Too-connected-to-fail Institutions and Payments System’s Stability: Assessing Challenges for Financial Authorities *

9th Payment and Settlement System Simulation Seminar
Bank of Finland, Helsinki, August 26, 2011

Clara Machado (cmachafr@banrep.gov.co)
Head of Financial Infrastructure Oversight Department (FIOD)

Freddy Cepeda (fcepedlo@banrep.gov.co)
Leader Professional of FIOD
Payments Systems and Banking Operation Division
Banco de la República (Colombia)

* This paper was presented at the Second BIS Consultative Council for the Americas Conference, Ottawa, Canada, May 2011. Co-authors of this were Carlos León and Miguel Sarmiento, Borradores de Economía No. 644 de 2011 - Banco de la República (Colombia).
Agenda

• Lessons from recent developments and their implications for the oversight framework

• Assessing systemic risk within the payments system

• Simulation: Data, results and analysis

• Concluding remarks
Lessons from recent developments

Too-connected-to-fail (TCTF) institutions were key in recent episodes...

Before...

Big banks were considered...
• the most connected.
• the institutions that most concentrated liquidity and payments.
• the main source of systemic risk.
• the only capable of affecting “widows or orphans” (i.e. the public).
• the most regulated and supervised.
• the target of the tools for crisis prevention and management (lender of last resort, deposit insurance).

• Banking systemic risk was the key.
• “Funding liquidity” crisis approach.

Now...

Non-bank institutions (securities and insurance firms, mutual and pension funds, others) are also considered...

• heavily connected.
• hubs of liquidity and payments.
• an important source of systemic risk.
• capable of affecting “widows or orphans” via market prices.
• More (but still insufficiently?) regulated and supervised.

But tools for crisis prevention and management were not designed for these institutions.

• “Connectedness” is as important as size.
• “Market liquidity crisis”.

How did we get here?

Why is this important?
Lessons from recent developments

How did we get here?

- Complexity
- Homogenity
- Opaqueness

Why is this important?

- We live in a robust-yet-fragile and uncertain system
- Liquidity risk management is defective (non-systemic)
- Liquidity facilities may turn insufficient
Lessons from recent developments

... strengthening emphasis on macro-prudential approach is mandatory.

Consequences

Regulation and supervision were too institution-centric to see through to the systemic risk (IMF, 2009)

Micro-prudential approach [...] to systemic risk [...] is insufficient

The connections between components are as important as the components themselves. (León et al., 2011)

[...] preventing failure of an institution is a necessary but not sufficient condition for effective and efficient clearing and settlement where connectedness matters

It is reasonable to put more emphasis on macro-prudential regulation and supervision

From micro to macro-prudential

Micro-prudential approach

Focus: financial institutions

Metrics: financial statements and solvency ratios

Scope: individually analyzing and inspecting financial institutions → default risk

Macro-prudential approach

Focus: financial infrastructures

Metrics: liquidity and connectedness (centrality).

Scope: system-wide perspective on the systemic risk

[...] the use of prudential tools with the explicit objective of promoting the stability of the financial system as a whole, not necessarily of the individual institutions within it. BIS (2010)
Agenda

• Lessons from recent developments and their implications for the oversight framework

• Assessing systemic risk within the payments system

• Simulation: Data, results and analysis

• Concluding remarks
Assessing systemic risk within the payments system

How to identify and assess systemic risk?

<table>
<thead>
<tr>
<th>Scope</th>
<th>TBTF</th>
<th>TCTF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Individually analyzing and inspecting financial institutions → default risk</td>
<td>Aggregately analyzing and inspecting the financial system → systemic risk</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Focus</th>
<th>Financial institutions.</th>
<th>Payment systems and instruments (infrastructure)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Assets, Deposits, Loans.</th>
<th>Centrality, betweenness.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Advantages</th>
<th>TBTF</th>
<th>TCTF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Based on observable accounting data.</td>
<td>• Captures complexity of financial systems.</td>
</tr>
<tr>
<td></td>
<td>• Easy to track.</td>
<td>• Identifies concealed sources of systemic risk.</td>
</tr>
<tr>
<td></td>
<td>• “Easy” to forecast.</td>
<td>• Recognizes the increasing role of non-banking institutions (“shadow banking system”)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disadvantages</th>
<th>TBTF</th>
<th>TCTF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Institution centric.</td>
<td>• Requires models able to capture cross-dependency, context-dependency, non-linearity, complexity.</td>
</tr>
<tr>
<td></td>
<td>• Focus on banking institutions.</td>
<td>• Define connection: claims? payments?</td>
</tr>
<tr>
<td></td>
<td>• Unreliable accounting data.</td>
<td>• Model risk.</td>
</tr>
<tr>
<td></td>
<td>• Unable to capture connectedness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Model risk.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key cases</th>
<th>TBTF</th>
<th>TCTF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Overend Gurney and Co. Ltd. (U.K., 1866)</td>
<td>• Herstatt Bankhaus (GER, 1974)</td>
</tr>
<tr>
<td></td>
<td>• Baring Brothers (U.K., 1890)</td>
<td>• LTCM (U.S., 1987)</td>
</tr>
<tr>
<td></td>
<td>• The Bank of United States (U.S., 1929)</td>
<td>• AIG, Bear Sterns, Lehman, Freddie Mac, Fannie Mae (U.S., 2008)</td>
</tr>
<tr>
<td></td>
<td>• Johnson Matthey Bankers (U.K., 1984)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Continental Illinois (U.S., 1984)</td>
<td></td>
</tr>
</tbody>
</table>
Assessing systemic risk within the payments system

*Centrality*: A key concept from Network Topology

Network Topology allows for identifying central institutions

**[centrality: the importance of the participant in the payments system]**

Simulation techniques allows for assessing the direct and indirect outcomes of “attacks” on central institutions

Node A…
- Maintains direct links with 7 nodes
- Sends payments to 7 nodes
- Receives payments from 4 nodes

If A fails…

Node B…
- Maintains direct links with 3 nodes
- Sends payments to 2 nodes
- Receives payments from 1 node

If B fails…

*Banco de la República Colombia (BR)* approach:

Network Topology + Simulation techniques

* Currently FIOD is working on a measure of substitutability to complement the systemic importance index
Assessing systemic risk within the payments system

Why is centrality a key concept?
Why not using the average financial institution?
Why not making random shocks to the system?

Financial and payments networks nowadays may be described as robust to random disturbances, but highly susceptible to targeted attacks (Haldane, 2009; León et al., 2011).

Systemic importance of financial institutions (i.e. size, connectedness, substitutability) being distributed with a high degree of asymmetry (right skew) and excess kurtosis, makes the average institution of low systemic importance.

As financial authorities should be prepared to confront a non-average but extreme threat to financial stability or payment systems safety, the supervision, oversight and regulation should be designed to cope with one (or even two) systemically important institution(s) failing or near failing.*

(*) As recently suggested by BIS’s Committee on Payment and Settlement Systems (2011)
Assessing systemic risk within the payments system

Banco de la República approach: NT + Simulation Techniques

- Centrality Rank by institution (NT)
- Simulation Techniques

Large-Value Payments System Simulation [Attacking Central Institutions]

- Effect on intraday individual liquidity
- Individual resilience to the attack

Liquidity sources:
- Own portfolios (eligible collateral)
- Central bank facilities

TCTF RELATED SYSTEMIC RISK (LVPS)

- Aggregate resilience to the attack

Liquidity requirements, unsettled transactions

Comprehensiveness of the:
- Individual liquidity responsiveness
- Financial safety net

Financial authorities’ challenges
Agenda

• Lessons from recent developments and their implications for the oversight framework

• Assessing systemic risk within the payments system

• Simulation: procedure, results and analysis

• Concluding remarks
Simulation: procedure, results and analysis

Motivation

An evaluation of liquidity mechanisms of BR required to (World Bank, 2008):
- Identify systemically important entities in the LVPS.
- Quantify the systemic effect generated by entities such as Brokers (BF) and Trusts (MF) on the stability of the LVPS.
- Assess the flexibility of liquidity mechanisms of BR under stress scenarios.

Study Objective

Evaluate the stability of large-value PS of Colombia (CUD) and analyze the PS participants’ capacity to absorb attacks to systemically important institutions (centrality).
Specific objectives

- Identify the LVPS systemically important participants under the too-connected-to-fail approach (TCTF) (Tarashev et al. 2009; Chan-Lau, 2010).

- Characterize and evaluate the performance of LVPS through network topology (NT) and simulation models.

- Identify the entities directly and indirectly affected by an attack, and quantify the magnitude of contagion.

- Ability to absorb attacks by:
  - Liquidating or collateralizing their own portfolio
  - Access to Central Bank liquidity (OMO and LLR)
Simulation: procedure, results and analysis

Methodological approach to systemic risk and the stability of LVSP

Environments → Periods
- TES Boom → Feb - 2006
- TES stress → Jun - 2006
- CUD trading peak → Sep - 2009

Ranking participants
- % Traded value
- % Connectivity

Selecting participants to attack
- 4 entities TCTF

Assumptions
- Evaluation and analysis
- NT + PSM
Simulation: procedure, results and analysis

The periods and the institutions were defined in order to assess the systemic risk and potential threat to the stability of the LVPS and the financial markets.

Selection criteria for analysis periods: liquidity and TES market activity (to capture different volatility and liquidity scenarios for the Colombian financial market)

Estimation of a typical day of transactions in LVPS - CUD

1. Selection of a month of daily transactions in the CUD
2. Estimation of main features of transactions in the period
3. Using bootstrap methods construction of one day that meets the average number of transactions, considering the seasonality of the day

Typical features of one day in MMM-YY

Bootstrap

<table>
<thead>
<tr>
<th>Time</th>
<th>Avg. Traded Value</th>
<th>Intraday Seasonality</th>
<th>Avg. number of Transactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18:00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

01-MMM-YY 02-MMM-YY 03-MMM-YY 04-MMM-YY 31-MMM-YY

08:00 10:00 12:00 14:00 16:00 18:00

08:00 10:00 12:00 14:00 16:00 18:00

Bootstrap

16:12 | Interbolsa → Davivienda | $1bn
12:42 | B.Bogota → AVVillas | $0.4bn
Simulation: procedure, results and analysis

Network Topology (NT)
Some relevant results

Graph

JUN2006

Adjacency matrix
(% of payments value)

Simulation: procedure, results and analysis

Network Topology (NT)
Some relevant results

Graph

JUN2006

Adjacency matrix
(% of payments value)
Simulation: procedure, results and analysis

An overall index was constructed for each period as primary approximation to the notion of systemic risk combining two measures about each institution (i) share of total traded value and (ii) share of total number of connections measures of centrality } TCTF

Ten foremost relevant institutions: TCTF and TBTF
3-period average

OVERALL INDEX
NUMBER OF CONNECTIONS
TRADED VALUE
Simulation: procedure, results and analysis

Network topology allowed for identifying central participants

1. Too-connected commercial banks are systemic relevant institutions (as with micro-prudential approach)

2. Commercial banks are systemic relevant institutions (as with micro-prudential approach)

3. Brokers are systemic relevant institutions (unlike with micro-prudential approach)

4. Too-connected brokers are systemic relevant institutions (unlike with micro-prudential approach)

Arrows: volume of payments
Nodes: asset value
Simulation: procedure, results and analysis

Large-value Payments System CUD simulation model

* The algorithm is developed in Matlab

Fuente: Elaboración de los autores.
## Main Colombian market’s financial institutions directly participating in CUD (2009)

<table>
<thead>
<tr>
<th>Class</th>
<th>Institution type</th>
<th>Main purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Institutions (CI)</td>
<td>Commercial Bank (CB)</td>
<td>Provision of deposit and loans, including mortgages. [18]</td>
</tr>
<tr>
<td></td>
<td>Commercial Financial Corporation (CFC)</td>
<td>Provision of deposit and loans focused on goods and services commercialization (e.g. leasing). [26]</td>
</tr>
<tr>
<td></td>
<td>Financial Corporation (CF)</td>
<td>Provision of deposit and loans focused on medium term industrial financing; akin to an investment bank. [3]</td>
</tr>
<tr>
<td>Non-Credit Institutions (NCI)</td>
<td>Mutual Fund (MF)</td>
<td>Provision of investment vehicles with the purpose of investing in securities and other assets according to the risk profile of the investor. [26]</td>
</tr>
<tr>
<td></td>
<td>Brokerage Firm (BF)</td>
<td>Provision of brokerage services with the purpose of buying and selling securities (e.g. stocks, bonds, currencies); allowed to trade for its own account. [32]</td>
</tr>
<tr>
<td></td>
<td>Pension Fund Manager (PFM)</td>
<td>Provision of investment vehicles with the purpose of investing for retirement. [6]</td>
</tr>
<tr>
<td></td>
<td>Special Official Institution (SOI)</td>
<td>Official (government owned) financial institutions with special objectives; due to its main features, they were excluded from the analysis. [10]</td>
</tr>
</tbody>
</table>

Source: authors’ design.
Simulation: procedure, results and analysis

### Banco de la República liquidity facilities

<table>
<thead>
<tr>
<th>Objective</th>
<th>Scope</th>
<th>Limit</th>
<th>Eligible Collateral</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Macro Liquidity [OMO]</strong></td>
<td>Implementing monetary policy</td>
<td>Linked to reservable liabilities or capital.</td>
<td>Sovereign securities (Central government debt)</td>
<td>1 day</td>
</tr>
<tr>
<td><strong>Payments System Liquidity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intraday Repo</td>
<td>Payments system’s efficiency and safety</td>
<td>OMO agents (not limited by type of institution)</td>
<td>Sovereign securities (Central government debt)</td>
<td>&lt; 1 day</td>
</tr>
<tr>
<td>Overnight Repo</td>
<td>Payments system’s efficiency and safety</td>
<td>OMO agents (not limited by type of institution)</td>
<td>Sovereign securities (Central government debt)</td>
<td>1 day</td>
</tr>
<tr>
<td>Lender of Last Resort [Transitory Liquidity Facility]</td>
<td>Tackling liquidity problems</td>
<td>15% of liabilities with the public</td>
<td>Sovereign securities + financial investment + credit loans</td>
<td>30-180 days</td>
</tr>
</tbody>
</table>

Our concerns regarding central bank’s role within the payments system.

Are the liquidity facilities’…
- Scope
- Limits
- Eligible collateral adequate to cope with systemic shocks?
Simulation: procedure, results and analysis

Simulation techniques allowed for assessing the outcomes of attacks on (i.e. failure of selected) central institutions

On average, Mutual Funds have no liquid portfolio to withstand an attack to a systemic relevant institution

On average, Brokers have insufficient access to OMO liquidity to withstand an attack to a systemic relevant institution

Some pension fund managers have insufficient access to OMO liquidity and portfolio liquidity to withstand an attack to a systemic relevant institution

Banking and credit institutions have enough access to liquidity via OMO and liquid portfolios (+ LLR) to withstand an attack to a systemic relevant institution
Simulation: procedure, results and analysis

### Banco de la República liquidity facilities

<table>
<thead>
<tr>
<th>Objective</th>
<th>Scope</th>
<th>Limit</th>
<th>Eligible Collateral</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Macro Liquidity [OMO]</strong></td>
<td>Implementing monetary policy</td>
<td>OMO agents (not limited by type of institution)</td>
<td>Linked to reservable liabilities or capital.</td>
<td>Sovereign securities (Central government debt)</td>
</tr>
<tr>
<td><strong>Intraday Repo</strong></td>
<td>Payments system’s efficiency and safety</td>
<td>OMO agents (not limited by type of institution)</td>
<td>Linked to reservable liabilities or capital.</td>
<td>Sovereign securities (Central government debt)</td>
</tr>
<tr>
<td><strong>Overnight Repo</strong></td>
<td>Payments system’s efficiency and safety</td>
<td>OMO agents (not limited by type of institution)</td>
<td>Linked to reservable liabilities or capital.</td>
<td>Sovereign securities (Central government debt)</td>
</tr>
<tr>
<td><strong>Lender of Last Resort [Transitory Liquidity Facility]</strong></td>
<td>Tackling liquidity problems</td>
<td>Credit Institutions Only (Banking)</td>
<td>15% of liabilities with the public</td>
<td>Sovereign securities + financial investment + credit loans</td>
</tr>
</tbody>
</table>

**Challenges**

- It is important to revise...
  - OMO limits for Brokers
  - Sufficiency of own eligible portfolio of Brokers and Mutual Funds.
  - Access to additional liquidity facilities by Brokers → TCTF

… in order to be able to supply liquidity to preserve the payments system’s integrity.
Agenda

- Lessons from recent developments and their implications for the oversight framework
- Assessing systemic risk within the payments system
- Simulation: procedure, results and analysis
- Concluding remarks
Concluding remarks

• Recent (subprime crisis) and non-recent (1987 crash, LTCM) episodes of turmoil provide evidence of the deficiency emerging from traditional micro-prudential approaches; a macro-prudential approach to systemic risk (oversight) is necessary.

• To be able to oversee financial systems as a whole it is necessary to acquire a comprehensive vision of the payments system, where connections between participants are as important as the participants themselves.

• Banco de la República, pursuant of its oversight and financial stability duties, established in 2010 the Financial Infrastructure Oversight Department…
Concluding remarks

• First results (Machado et al., 2010 & León et al., 2011) are the mainstay of current regulatory challenges and tasks:
  • Limits on ordinary liquidity facilities for non-banking institutions and prudential requirements on own eligible portfolio for Brokers and Mutual Funds
  • Non-ordinary liquidity facilities for too-connected non-banking institutions (i.e. Brokers)

• Results will provide valuable information for financial stability purposes:
  • Assessing liquidity management by non-banking institutions
  • Supporting the Financial Authorities macro-prudential regulatory and supervisory tasks.
  • Promoting a convenient cooperation between the supervision (by the Financial Superintendence) and the oversight (by the central bank)
Concluding remarks

• Some challenges:

  • User-friendly algorithm for supporting regular oversight duties, including reaction functions to systemic attacks.

  • Simulating transactions taking place in other infrastructures of the payments system (FX settlement, public debt settlement, etc.); not only in the large-value payments system.

  • Analyzing the convenience of direct participation (Colombia) against non-direct participation (U.K.).

  • Ongoing work: a systemic importance index based on 3 criteria: size, connectivity and substitutability (forthcoming Q4-2011)
¡Paljon kiitoksia!

Clara Machado (cmachafr@banrep.gov.co)
Head of Financial Infrastructure Oversight Department (FIOD)

Freddy Cepeda (fcepedlo@banrep.gov.co)
Leader Professional of FIOD
Payments Systems and Banking Operation Division
Banco de la República (Colombia)