Margin Regulation and Volatility

Johannes Brumm[1] Michael Grill[2]

Felix Kubler[3] Karl Schmedders[3]

[1]University of Zurich [2]Deutsche Bundesbank

[3]University of Zurich and Swiss Finance Institute

Workshop: Advances in Numerical Methods for Economics

PSE, IMF, ESRC

Washington, D.C. – June 28, 2013

swiss:finance:institute

Motivation

Active policy debate on regulation of margin requirements after the recent financial crises

Example: Policy framework for addressing risks in securities lending and repo markets, Financial Stability Board (2012)

> *Such a framework would be intended to set a floor on the cost of secured borrowing against risky asset in order to limit the build-up of excessive leverage.*

Economic literature: Borrowing against collateral increases price volatility, e.g., Geanakoplos (1997), Aiyagari and Gertler (1999)

Quantitative Effects of Collateral

Due to lack of financial regulation in many markets for many years, lack of data to assess quantitative significance of regulation

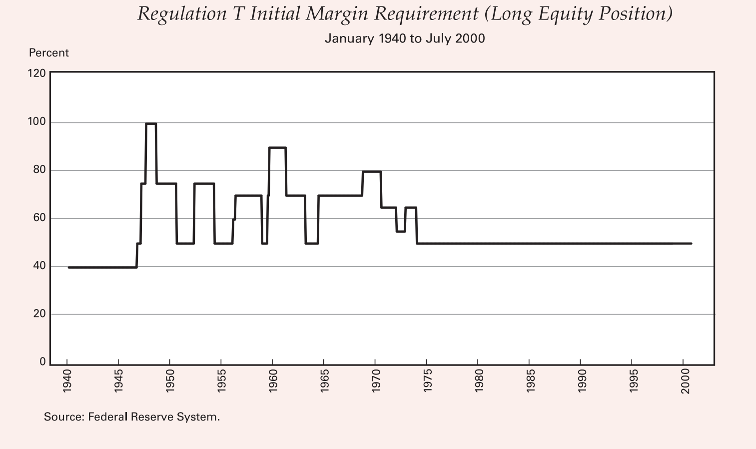
Notable exception: U.S. Regulation T

Securities Exchange Act of 1934 granted the "Fed" the power to set initial margin requirements on national exchanges

Fed pursued active margin policy between 1947 and 1974

U.S. Regulation T

Fortune (2000)



Effects of Regulation T

Empirical literature does not find convincing evidence that higher margin requirements decrease volatility in stock markets

Fortune (2001)

> *The literature evaluating the effects of Regulation T does provide some evidence that margin requirements affect stock price performance, but the evidence is mixed and it is not clear that the statistical significance found translates to an economically significant case for an active margin policy.*

Kupiec (1998)

> *There is no substantial body of scientific evidence that supports the hypothesis that margin requirements can be systematically altered to manage the volatility in stock markets.*

This Paper

Calibrated Lucas asset pricing model with heterogeneous agents and disaster shocks

Collateralized borrowing increases return volatility of long-lived assets

Changes of margin requirements (as under Regulation T) have little effect if other long-lived assets are not regulated

Spillover effects: If margins on one asset are increased, the volatility of other assets decreases

Changes of margin requirements may have strong effects when all markets are regulated

Related Literature (Incomplete)

Impact of collateralized borrowing on returns

Hindy and Huang (1995), Garleanu and Pedersen (2011)

Impact of collateralized borrowing on return volatility

Coen-Pirani (2005), Brunnermeier and Pedersen (2009), Brunnermeier and Sannikov (2011)

Theoretical literature on margin requirments

Chabakauri (2012), Rytchkov (2013)

Outline

Model: Physical Economy

Infinite-horizon exchange economy in discrete time, $t = 0, 1, 2, \ldots$

Finite number S of i.i.d. shocks, $s = 1, 2, \ldots, S$

History of shocks $s^t = (s_0, s_1, \ldots, s_t)$, called date-event

Single perishable consumption good

$H = 2$ types of agents, $h = 1, 2$, with Epstein-Zin recursive utility

Agent h receives individual endowment $e^h(s^t)$ at date-event s^t

$A = 2$ long-lived assets ("Lucas trees"), $a = 1, 2$, dividends $d_a(s^t)$, in unit net supply

Aggregate endowments $\bar{e}(s^t) = e^1(s^t) + e^2(s^t) + d_1(s^t) + d_2(s^t)$

Model: Financial Markets

Agent h can buy shares $\theta_a^h(s^t) \geq 0$ of asset a at price $q_a(s^t)$

$J = 2$ short-lived bonds, $j = 1, 2$ also available for trade

Agent h can buy ${\phi_j}^h(s^t)$ of security j at price $p_j(s^t)$

Short position in bond j must be **collateralized** by long position in long-lived asset $a = j$

Borrowing funds by short-selling a bond, $p_j(s^t){\phi_j}^h(s^t) < 0$, requires sufficient long position $q_j(s^t)\theta_j^h(s^t) > 0$

Margin requirement $m_j(s^t)$ imposes lower bound on 'equity' relative to value of collateral

$$m_j(s^t)\left(q_j(s^t)\theta_j^h(s^t)\right) \leq q_j(s^t)\theta_j^h(s^t) + p_j(s^t)\phi_j^h(s^t)$$

Default

Default possible without personal bankruptcy

Agent who defaults incurs no penalty or utility loss

Default whenever debt exceeds current value of collateral

$$-\phi_j^h(s^t) > \theta^h(s^t)\left(q_j(s^{t+1}) + d_j(s_{t+1})\right)$$

Rules for margin requirements sufficiently large so that no default in equilibrium

Margin Requirements

Market-determined (endogenous) margin requirements

Lowest possible margin $m_j(s^t)$ such that no default in subsequent period

$$m_j(s^t) = 1 - \frac{p_j(s^t) \cdot \min_{s_{t+1}} \left\{ q_j(s^{t+1}) + d_j(s_{t+1}) \right\}}{q_j(s^t)}$$

Stochastic version of Kiyotaki and Moore (1997) constraint

$$-\phi_j^h(s^t) \geq \theta^h(s^t) \min_{s_{t+1}} \left\{ q_j(s^{t+1}) + d_j(s_{t+1}) \right\}$$

Regulated (exogenous) margin requirements

Regulating agency (not further modeled) imposes margin restriction $m_j(s^t)$

No collateralized borrowing: $m_j(s^t) = 1$

Exogenous Growth Rate

Aggregate endowments grow at a stochastic rate

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

$S = 6$ exogenous i.i.d. shocks, calibrated to match the distribution of disasters in Barro and Jin (2011)

Table : Growth rates and probabilities of exogenous shocks

Shock s	1	2	3	4	5	6
$g(s)$	0.565	0.717	0.867	0.968	1.028	1.088
$\pi(s)$	0.005	0.005	0.024	0.053	0.859	0.053

Average growth rate of 2%, standard deviation also 2%

Dividends and Endowments

Two long-lived assets with dividends $d_a(s^t) = \delta_a \bar{e}(s^t)$, $a = 1, 2$

Collateralizable income from NIPA: $\delta_1 + \delta_2 = 0.11$

Regulated asset 1 are stock dividends, $\delta_1 = 0.04$

Unregulated asset 2 are interest and rental income, $\delta_2 = 0.07$

Two agents with total endowment $e^1(s^t) + e^2(s^t) = 0.89\bar{e}(s^t)$

Agent h receives fixed share η^h of aggregate endowment as individual endowment, $e^h(s^t) = \eta^h \bar{e}(s^t)$

Small agent 1 with $\eta^1 = 0.089$ (10% of labor endowments)

Large agent 2 with $\eta^2 = 0.801$ (90% of labor endowments)

Dividends and Endowments

Two long-lived assets with dividends $d_a(s^t) = \delta_a \bar{e}(s^t)$, $a = 1, 2$

Collateralizable income from NIPA: $\delta_1 + \delta_2 = 0.11$

Regulated asset 1 are stock dividends, $\delta_1 = 0.04$

Unregulated asset 2 are interest and rental income, $\delta_2 = 0.07$

Two agents with total endowment $e^1(s^t) + e^2(s^t) = 0.89\bar{e}(s^t)$

Agent h receives fixed share η^h of aggregate endowment as individual endowment, $e^h(s^t) = \eta^h \bar{e}(s^t)$

Small agent 1 with $\eta^1 = 0.089$ (10% of labor endowments)

Large agent 2 with $\eta^2 = 0.801$ (90% of labor endowments)

Utility Parameters

Agents have identical IES of 2

Small agent 1 has low risk aversion of 0.5

Large agent 2 has high risk aversion of 7

Discount factor $\beta^h = 0.942$ calibrated to match annual risk-free rate of 1% with a regulated margin of 60%

Collateral Constraints Increase Volatility

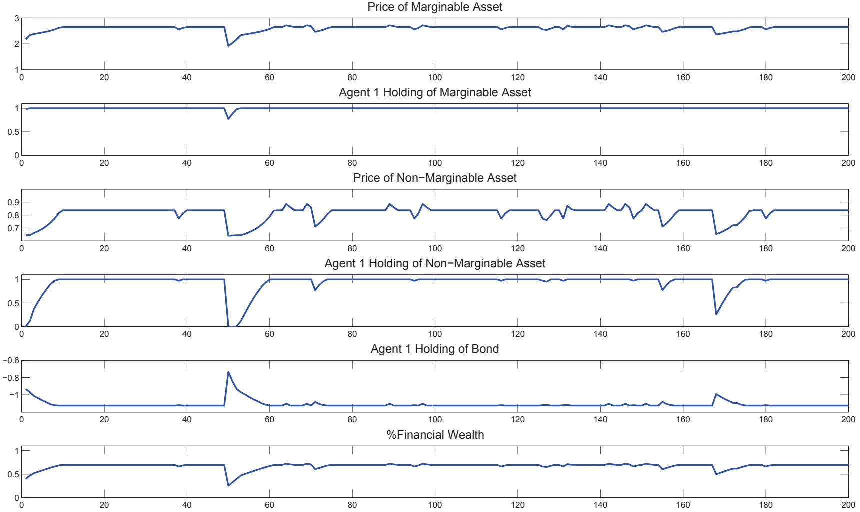
Margin requirement on first asset $m_j(s^t) \equiv 1$, so this asset is non-marginable

Aggregated STD of long-lived asset returns: 7.4% (with natural borrowing limits: 5.3%)

Aggregated excess return: 5.0% (with natural borrowing limits: 0.2%)

Table : Asset returns with marginable and non-marginable asset

Asset	STD	ER
Non-marginable ($\delta_1 = 0.04$)	8.5	6.8
Marginable ($\delta_2 = 0.07$)	7.1	4.4


Price of Marginable Asset
Agent 1 Holding of Marginable Asset
Price of Non−Marginable Asset
Agent 1 Holding of Non−Marginable Asset
Agent 1 Holding of Bond
%Financial Wealth

Basic Mechanism

In ‘normal’ times, small low RA agent 1 holds both risky assets and is highly leveraged

A bad growth shock reduces wealth of agent 1; she must sell a portion of the risky assets

Agent 1 sells first the non-marginable asset; only if her position in that asset is zero, she begins selling the marginable asset

Only the large high RA agent 2 can buy a risky asset; for that the (normalized) price must drop significantly

As a result, the non-marginable asset exhibits both larger trading volume and higher price volatility

Regulating the Stock Market

Regulation T had small (if any) quantitative impact on stock market volatility (Kupiec 1998, Fortune 2001)

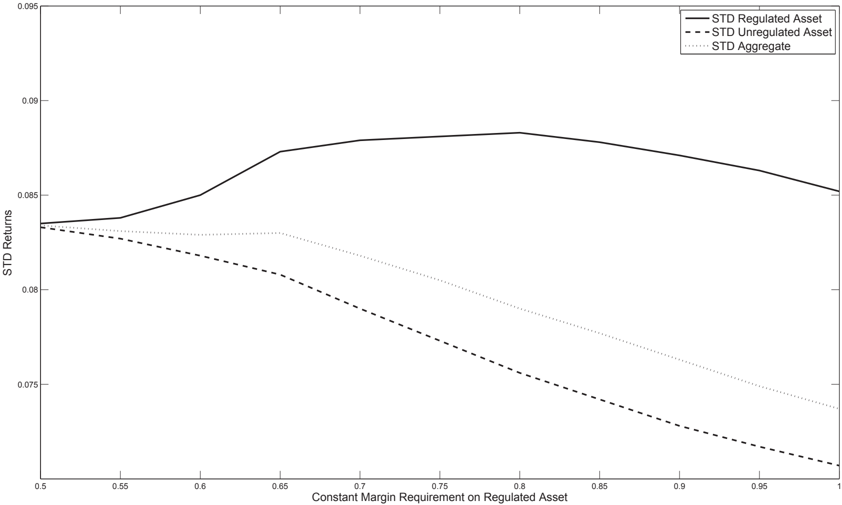
Regulation of "stock market" in our model

- Asset 1 regulated with constant $m_1(s^t)$
- Asset 2 unregulated (endogenous margins)

How does asset return volatility react to changes in m_1?

Not much!

Return Volatility as a Function of m_1



Two Offsetting Effects

As margin requirement m_1 increases

- Regulated asset 1 becomes less attractive as collateral
- Agents' ability to leverage decreases

Both effects influence the small low RA agent 1 after a bad shock

- She sells regulated asset 1 sooner the higher m_1
- She has a reduced ability to leverage

State-dependent Regulation

Committee on the Global Financial System (CGFS)

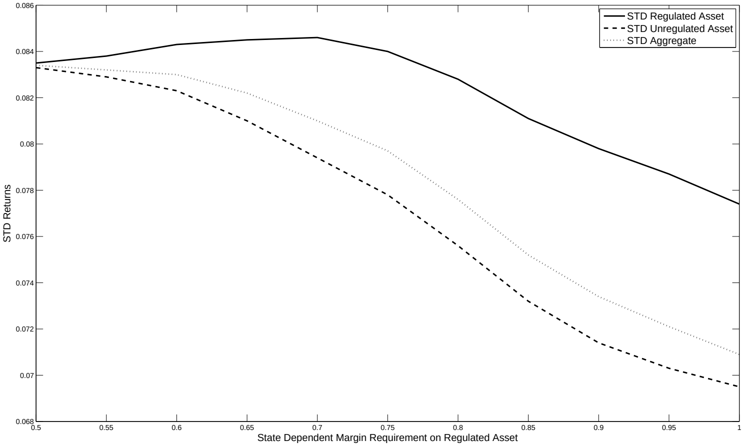
> *. . . a countercyclical add-on to the supervisory haircuts should be used by macroprudential authorities as a discretionary tool to regulate the supply of secured funding, whenever this is deemed necessary.*

Quantitative effects of countercyclical dimension of margin regulation unknown

State-dependent regulation in our model

- Low margin $m_1(s^t) = 0.5$ in bad states and recession
- Higher margin $m_1(s^t) = 0.5$ in good states
- Asset 2 remains unregulated (endogenous margins)

Return Volatility with State-dependent $m_1(s^t)$



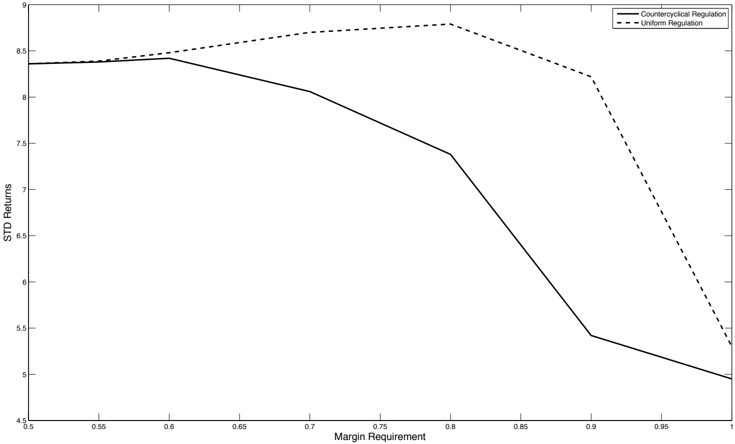
Regulation in All Markets

Change of margin requirements for asset 1 has small impact on its return volatility

Agents have the opportunity to leverage against a large and unregulated second asset

Final exercise in our model: Regulation of both assets

Regulation of Both Assets



Conclusion

Changes of margin requirements (as under Regulation T) have little effect if other long-lived assets are not regulated

Spillover effects: If margins on one asset are increased, the volatility of other assets decreases

Changes of margin requirements may have strong effects when all markets are regulated