Diversity and the financial system

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Diversity in the financial system

Diversity: Agents and financial institutions **undertake different activities** and display **heterogenous behavior**

Lack of diversity (**homogeneity**) can arise from several sources:

1. similar risk exposures (asset or liability side)
2. interlinkages
3. common risk management systems
4. similar trading strategies
5. ...

Three Dimensions of Homogeneity

- Similar exposures
- Similar constraints
- Similar evaluation of risk

Diversity in other disciplines

Diversity is a **well established** theme in **other disciplines**...

1. Biology: biodiversity
2. Engineering: safety engineering
3. Information theory
4. Information aggregation

... but relatively ignored in macroeconomics and finance!

Wisdom of the crowds (Surowiecki, 2004)

Galton's observation: A crowd at a fair is asked to estimate the weight of an ox. While each individual guess is fairly inaccurate, the median of the guesses is very close to the real weight (**1197 instead of 1198** pounds). In addition, the median is better than the guess of any expert.

Wisdom of the crowds

Conditions for information aggregation to work:

1. **Diversity.** Each person should have private information even if it's just an eccentric interpretation of the known facts.
2. **Independence**. People's opinions aren't determined by the opinions of those around them.
3. **Decentralization.** People specialize and draw on local knowledge.
4. **Aggregation**. Some mechanism exists for turning private judgments into a collective decision.

Why is diversity important?

Lack of diversity creates financial and macroeconomic risk!

Systemic risk can be broken down into **two dimensions** (*Borio, 2003*): the cross-sectional and the time dimension.

Diversity **lowers systemic risk in the cross-section** because correlated failures arise from similar exposures, interlinkages, contagion.

Diversity also **lowers systemic risk in the time dimension** (procyclicality) because amplification requires that institutions are exposed to the same shocks (*Horvath and Wagner, 2014*).

Is there a need for policy?

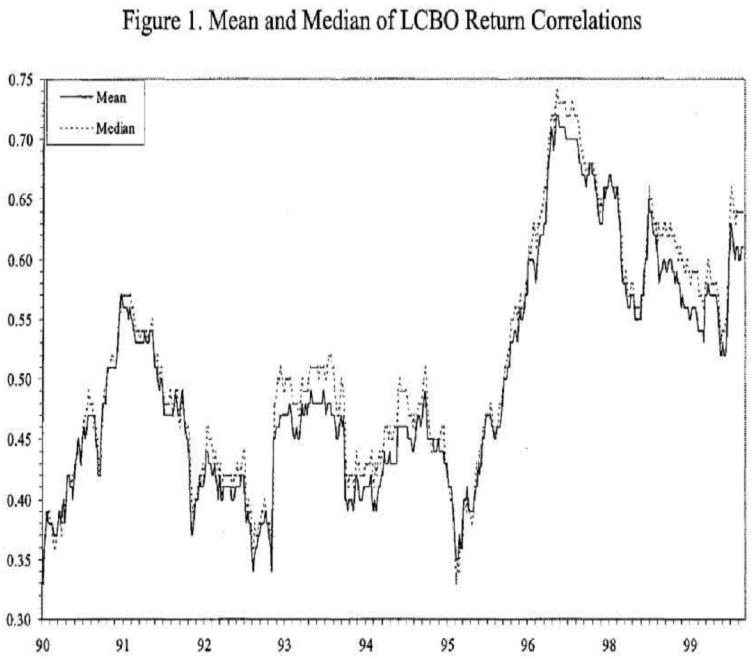
Regulation has to be based on **first principles!**

Homogeneity tends to create **negative externalities**. For example, institutions do not fully internalize higher systemic costs arising from herding (*Acharya and Yorulmazer, 2007*).

An unregulated financial system is hence likely to display **insufficient diversity** from a welfare perspective.

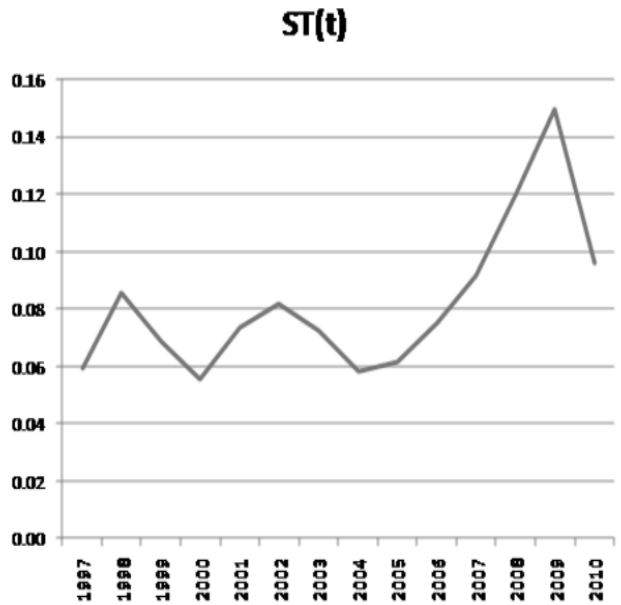
Homogeneity has increased in recent years

Correlation of Equity Returns



Source: De Nicoló and Kwast (2003)

Correlation in Bank Default Prob.



Source: Anginer and Demirgüc-Kunt (2014)

What has caused the fall in heterogeneity?

- institutions have become larger (M&As, cross-border activities)
- institutions are more similar in their activities (globalization, diversification of activities)
- institutions are more interconnected (counterparty risk through derivatives, interbank lending, securitization)
- institutions have increased common exposure on liability side (wholesale financing)
- financial markets have become dominated by institutional investors who are subject to constraints (such as performance evaluation)

How could a diversity policy look like?

Capital requirements based on correlation risk can

1. incentivize banks to take less correlated risks
2. create higher buffers for correlated banks

For example, regulation tied to the **MES** (Acharya et al), **SRISK** (Brownlees et al) or the **CoVAR** (Adrian and Brunnermeier) can achieve this as both measures will increase when a bank is more correlated with other banks.

Three models of diversity

1. A workhorse model of diversity
2. Optimally heterogenous regulation
3. Diversity and procyclicality

A workhorse model

A workhorse model for analyzing diversity

Setup

- There are two banks (1,2) with one unit of funds each
- Bank can spread funds across two regions (X, Y)
- A bank fails if its portfolio return falls below a threshold (d). Failure occurs when

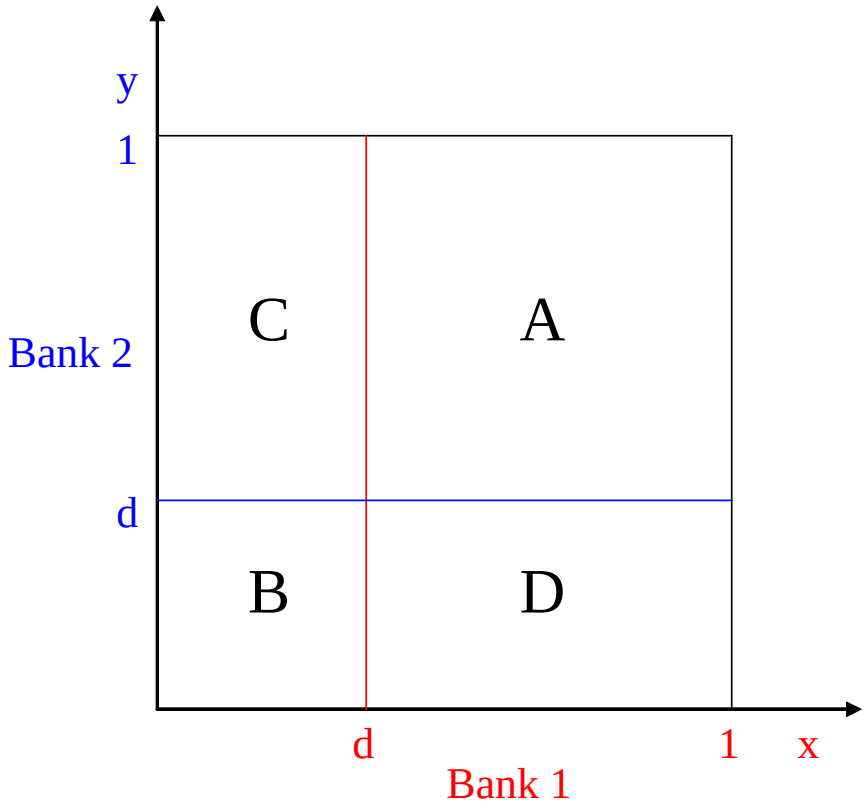
$$\alpha x + (1 - \alpha) y < d,$$

  where α is share in region X
- Joint failures are more costly than individual failures $(c_J > c_I)$

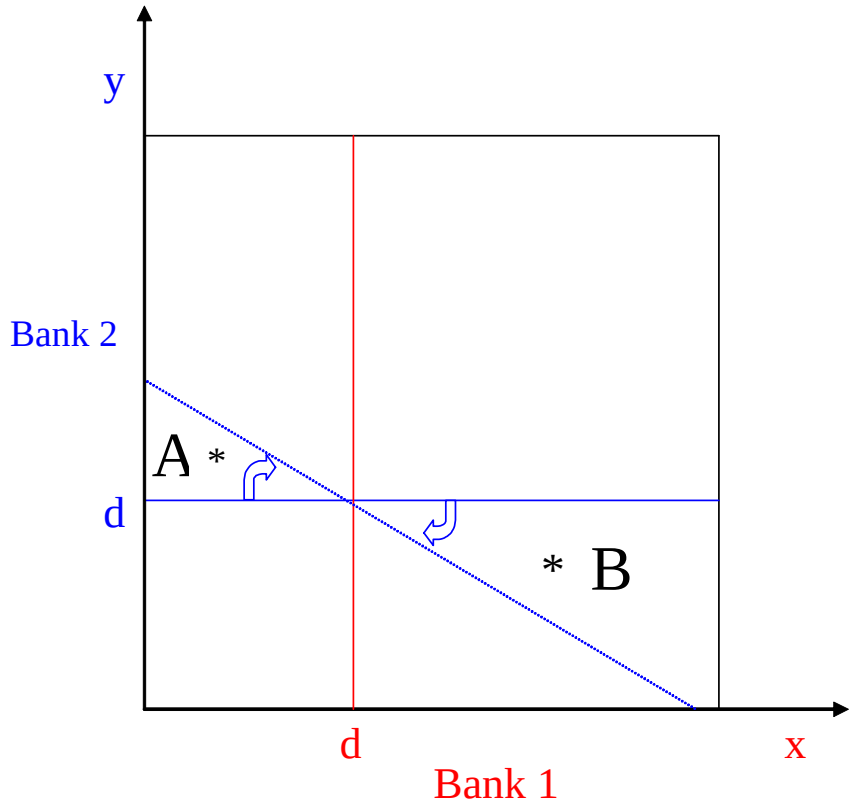
Compare two situations

1. Banks fully specialize in a different region ($\alpha_1 = 0$ and $\alpha_2 = 1$)
2. Bank 2 diversifies ($\alpha_2 < 1$)

A workhorse model for analyzing diversity



The undiversified banking sector



Bank 2 diversifies

A workhorse model for analyzing diversity

There is a **trade-off** between **diversity** and **diversification.** Diversification reduces the expected likelihood of bank failures but increases systemic risk through a **loss of diversity**.

Full diversification is **not (socially) efficient** nor an equilibrium.

Because of an **interbank externality**, the equilibrium level of **diversity is lower than** the **socially optimal** one.

Regulation can **improve** the **utility** of the banks **by increasing diversity**.

Diversity with many agents (Wagner, Journal of Finance 2008)

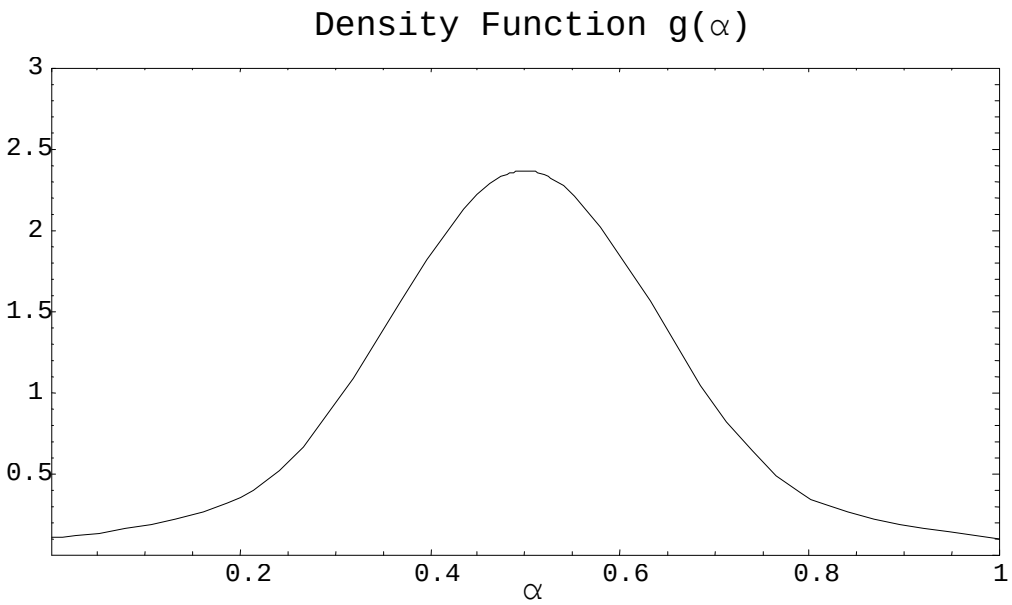
Modification of setup

- consider a **continuum of agents/banks**
- Agents have to liquidate when value of portfolio drops below d
- **Liquidation costs** are an **increasing function of mass of agents (m) liquidating**: $c = c(m)$ with $c(0) = 0$ and $c'(m) > 0$ and (for example, may arise from *cash-in-the-market pricing*)

We solve for the **equilibrium** in the economy.

Diversity with many agents

Mass of investors choosing portfolio α



Diversity with many agents

All portfolio allocations are chosen **by at** least **some agents**.

More diversified portfolios are chosen by more agents. **Diversity trades-off frequency** and **severity** of liquidation.

Heterogenous Regulation

(Malherbe and Wagner, 2014)

Financial regulation and diversity

Because of the negative externality from homogeneity, **regulation should promote diversity**

However, actual regulation may contribute to lower diversity:

1. Best practice in risk management systems (Danielsson, 2009)
2. Centralization of supervisory powers (e.g., Banking Union)
3. Extension of bank-style regulation to other parts of the financial system

Optimally heterogenous regulation

In recent years, we have seen application of bank-style regulation also to other parts of the financial system:

1. investment banks
2. shadow banks
3. insurance companies
4. pension funds

This may be good for **reducing regulatory arbitrage** and making sure there are **no unregulated pockets** in the financial system.

Optimally heterogenous regulation

Malherbe and Wagner (2014) consider optimal regulation in an economy with a **traditional** (eg, commercial banks) and an **innovative sector** (eg, hedge funds, private equity).

Sectors differ because fixed costs and effort are more important in the innovative sector.

Sectors interact in times of crisis (common market for liquidity and assets)

Optimally heterogenous regulation

Results

1. The **optimal level of risk** is set at the level of the **entire system**, not at an individual sector.
2. Heterogenous regulation is optimal. **Traditional sector** acts as **backstop** for **lightly regulated innovative sector**. This allows the latter to specialize in new activities.
3. **Regulatory arbitrage is** part of the **optimal** outcome.

Diversity and Procyclicality

(Horvath and Wagner, 2014)

Motivation

- Two dimensions of systemic risk
  - cross-sectional (due to common exposures or interconnectedness)
  - time dimension (procyclicality)
- Both dimensions are usually analyzed in isolation with consequences for policy formulation

This paper: study interaction among dimensions.

Specific question: how does policy intervention in one dimension of systemic risk affect systemic risk in the other dimension?

Main results

- Key insight from model: counter-cyclical macroprudential regulation can increase systemic risk in the cross-section
- Reason: Countercylical policies insulate banks from sector-wide fluctuations but not against bank-specific shocks $\Rightarrow$ relative cost of being exposed to idiosyncratic risk increases and leads to more systemic risk-taking
- The consequence is that macroprudential policies that improve systemic risk in one dimension (countercyclicality) worsen systemic risk in the other dimension (cross-sectional risk). Ultimately they can even lead to more procyclicality.
- The reverse problem does not arise: policies that reduce cross-sectional risk at the same time lower countercyclicality.

Literature

- Procyclicality
  - Procyclicality may arise from capital (Blum and Hellwig (1995) and others), haircuts and margining practices (CGFS (2010)), loan-loss provisioning (Borio et al. (2001))
  - Can make countercyclical capital requirements (CR) optimal (e.g., Kashyap and Stein (2004), Repullo and Suarez (2012), Malherbe (2013))
- Cross-sectional systemic risk
  - Common exposures on asset or liability side (Rajan (1994), Acharya and Yorulmazer (2007), Wagner (2010), Farhi and Tirole (2012))
  - Banks may correlate "too much", providing rationale for policy

Preview of model

- banks are subject to a moral hazard problem (akin to Holmstrom and Tirole, 1997) that can be addressed by requiring bankers to put capital into the bank
- banker's endowment with capital determined by prior returns on projects
  - if these returns are low it is more costly to put a certain amount of capital in the bank (banker has to give up consumption)
  - this creates scope for capital requirements that depend on state of the economy (project returns)
- systemic costs: if both banks fail, the economy has insufficient funds to undertake a worthwhile project.
- bankers can choose correlation of their projects, choice interacts with capital requirements

The model

- three dates (0,1,2), two bankers (A and B), a consumer and a producer
- bankers are impatient (time preference $\alpha > 1$) which makes (bank) capital costly

Date 0:

- each banker needs 1 unit of funds to start a project
- banker i determines amount of own funds k_0^i, remainder $1 - k_0^i$ comes from consumer through (insured) one-period deposits
- bankers invest in a project
  - banker A can choose between common and alternative project, banker B can only invest in the common project
  - returns on alternative project is uncorrelated to common project at later dates, but is otherwise identical

The model

Date 1:

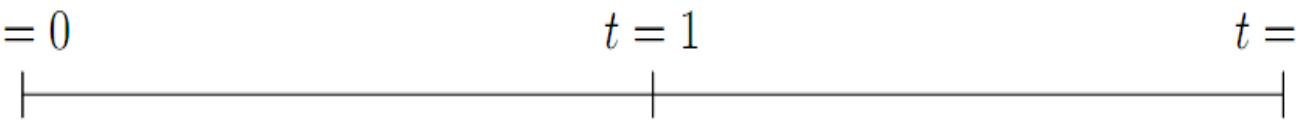
- each bank's project produces an amount of $\widetilde{x}$ (uniformly distributed on $[\underline{x},\overline{x}]$)
- banks have to fulfill a capital requirement k.
  - if $k_0 + x^i \geq k$, banker consumes excess capital $(k_0 + x^i - k)$ and adjusts deposit level to $1 - k$
  - if $k_0 + x^i < k$, banker cannot fulfill capital requirement and bank is closed down
- each banker decides whether to exert effort at private cost $z > 0$

The model

Date 2:

- projects mature
  - with probability p_F a project fails and returns zero
  - no effort: with probability p_H project reaches high state and returns R_H; otherwise it reaches the low state and returns R_L $(R_L < R_H)$
  - effort: shifts probability mass of $\triangle p$ from low to high state
  - note: in equilibrium, bank will default in low state which may produce inefficient effort
- producer: has no endowment but has non-scaleable technology that converts m units into $m + \kappa$ $(\kappa > 0)$ units
  - raises funds from consumer/bankers (surplus from production accrue to producer)
  - parameters in economy are such that there are sufficient funds to operate technology at date 2, unless both banks fail

Timing



Regulator announces $k(x_C)$.
Banker A chooses project.
Bankers learn about x^i
and invest k_0^i in the banks.
Bankers and consumers
consume.

Interim returns x^i realize.
Bankers invest additional $k^i - k_0^i$.
Bankers decide about monitoring.
Bankers and consumers
consume.

Returns R^i realize.
Depositors are repaid.
The producer raises funds.
Production may take place.
All agents consume.

Benchmark: Project choice is observable

Let us first assume that regulator can also determine the project choice. Regulator thus sets capital requirement $k(x_C)$ and decides whether bank A takes the common or the alternative project.

Date 2

- if at least one bank survives, producer can operate technology and captures surplus κ from production

Benchmark: Project choice is observable

Date 1

- At the end of date 1 each banker has to make the effort choice. Critical level of capital for which effort will be exerted is given by

$$\bar{k} := \frac{z}{\triangle p} - (R_H - 1). \tag{1}$$

  For $k < \bar{k}$ banker does not monitor; for $k \geq \bar{k}$ he monitors.

- At the beginning of date 1, a banker has to fulfill capital requirements k by adjusting capital structure. Debt is $d = 1 - k$.

Benchmark: Project choice is observable

Date 0

- Banker (anticipating the realization of x^i) will choose amount of own funds (capital) to put into bank. Given impatience of banker ($\alpha > 1$), banker will only use capital to the extent that it is required to fulfilled requirements at date 1.
  - if $k > x^i$, banker will use amount of equity to just fulfill capital requirement at date 1: $k_0^i = k - x^i$
  - if $k \leq x^i$, banker will use zero equity financing: $k_0^i = 0$

Benchmark: The regulator's problem

- The regulator maximizes welfare W, consisting of the utilities of bank owners, the consumer and the producer.
- Welfare in the correlated and uncorrelated economy is given by

$$W_C(k(x_C)) = 2U_C^{-p}(k) + (1 - p_F)\kappa \tag{2}$$

$$W_U(k(x_C)) = U_C^{-p}(k) + U_U^{-p}(k) + (1 - p_F^2)\kappa. \tag{3}$$

where $U_t^{-p}(k(x_C))$ is the combined utility (for banker, consumer and deposit insurance fund) arising from pay-outs of a bank that is operating a project of type t

Benchmark: Optimal capital requirements

Proposition

The welfare-maximing policy rule (for given correlation) is countercyclical: $\mathrm{Cov}(k^*, x_C) > 0$ *and takes the form:*

$$k^*(x_C) = \begin{cases} \bar{k} & \text{if } x_C \geq \widehat{x}_t^* \\ 0 & \text{otherwise} \end{cases}$$

The reason for countercyclicality: trade-off between benefits from monitoring and cost of capital. If capital at date 1 is sufficiently low ("bad" state in the cycle), the cost of incentivising banks to monitor using capital outweighs the benefits of it.

Benchmark: Optimal capital requirements

Corollary

The optimal degree of countercyclicality is lower in the uncorrelated economy

- Reason: in uncorrelated economy countercyclical CR only lower costs at one bank, hence lower benefits from countercyclicality.

Benchmark: Optimal correlation

- Suppose regulator imposes the same policy rule (characterized by a threshold $\widehat{x} \in (\underline{x}, \overline{x})$) irrespective of the correlation choice
- Then, correlated economy provides higher welfare than an uncorrelated economy if and only if

$$U_C^{-p}(k_{\widehat{x}}(x_C)) - U_U^{-p}(k_{\widehat{x}}(x_C)) > \left(p_F - p_F^2\right)\kappa, \tag{4}$$

- The RHS of (4) is the expected cost of choosing correlated projects arising from higher likelihood of joint failures
- The LHS of (4) represents the gains from correlation. These gains arise because in a correlated economy both banks can profit from countercyclical capital requirements (while in the uncorrelated economy only one bank can benefit)

Benchmark: Optimal correlation

- To see benefits, we can rearrange the LHS to

$$U_C^{-p}(k_{\widehat{x}}(x_C)) - U_U^{-p}(k_{\widehat{x}}(x_C)) = \frac{\alpha^2 - \alpha}{k}\mathrm{Cov}(k_{\widehat{x}}(x_C), x_C). \quad (5)$$

- Expression is strictly positive whenever the policy rule is countercyclical ($\mathrm{Cov}(k_{\widehat{x}}(x_C), x_C) > 0$).
- The reason is that under countercyclical capital requirements common projects have lower costs as such capital requirements tend to be low when capital from common projects is scarce

Benchmark: Optimal correlation

Proposition

There is a critical value $\widehat{p}_F$, such that for $p_F \geq \widehat{p}_F$ uncorrelated investment maximizes welfare, while for $p_F < \widehat{p}_F$ correlated investment is welfare-maximizing.

Reason: cost of correlated investment is increasing in p_F, while benefit is independent of it.

Optimal capital requirements when project choice is unobserveable

Project choice now has to be privately optimal for bank A.

Consider bank A' incentives to choose correlated investment:

- Private benefits from projects are identical to the benefits in the benchmark case ($\frac{\alpha^2-\alpha}{k} Cov(k^*, x_C)$)
- However, bank A does not perceive the cost of correlated investment (higher likelihood of joint bank failure in which case technology cannot be operated at date-2)

Proposition

For a given capital requirement rule, bank A may choose correlated investment even if the uncorrelated investment maximizes welfare.

Optimal capital requirements when project choice is unobserveable

Proposition

Compared to the policy in the benchmark case ($k^*(x_C)$), the optimal policy rule now displays either the same or lower countercyclicality.

Intuition: Countercyclicality increases incentives to choose common project (gain from correlation is $\frac{\alpha^2-\alpha}{k} Cov(k^*, x_C)$). If welfare-maximizing outcome in benchmark case was alternative investment, it may be optimal to lower countercyclicality in order to avoid choice of correlated investment.

Discussion I

Countercyclical policies may increase "procyclicality": Countercyclicality may induce banks to choose correlated investments. Common shocks then have bigger implications (higher variance of interim returns and higher likelihood of joint failure).

Discussion II

An alternative to countercyclical policies are cross-sectional policies. For example, the regulator may tie capital requirements to the CoVAR or MES of a bank (thus banks with higher correlation will have to hold more capital).

Cross-sectional policies are preferred to countercyclical policies. Such policies will both reduce cross-sectional risk but also lower procyclicality as exposure to aggregate state declines. It will reduce need for countercyclical policies.

Discussion III

Mechanism is not confined to capital regulation. The same intuition holds for other types of counter-cyclical policies that are based on aggregate triggers.

Role of credibility

Note: we assumed that the regulator can commit.

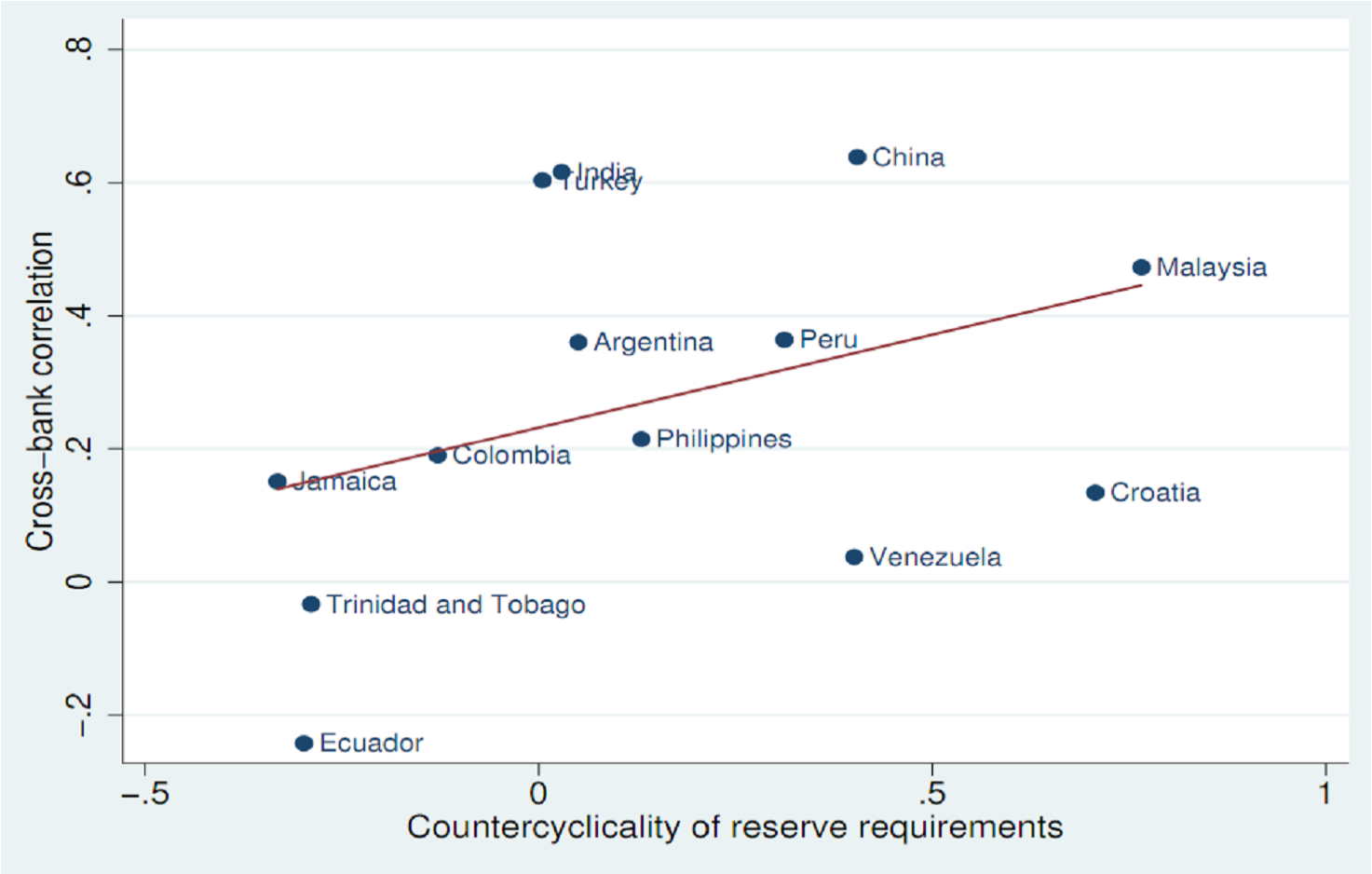
Proposition

If the regulator lacks commitment, the availability of a countercylical policy tool may reduce welfare (compared to situation where regulator can only set fixed capital requirements).

Reason: *ex post* (date 1) it is optimal to provide insurance against common fluctuations (shocks to x_C). Banks anticipate this and will choose correlated investment even if alternative investment is optimal. Availability of countercyclical policy tool may lead to lower welfare.

$\Rightarrow$ This provides a negative message for Basel III which envisages discretionary macro-prudential policies

Countercyclical Reserve Requirements in EM



Summary of Paper

- The two dimensions of systemic risk, procyclicality and cross-sectional risk, are inherently related.
- Policies that address one dimension of systemic risk will also affect the other dimension
- In particular, counter-cyclical bank regulation might increase cross-sectional risk. By contrast, policies that reduce cross-sectional risk reduce procyclicality.

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   - they can reduce risk without increasing the cost of intermediation
   - they can also reduce procyclicality
4. Diversity provides common thread to many aspects of financial policies: regulation of shadow banks, diversity of business models in a banking union, best practice in risk management