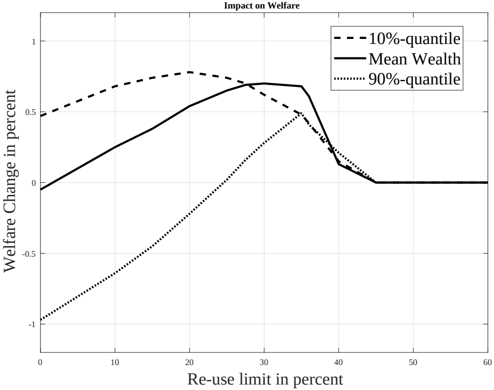


Welfare Analysis

- Unanticipated change in re-use regulation from free re-use ($\kappa = 1$) to limited re-use with $\kappa < 1$
- Starting point is the median of the ergodic wealth distribution and exogenous state 3 ("normal growth")
- Evaluation of welfare changes under objective beliefs
  - Results are robust to using convex combination of beliefs (as proposed by Brunnermeier et al. 2014)

Welfare Effects of Change in Regulation

- Welfare change for agent 2 after compensating agent 1 for the impact of the regulatory reform
- Moderate (interior) re-use limit maximizes welfare



Counteracting Economic Forces

Two direct effects of greater ability to re-use collateral ($\kappa \uparrow$)

More risk-sharing in the economy; beneficial for welfare of agents with heterogeneous risk–aversion

More leverage; harmful for welfare of agents with heterogeneous beliefs;

Contribution

Collateral re-use is a trillion-dollar global business with obvious benefits and risks for global financial markets

First quantitative analysis of re-use in a dynamic economic model

General equilibrium infinite-horizon economy with heterogeneous agents, collateral constraints, and collateral re-use

- Re-use (monotonically) increases asset price volatility
- Moderate (interior) re-use limit maximizes welfare

Analysis in this paper provides a rationale for limiting, yet not banning, re-use in financial markets

Some limitations: only two types of agents, no default, . . .