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A new look into credit procyclicality: International panel evidence

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* This presentation reflects the views of the authors and not necessarily those of the BIS or of central banks participating in the meeting.

A New Look into Credit Procyclicality: International Panel Evidence

March 2010

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Rochet (2008):

"The subprime crisis is a perfect illustration of the "procyclicality" of financial systems....Financial history abounds with examples of such financial cycles, with an alternation of credit booms fuelled by "exuberant" optimism during growth phases, followed by dramatic episodes of credit "crunches" … ultimately generating major downturns in economic activity".

Agenda

- **Goals and motivation**
- **Literature review**
- **Empirical strategy**
- **Baseline results**
- **Robustness checks**
- **Granger vs. economic causality**
- **Rationalizing the evidence**
- **Conclusions and policy implications**

Goals and Motivation

Goals

Based on a panel of 144 countries over 1990-2007, we tackle two questions on the credit-GDP link in the ***short-run*** (as opposed to the financial deepening and growth literature):

1. **Is credit procyclical?** (in the sense of a significant contemporaneous correlation between private credit growth and GDP growth).

2. **Does private credit growth actually precede GDP growth?** (in a panel Granger sense, using state-of-the-art techniques).

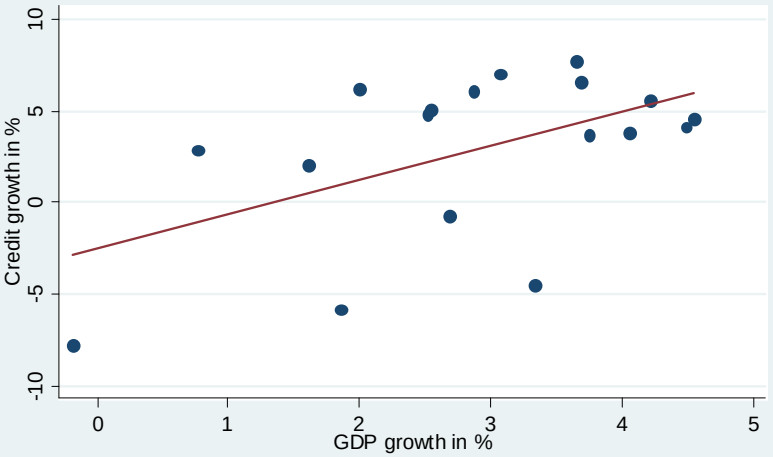
Motivation

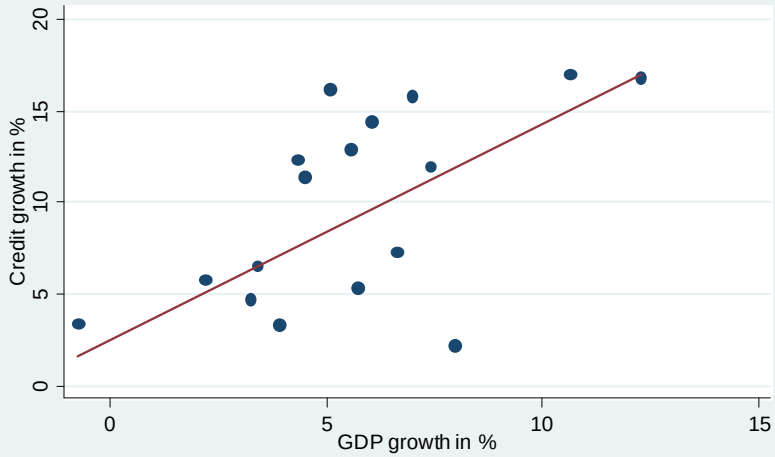
- A mainstream consensus has been built around the procyclicality of credit and a strong impact of credit changes on output changes

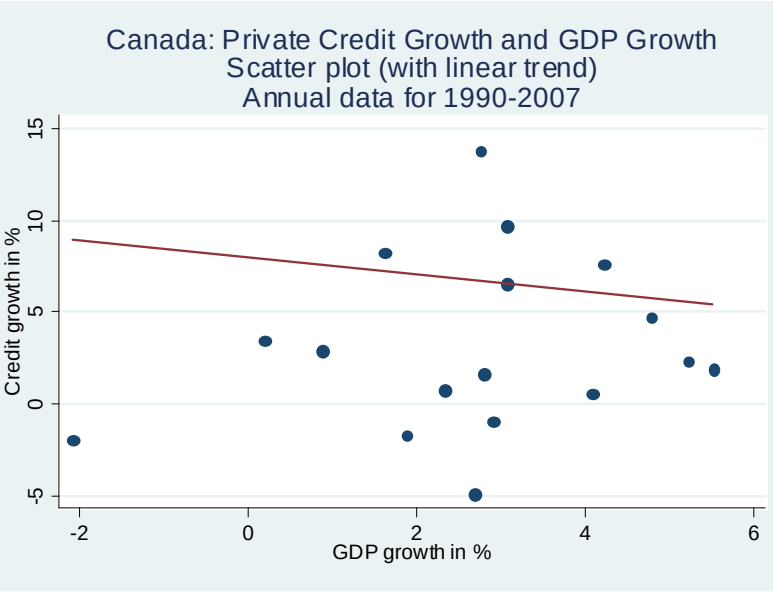
- Credit procyclicality is a major issue in the academic and policy agenda because it affects:

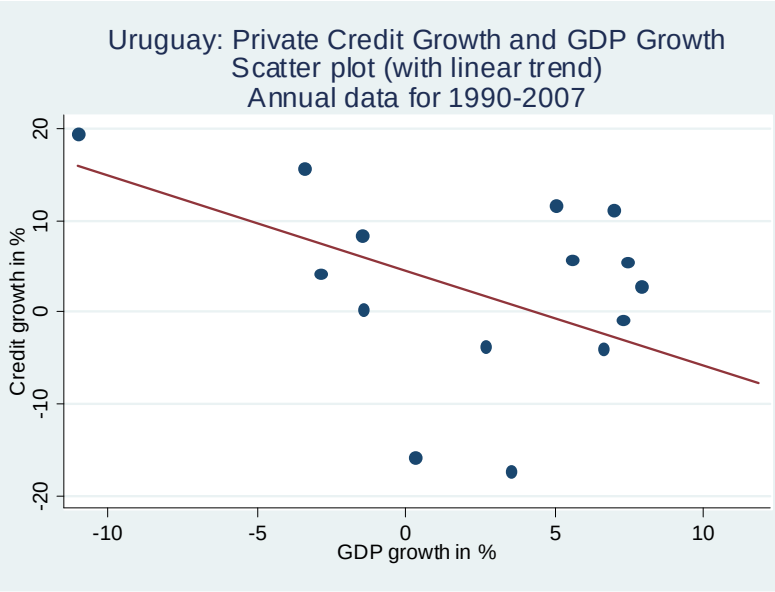
  - *The design of bank capital regulations, including mechanisms to attenuate credit procyclicality (i.e., dynamic provisions)*
  - *The transmission channels from the banking system to the macroeconomy*
  - *The extent of government intervention during financial crises*

At first glance…









What do we find?

- Based on a sample of 144 countries over 1990-2007, we produce the following conventional wisdom-defying results:

1. ***Credit is procyclical in just 45% of countries*** *(annual data)* ***and 23%*** *(quarterly data)*

2. ***Based on the whole sample, Granger causality runs from GDP to credit***

3. ***The only exception is the subset of financially deep countries*** (those above the world mean of credit-to-GDP)

- Results are highly robust to different data frequencies and random country resampling

- After taking into account potential endogeneity, we contend that our findings uncover ***not just mere Granger causality but economic causality***

Literature Review

What does theory say?

Both the theoretical **sign** *and the* **direction of causality** *between credit and business cycles can go either way:*

Question 1: Is credit procyclical?	
Yes	**No**
Good business prospects and (over)confidence stimulates both the demand and the supply of credit ***[financial accelerator theory]***	In good times, firms are able to self-funding their projects, diminishing their demand for credit ***[pecking order theory]***
	Households may apply for credit in bad times so as to smooth consumption ***[permanent income theory]***

What does theory say?

Both the theoretical **sign** *and the* **direction of causality** *between credit and business cycles can go either way:*

Question 2: Does private credit growth precede GDP growth in the short-run or the other way around?	
Credit → GDP	***GDP → Credit***
By a simple flow-of-funds argument, financially constrained units will be able to spend more as more credit is granted	Booming cycles fuel both the **demand** for *(optimism)* and the **supply of credit** *(stronger balance sheets and financial accelerator)*

Previous literature

A handful of applied papers exist dealing with the short-term procyclicality of financial systems. They have in common:

- Published since 2002 onwards
- Quite heterogeneous regarding:
  - –Country and time coverage.
  - –Econometric technique.
  - –Financial variable of interest: private credit, corporate credit, bank profits, non-performing loans.
  - –Which variable is on the LHS and which on RHS.
- However, no comprehensive international evidence was available so far

Some references: Bikker and Hu (2002), Goodhart, Hofmann and Segoviano (2004), Saurina and Jimenez (2006), Greenlaw, Hatzius, Kashyap and Shin (2008), Jeong (2009)

Empirical Strategy

Panel Granger test (1)

- Hurlin (2008) proposes a panel Granger test based on the methodology developed by Im, Pesaran and Shin (2003) (IPS) for panel unit roots test

- ***Granger Non Causality test for panels*** takes into account ***two heterogeneity dimensions***, namely:

  - ***Heterogeneity of the DGP***, associated to the dynamic model specification of each individual.

  - ***Heterogeneity of the causal relationship from X to Y*** arising from the multiple units included in the analysis (a causality relation could be present just for a subgroup of individuals)

Panel Granger test (2)

- For two stationary variables, X and Y, and for N countries, we have the following model:

$$Y_{it} = \alpha_i + \sum_{k=1}^{K} \gamma_i^k Y_{it-k} + \sum_{k=1}^{K} \beta_i^k X_{it-k} + \varepsilon_{it}$$

- ***Under H_0***: Non causal relationship at all

$$H_0 : \beta_i = 0 \quad \forall i = 1,..., N \quad with \ \beta_i = (\beta_i^1,..., \beta_i^K)$$

- ***Under H_1***: Different heterogeneity patterns (in terms of dynamic specification and causality across individual countries)

$$H_1 : \beta_i = 0 \quad \forall i = 1,..., N_1$$

$$\beta_i \neq 0 \quad \forall i = N_1 + 1, N_1 + 2,..., N$$

$0 \leq$ N1/N <1

Panel Granger test (3)

- Under H_1, conclusions depend on the N_1 value.
  - If $N_1=0 \rightarrow$ X Granger cause Y for all individuals in the sample.
  - If $0<N_1<N \rightarrow$ Heterogeneous hypothesis.
- N_1 is unknown and satisfies the condition that $0 \leq N_1/N<1$.
- The test consists on the sample average of the individual Wald statistics of Granger non causality tests for each country, evaluated through a normal distribution (semi-asymptotic convergence).
- We have implemented Hurlin's methodology in Stata (to our knowledge, for the first time).

Baseline Results

Variable definitions and lag structure

***Change in credit*:** Percentage change of real private sector loans
(also robust when using the change in credit-to-GDP ratio)

***Change in GDP*:** Real GDP growth rate

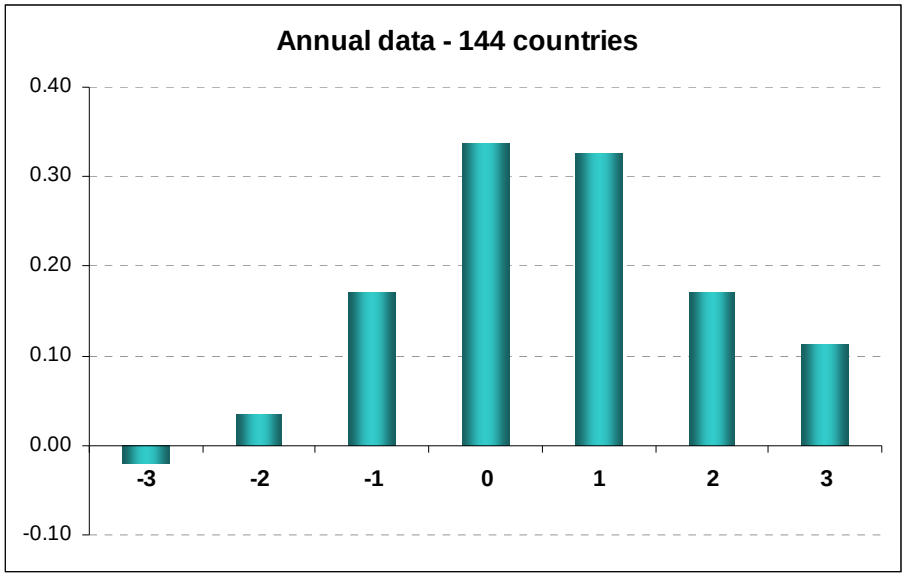
Lags: As many as required to make the residual term a white noise (and thus unrestricted to vary across countries)

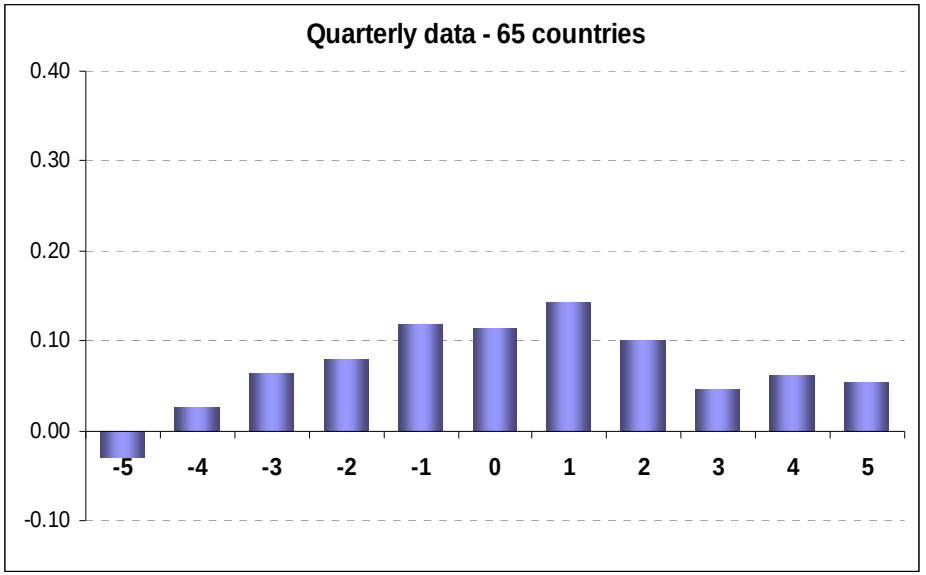
Two time frames (for robustness):

1. ***Annual***
2. ***Quarterly***

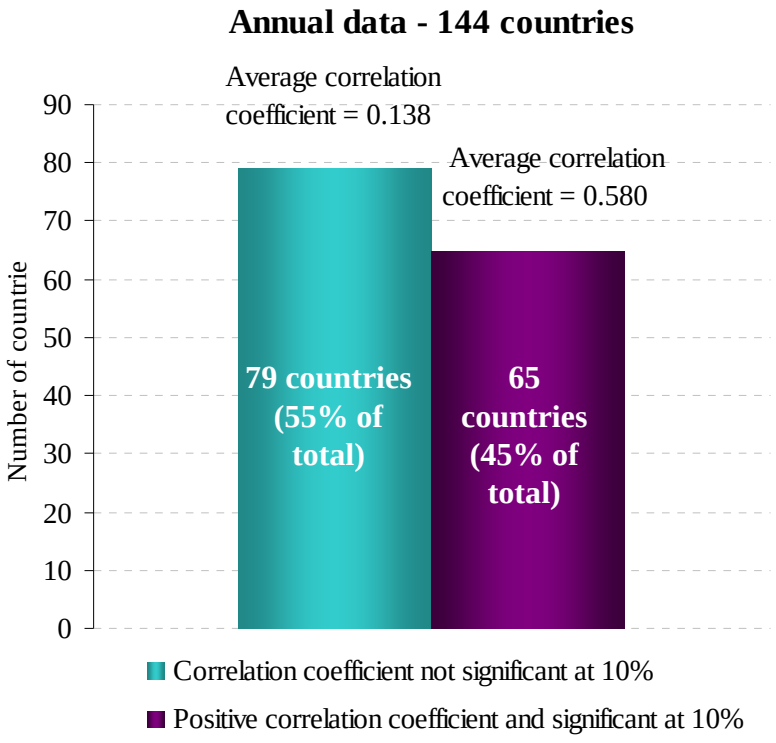
Cross correlation between GDP Growth and Private Credit Growth

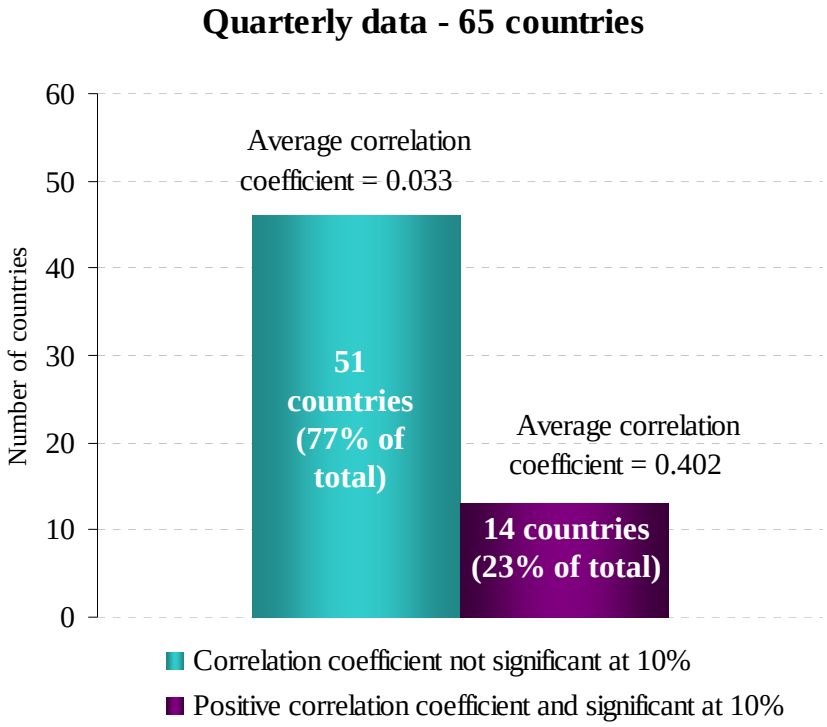
with lags and leads





Contemporaneous correlation between GDP Growth and Private Credit Growth





Panel Granger causality tests between GDP growth and Credit growth

Annual data for 1990-2007 - 144 countries

	H_0: Homogeneous non-causality	p-value
One lag	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.179
No serial correlation (*based on Q statistic*)	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.155
No serial correlation (*based on LM statistic*)	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.133

Recall: Panel Granger test has very high power, especially for large N (as in this study) $\rightarrow$ *reassuring for non-significant effect of credit on GDP growth*

Robustness Checks

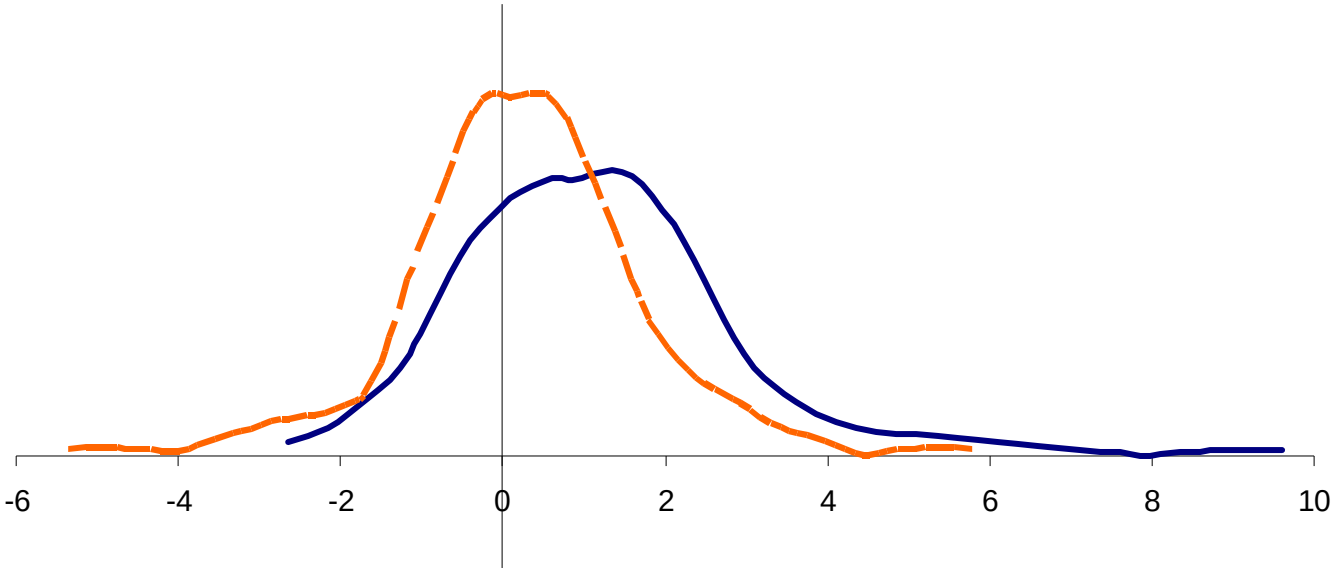
Random country resampling

Panel Granger causality tests
between GDP growth and private credit growth
for 100 random samples of different country size
Total sample of 144 countries with annual data for 1990-2007

Number of countries	H_0: Homogeneous non-causality	% of cases rejecting H_0
20	From GDP growth to real Private Loans growth	88%
	From real Private Loans growth to GDP growth	19%
30	From GDP growth to real Private Loans growth	97%
	From real Private Loans growth to GDP growth	5%
40	From GDP growth to real Private Loans growth	100%
	From real Private Loans growth to GDP growth	10%
50	From GDP growth to real Private Loans growth	100%
	From real Private Loans growth to GDP growth	8%
60	From GDP growth to real Private Loans growth	99%
	From real Private Loans growth to GDP growth	7%

From *panel* to *individual* Granger coefficients

T-statistic Distribution of
Individual Country Granger Equations
Smoothed values using kernel density



$$Y_{it} = \alpha_i + \sum_{k=1}^{K} \gamma_i^k Y_{it-k} + \sum_{k=1}^{K} \beta_i^k X_{it-k} + \varepsilon_{it}$$

Dealing with potential cross-section dependence

Panel Granger causality tests between GDP growth and credit growth
Demeaned Data

Annual data,144 countries, 1990-2007

	H_0: Homogeneous non-causality	p-value
One lag	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.058
No serial correlation (*based on Q statistic*)	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.061
No serial correlation (*based on LM statistic*)	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.058

Panel Granger causality tests between GDP growth and Credit growth

Quarterly data, 65 countries

	H_0: Homogeneous non-causality	p-value
No serial correlation (*based on Q statistic*)	From GDP growth to real Private Loans growth	0.004
	From real Private Loans growth to GDP growth	0.667
No serial correlation (*based on LM statistic*)	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.317

Panel Granger causality tests between GDP and credit

Countries above and below average GDP per capita with annual data for 1990-2007

Developed

	H_0: Homogeneous non-causality	p-value
No serial correlation (*based on Q statistic*)	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.095
No serial correlation (*based on LM statistic*)	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.150

Developing

	H_0: Homogeneous non-causality	p-value
No serial correlation (*based on Q statistic*)	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.292
No serial correlation (*based on LM statistic*)	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.201

Subsamples according to financial development

Panel Granger causality tests between GDP Growth and Credit growth

Countries above and below average Private Credit-to-GDP with annual data for 1990-2007

High financial depth

	H_0: Homogeneous non-causality	p-value
No serial correlation (*based on Q statistic*)	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.011
No serial correlation (*based on LM statistic*)	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.019

Low financial depth

	H_0: Homogeneous non-causality	p-value
No serial correlation (*based on Q statistic*)	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.698
No serial correlation (*based on LM statistic*)	From GDP growth to real Private Loans growth	0.000
	From real Private Loans growth to GDP growth	0.578

Granger causality or economic causality?

Arguments

Question: Granger non-causality from credit to GDP growth implies economic non-causality?

$$y_{i,t} = \delta_1 y_{i,t-1} + \delta_2 x_{i,t} + \delta_3 x_{i,t-1} + \delta_4 z_{i,t} + \varepsilon_{i,y,t}$$
$$x_{i,t} = \delta_5 x_{i,t-1} + \delta_6 y_{i,t} + \delta_7 y_{i,t-1} + \delta_8 z_{i,t} + \varepsilon_{i,x,t}$$

where y and x stand for GDP growth and credit growth, respectively, z is a vector of other variables potentially affecting y and x, and ε are error terms

Granger causality implies economic causality (in the sense of weak exogeneity) if the following conditions are met:

(1) $\varepsilon_{i,y,t}$ and $\varepsilon_{i,x,t}$ are white noise *(true by construction)*

(2) δ_4 and δ_8 are zero *[no omitted variables]*

(3) δ_2 and δ_6 are zero *[no contemporaneous feedback relationship]*

If either (2) or (3) are not met, endogeneity would typically upward bias δ_3 (and δ_7)

→ *If endogeneity is controlled for, the effect of credit growth on GDP growth would be even smaller than it already is!*

Two-step Arellano-Bond with two-way fixed effects (1)

144 countries with annual data for 1990-2007

Explanatory Variables	*Dependent variable*					
	Full Sample		**Low Financial Deepening Subsample**		**High Financial Deepening Subsample**	
	Private credit Growth	GDP Growth	Private credit Growth	GDP Growth	Private credit Growth	GDP Growth
GDP Growth	0.986***		1.150***		0.526***	
	[0.180]		[0.225]		[0.168]	
Lagged GDP Growth	0.660***	0.0662	0.708***	0.065	0.425***	0.103
	[0.123]	[0.0587]	[0.153]	[0.0652]	[0.150]	[0.126]
Private credit Growth		0.0459***		0.039***		0.118***
		[0.0113]		[0.0113]		[0.0194]
Lagged Private credit Growth	0.207***	0.00286	0.211***	-0.003	0.214***	0.0391**
	[0.0434]	[0.00624]	[0.0505]	[0.00662]	[0.0464]	[0.0182]
Observations	2089	2089	1287	1287	802	802
Number of countries	144	144	89	89	55	55
Individual effects	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Financial crisis dummy	Yes	Yes	Yes	Yes	Yes	Yes
Number of instruments	22	22	22	22	22	22
Arellano-Bond test for AR(1)	0.000	0.000	0.000	0.000	0.000	0.000
Arellano-Bond test for AR(2)	0.616	0.686	0.567	0.931	0.886	0.370
Sargan test of overid. Restrictions - Chi^2(2)	0.201	0.509	0.334	0.711	0.515	0.195
Hansen test of overid. restrictions - Chi^2(2)	0.439	0.514	0.488	0.742	0.623	0.337

(1)Standard errors in brackets corrected by Windmeijer finite-sample correction. ***Significant at 1%, **Significant at 5%, *Significant at 10%.

Rationalizing the evidence

Towards an explanation

Why is it that the evidence on credit procyclicality and the credit-to-growth view is so weak and against mainstream stand?

Two possible explanations:

1. ***Credit dependency overestimation:*** On the aggregate, neither firms nor households heavily rely on external funding (see next slide)

2. ***Saliency***: financial crises (when credit and output abruptly drop) easily catches the eye of both experts and the media, but this is not necessarily a good explanation of the dynamics over longer horizons.

According to conventional wisdom…

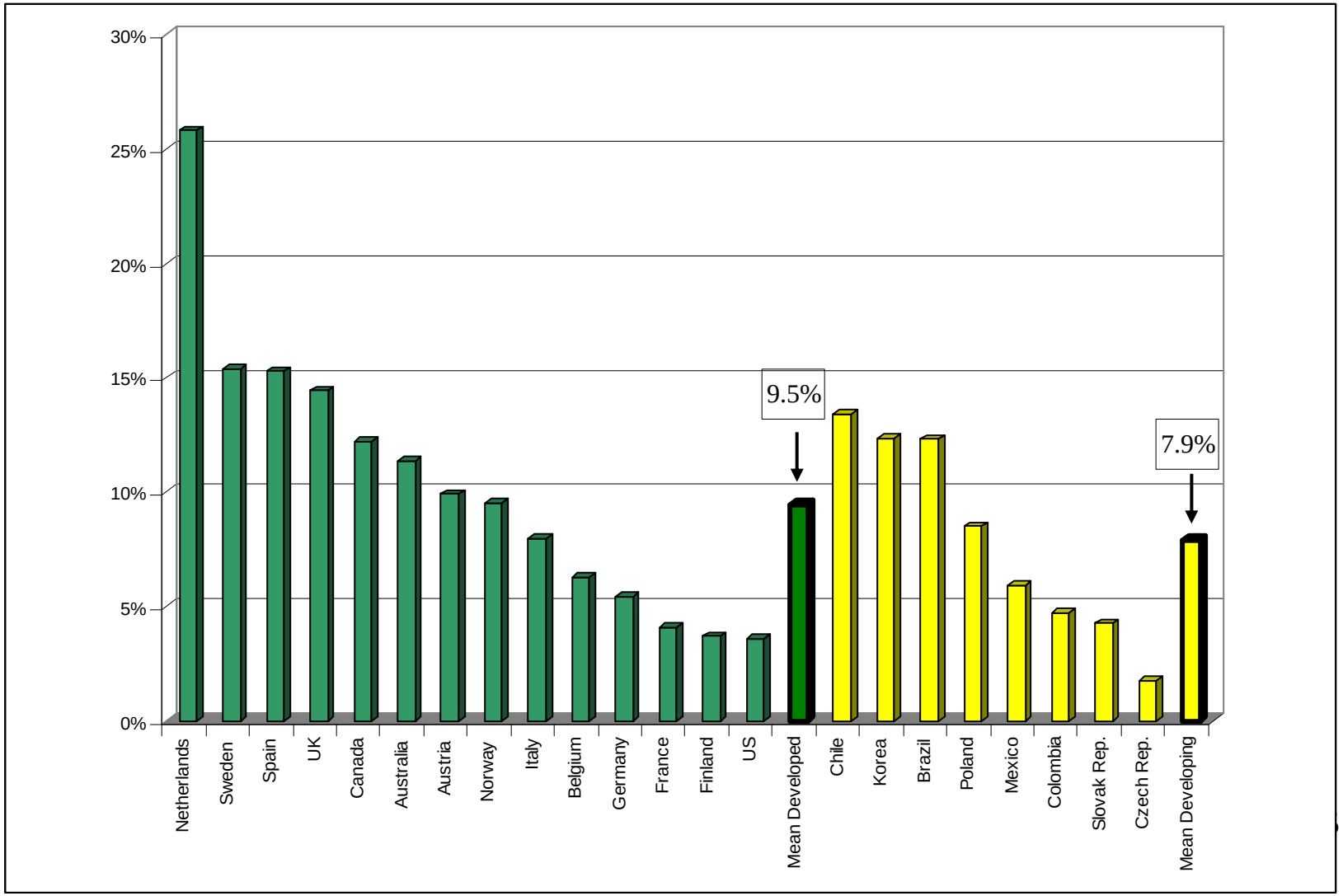
Bernanke (2007):

"To expand and modernize their plants and increase their staffs, most firms must turn to financial markets … Families rely on the financial markets to obtain mortgages or to help finance their children's educations."

In reality credit dependency is low

Ratio of private loan flows to private spending (consumption plus investment) in developed and developing countries

Average value for 1990-2005, in descending order



Conclusions and policy implications

- Based on a sample of 144 countries over 1990-2007, we produce the following conventional wisdom-defying results:

1. ***Credit is procyclical in just 45% of countries*** *(annual data)* ***and 23%*** *(quarterly data)*

2. ***Based on the whole sample, Granger causality runs from GDP to credit***

3. ***The only exception is the subset of financially deep countries*** (those above the world mean of credit-to-GDP)

- Results are highly robust to different data frequencies and random country resampling

- After taking into account potential endogeneity, we contend that our findings uncover ***not just mere Granger causality but economic causality***

Results invite to revisit some core financial notions and policies:

- *The design of bank capital regulations, including mechanisms to attenuate credit procyclicality (i.e., dynamic provisions)*
- *The transmission channels from the banking system to the macroeconomy in the short- and the long-run*
- *The extent of government intervention during a financial crisis*

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