How does the interaction of macroprudential and monetary policies affect cross-border bank lending?

Előd Takáts
Bank for International Settlements

Judit Temesvary
Federal Reserve Board

Monetary Policy, Capital Flows and Globalization
January 3, 2020 – CSWEP @ AEA, San Diego

The views expressed in this presentation are those of the authors and do not necessarily reflect the views of the Board of Governors of the Federal Reserve System or the Bank for International Settlements.
Motivation

- Growing use of macroprudential tools since the financial crisis, which seem to affect cross-border bank lending
  - as they are being implemented (Avdjiev et al, IJCB, 2017) and
  - stabilise lending in stress (Takats and Temesvary, IJCB, 2019)

- Little evidence on how they interact with monetary policy changes; particularly in an international context
  - Policy-relevant to understand this for coordination

- Unique chance to look into this question by combining
  - the BIS IBS cross-border bank lending and
  - the IBRN and the IMF macroprudential databases
Roadmap

1. Identification

2. Overview of results

3. Data
   1. BIS IBS
   2. IBRN and IMF

4. Panel regression

5. Regression results
Identification

- Difficulty: monetary & macroprudential policies intertwined in same country

- Idea: use the currency dimension of the international bank lending channel
  - Monetary policy affects loans denominated in that currency even when the country of the currency is neither the lender nor the borrower, e.g. UK bank lends in USD to Malaysia, (Takats and Temesvary, 2016)

- Interact
  - changes in monetary policy by the currency issuer with macroprudential policy enacted in the source lending banking system,
  - while applying extensive demand-side fixed effects to control for non-monetary/regulatory changes in credit demand in borrowers' countries and changes in credit supply in source lending banking systems
Identification (2)

- We need the currency dimension to be exogenous to source macroprudential policy
  - Exclude “same country” lending
    - E.g. US banks lend “back” to borrowers in the US
  - Exclude “own currency” lending
    - E.g. German banks lend in EUR
    - E.g. US banks lend in USD
Overview of results

- **Conjecture**: Tighter macroprudential policies ensure more stable funding access for banks & enable banks to better buffer monetary tightening-induced effects on cross-border lending flows.

- **Robust finding**: Macroprudential tools in source lending banking systems interact with monetary policy in cross-border bank lending.
  
  - Tighter macroprudential policy mitigates the lending impact of monetary policy (irrespective whether monetary policy tightens or eases); easier macroprudential policy amplifies monetary effect.
  
  - E.g: macroprudential tightening in the UK mitigates the negative impact of US monetary tightening on USD cross-border bank lending outflows from the UK banking system (say, to Malaysia).
Overview of results

| How do monetary and macroprudential policy interactions impact cross-border bank lending? | Monetary easing (in lending currency) | Monetary tightening (in lending currency) | Macroprudential policy impact on monetary policy |
|---|---|---|---|
| Macroprudential easing (in source bank lending system) | **Amplify (positive)**<br>Macropurdential easing strengthens the positive impact of monetary easing | **Amplify (negative)**<br>Macropurdential easing strengthens the negative impact of monetary tightening | **Amplify**<br>Macropurdential easing strengthens the impact of monetary policy |
| Macroprudential tightening (in source bank lending system) | **Mitigate (negative)**<br>Macropurdential tightening weakens the positive impact of monetary tightening | **Mitigate (positive)**<br>Macropurdential tightening weakens the negative impact of monetary tightening | **Mitigate**<br>Macropurdential tightening weakens the impact of monetary policy |
Data

- **BIS IBS Stage 1**
  - Around US$ 30 trillion
  - Available by major currencies: USD, EUR, and JPY (stock and flow)
  - 27 source bank lending system and 50 borrowers’ countries
  - Covers quarterly observations starting from 2012 Q2

- **Macroprudential regulation: no agreed standard on stance**
  - IBRN database
    - Covers quarterly observations over 2000 Q1 - 2014 Q4
    - Cerrutti et al (2015); Correa et al (2016)
  - IMF database
    - Available up until 2016 Q4
Data: Bilateral cross-border bank flows: BIS IBS Stage 1

- Linking lending banking systems with borrowing countries while retaining information on currency composition

|                         | Currency composition (A) | Residence of borrower (B) | Nationality of lending bank (C) |
|-------------------------|--------------------------|----------------------------|--------------------------------|
| Consolidated Data       | No                       | Yes                        | No                             |
| Locational Data         |                          |                            |                                |
| by Residence            | Yes                      | Yes                        | No                             |
| by Nationality          | Yes                      | No                         | Yes                            |
| **Stage 1 data**        | **Yes**                  | **Yes**                    | **Yes**                        |

- Why nationality and not residence of the lender?
  - Example: German bank’s UK subsidiary lending to the US
  - “Same country” lending
Data: IBRN and IMF iMap

| Panel A: IBRN Macroprudential Subcategories |
|--------------------------------------------|
| `sscb_res` | Change in sector specific capital buffer: Real estate credit. Requires banks to finance a larger fraction of these exposures with capital. |
| `sscb_cons` | Change in sector specific capital buffer: Consumer credit. Requires banks to finance a larger fraction of these exposures with capital. |
| `sscb_oth` | Change in sector specific capital buffer: Other sectors. Requires banks to finance a larger fraction of these exposures with capital. |
| `Concrat` | Change in concentration limit. Limits banks' exposures to specific borrowers or sectors. |
| `ibex` | Change in interbank exposure limit. Limits banks exposures to other banks. |
| `ltv_cap` | Change in the loan-to-value ratio cap. Limits on loans to residential borrowers. |
| `rr_foreign` | Change in reserve requirements on foreign currency-denominated accounts. |
| `rr_local` | Change in reserve requirements on local currency-denominated accounts. |

| Panel B: IMF iMapp Macroprudential Subcategories |
|-----------------------------------------------|
| `CCB` | Changes in countercyclical capital buffers based on various private sector credit exposures. |
| `LCG` | Changes in limits and penalties on banks' household-sector and corporate-sector credit growth. |
| `LTV` | Changes in limits to the loan-to-value ratios, including those targeted at housing, automobile and commercial real estate loans. |
| `RR` | Changes in reserve requirements (domestic or foreign currency) for macroprudential purposes. |

Capital requirements: prudential policy, particularly Basel III implementation vs macroprudential policy.
Macroprudential data transformation

- No simple macroprudential policy rate

- Each category shows tightening (+1), unchanged (0) or easing (-1) of macroprudential policies

- Sum these changes across all categories,
  - but maximize this sum at 1 and minimize it at -1
Effective monetary policy rates

Short –term policy and shadow interest rates

In per cent

Figure 1

Target rates

Shadow rates

Sources: Krippner (2016); national data.
Panel regression setup

- **Difference-in-difference regression:**

\[
\Delta \text{claims}_{ijct} = \sum_{k=1}^{4} \lambda_{1k} \Delta \text{macroprudential}_{it-k} \ast \Delta \text{monetary}_{ct-k} + \text{controls} + \epsilon_{ijct}
\]

- **\(\Delta \text{flows}\):** change in bilateral flows (i.e. claims growth adjusted for exchange rate movements) from lending banking system i to country j in currency c
- **\(\Delta \text{macroprudential}\):** change over the previous year (four quarters) in the aggregate macroprudential measure of lending banking system j
- **\(\Delta \text{monetary}\):** change over the previous year (four quarters) in the monetary policy measure of currency c issuer central bank (Krippner shadow rate)
- Two-way clustering of standard errors
Table 2: Main specifications: Source Macroprudential Stringency - IBRN Database; 2012 Q2 - 2014 Q4

| Model | [1] | [2] | [3] | [4] | [5] | [6] |
|-------|-----|-----|-----|-----|-----|-----|
| ΣΔ Source Macropru Stringency {t-1 to t-4} | 9.939 | 10.08 | 5.609 | 5.787 | 6.000 | 6 | ΣΔ Shadow Interest Rate {t-1 to t-4} | -3.319 | -4.342 |
|       | [4.796]** | [5.069]** | [2.782]** | [6.401] | [5.628] |       | [2.25] | [2.304]** |
| ΣΔ Source Macropru Stringency * ΣΔ Shadow Interest Rate {t-1 to t-4} | 9.791 | 10.733 | 6.755 | 10.09 | 10.304 | 6 | ΣΔ Borrower Macropru Stringency {t-1 to t-4} | -1.181 | |
|       | [4.672]** | [5.453]** | [2.310]** | [6.134]** | [5.296] |       | [5.296] | |
| ΣΔ Shadow Interest Rate* ΣΔ Source Macropru Stringency {t-1 to t-4} * ΣΔ Borrower Macropru Stringency {t-1 to t-4} | 0.634 | |
| Constant | 2.854 | 1.792 | 1.579 | 2.64 | 1.765 | -0.735 |
|       | [2.276] | [1.962] | [2.162] | [2.752] | [0.393]** | [1.981] |

Source Macro Controls | Yes | Yes | Yes | Yes | n/p | Yes |
Borrower Macro Controls | Yes | Yes | Yes | n/p | n/p | Yes |
Source Fixed Effects | Yes | Yes | Yes | n/p | n/p | Yes |
Time Fixed Effects | Yes | Yes | Yes | -- | -- | -- |
Borrower Fixed Effects | Yes | Yes | Yes | -- | -- | -- |
Currency Fixed Effects | Yes | Yes | Yes | -- | -- | -- |
Source * Borrower Fixed Effects | No | No | No | No | No | Yes |
Borrower * Time Fixed Effects | No | No | No | Yes | Yes | No |
Source * Time Fixed Effects | No | No | No | Yes | No | No |
Currency * Time Fixed Effects | No | No | No | Yes | Yes | Yes |
R - squared | 0.07 | 0.07 | 0.06 | 0.10 | 0.15 | 0.07 |
Number of Observations | 8,155 | 8,155 | 9,173 | 9,173 | 9,173 | 9,173 |

Economic significance: Difference (in percentage points) in the impact of a 100 basis point change in the short-term shadow interest rate associated with the currency of lending, originating from a source lending system with easing macroprudential rules (at the 1st percentile of the Source Macropru Stringency index) vs a source banking system with tightening macroprudential rules (at the 99th percentile).
Table 3: Main specifications: Source Macroprudential Stringency - IMF iMapp Database; 2012 Q2 - 2014 Q4

| Model                                                                 | [1]          | [2]          | [3]          | [4]          | [5]          | [6]          |
|-----------------------------------------------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| \( \Sigma \Delta \) Source Macropru Stringency \{t-1 to t-4\}         | -3.396       | -2.586       | -13.781      | -15.378      | -33.45       | [12.36]***   |
|                                                                      | [11.43]      | [12]         | [14.752]     | [12.194]     |              |              |
| \( \Sigma \Delta \) Shadow Interest Rate \{t-1 to t-4\}              | -15.51       | -3.104       | [9.757]      | [5.509]      |              |              |
| \( \Sigma \Delta \) Source Macropru Stringency \times \Sigma \Delta \) Shadow Interest Rate \{t-1 to t-4\} | 25.2         | 20.51        | -107.485     | 16.17        |              |              |
|                                                                      | [10.13]**    | [8.481]**    | [69.491]     | [7.896]**    |              |              |
| \( \Sigma \Delta \) Borrower Macropru Stringency \{t-1 to t-4\}      | -14.96       |              | [21.2]       |              |              |              |
| \( \Sigma \Delta \) Shadow Interest Rate \times \Sigma \Delta \) Source Macropru Stringency \times \Sigma \Delta \) Borrower Macropru Stringency \{t-1 to t-4\} | -82.13       |              | [59.71]      |              |              |              |
| Constant                                                              | 4.589        | -7.883       | -6.838       | -7.536       | 1.037        | -2.51        |
|                                                                      | [13.84]      | [17.2]       | [5.693]      | [3.529]      | [2.496]      | [5.854]      |
| Source Macro Controls                                                 | Yes          | Yes          | Yes          | Yes          | n/p          | Yes          |
| Borrower Macro Controls                                              | Yes          | Yes          | Yes          | n/p          | n/p          |              |
| Source Fixed Effects                                                 | Yes          | Yes          | Yes          | Yes          | --           | --           |
| Time Fixed Effects                                                   | Yes          | Yes          | Yes          | --           | --           | --           |
| Borrower Fixed Effects                                               | Yes          | Yes          | Yes          | --           | --           | --           |
| Currency Fixed Effects                                               | Yes          | Yes          | Yes          | --           | --           | --           |
| Source * Borrower Fixed Effects                                      | No           | No           | No           | No           | No           | Yes          |
| Borrower * Time Fixed Effects                                        | No           | No           | No           | Yes          | Yes          | No           |
| Source * Time Fixed Effects                                          | No           | No           | No           | No           | Yes          | No           |
| Currency * Time Fixed Effects                                        | No           | No           | No           | No           | Yes          | Yes          |
| R - squared                                                          | 0.08         | 0.08         | 0.08         | 0.13         | 0.18         | 0.08         |
| Number of Observations                                               | 6,304        | 5,393        | 5,440        | 5,440        | 5,440        | 5,393        |

Economic significance: Difference (in percentage points) in the impact of a 100 basis point change in the short-term shadow interest rate associated with the currency of lending, originating from a source lending system with easing macroprudential rules (at the 1st percentile of the Source Macropru Stringency index) vs a source banking system with tightening macroprudential rules (at the 99th percentile).
Table 4: Main specifications: Source Macroprudential Stringency - IMF iMapp Database; 2012 Q2 - 2016 Q4

| Model                                                                 | [1]    | [2]    | [3]    | [4]    | [5]    | [6]    |
|----------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|
| ΣΔ Source Macropru Stringency {t-1 to t-4}                           | -9.988 | -10.33 | -6.176 | -4.954 | -6.467 |
|                                                                      | [8.763] | [9.463] | [6.692] | [5.879] | [11.12]|
| ΣΔ Shadow Interest Rate {t-1 to t-4}                                 | 1.916  | 2.789  |        |        |        |        |
|                                                                      | [5.736] | [7.066] |        |        |        |        |
| ΣΔ Source Macropru Stringency * ΣΔ Shadow Interest Rate {t-1 to t-4}  | 15.253 | 14.02  | -11.601| 14.72  |        |        |
|                                                                      | [6]*** | [6.10]**| [19.485]|        | [6.694]**|
| ΣΔ Borrower Macropru Stringency {t-1 to t-4}                         | -9.533 |        |        |        |        |        |
|                                                                      | [11.94] |        |        |        |        |        |
| ΣΔ Shadow Interest Rate* ΣΔ Source Macropru Stringency {t-1 to t-4}* ΣΔ Borrower Macropru Stringency {t-1 to t-4} | -28.84 |        |        |        |        |        |
|                                                                      | [29.1]  |        |        |        |        |        |
| Constant                                                             | 11.31  | 9.94   | 12.682 | -2.65  | -3.085 | 6.386  |
|                                                                      | [8.583] | [10.26] | [5.805]**| [1.540]**| [1.903] | [3.092]**|
| Source Macro Controls                                                | Yes    | Yes    | Yes    | Yes    | n/p    | Yes    |
| Borrower Macro Controls                                             | Yes    | Yes    | Yes    | n/p    | n/p    | Yes    |
| Source Fixed Effects                                                | Yes    | Yes    | Yes    | Yes    | --     | --     |
| Time Fixed Effects                                                  | Yes    | Yes    | Yes    | --     | --     | --     |
| Borrower Fixed Effects                                              | Yes    | Yes    | Yes    | --     | --     | --     |
| Currency Fixed Effects                                              | Yes    | Yes    | Yes    | --     | --     | --     |
| Source * Borrower Fixed Effects                                     | No     | No     | No     | No     | No     | Yes    |
| Borrower * Time Fixed Effects                                       | No     | No     | No     | Yes    | Yes    | No     |
| Source * Time Fixed Effects                                         | No     | No     | No     | Yes    | No     | No     |
| Currency * Time Fixed Effects                                       | No     | No     | No     | Yes    | Yes    | Yes    |
| R - squared                                                         | 0.08   | 0.08   | 0.08   | 0.13   | 0.18   | 0.08   |
| Number of Observations                                              | 10,794 | 9,875  | 10,076 | 10,076 | 9,875  | 9,887  |

Economic significance: Difference (in percentage points) in the impact of a 100 basis point change in the short-term shadow interest rate associated with the currency of lending, originating from a source lending system with easing macroprudential rules (at the 1st percentile of the Source Macropru Stringency index) vs a source banking system with tightening macroprudential rules (at the 99th percentile).
Economic significance

- Interaction: non-trivial to interpret magnitude of interaction impact

- We look at impact of
  - 100 basis point monetary tightening over four quarters
  - Moving from 99th to 1st percentile in macroprudential tightness

- Such monetary tightening would reduce cross-border lending outflows from a source banking system that has *eased regulations* by 14-22 percentage points *more* than outflows from a source that has *tightened* regulations (Table 2, Models 3-6)
Conclusion

- Macroprudential tools in source lending banking systems interact with monetary policy when affecting cross-border bank lending
  - Tighter source macroprudential rules substantially mitigate the lending impact of monetary policy
    - E.g. Higher LTV in the UK mitigates the impact of tighter US monetary policy on USD lending outflows from the UK
    - Consistent with macroprudential tools stabilizing funding sources

- This interaction is
  - Relevant for domestic macroprudential & monetary policy authorities
  - Also for potential international policy coordination

- (Interaction with borrowers’ country macroprudential rules insignificant)
Thank you for your comments!

Előd Takáts (elod.takats@bis.org)
Judit Temesvary (judit.temesvary@frb.gov)
### Table 1: Summary Statistics

#### Panel A: IBRN Database 2012 Q2 - 2014 Q4

| Mean | S.D. | Min | p1 | p5 | p25 | p50 | p75 | p95 | p99 | Max | N   |
|------|------|-----|----|----|-----|-----|-----|-----|-----|-----|-----|
| 1.24 | 32.98| -86.88 | -86.88 | -57.61 | -10.80 | -0.03 | 12.49 | 66.54 | 93.51 | 93.51 | 8,155 |

**Dependent variable:**
Total Currency-specific Cross-border Lending Flows

**Regulatory measures:**

| Source              | Mean | S.D. | Min | p1 | p5 | p25 | p50 | p75 | p95 | p99 | Max | N   |
|---------------------|------|------|-----|----|----|-----|-----|-----|-----|-----|-----|-----|
| PruC6 Macropru      | 0.06 | 0.29 | -1  | -1 | 0  | 0   | 0   | 0   | 1   | 1   | 1   | 8,155 |
| Stringency          |      |      |     |    |    |     |     |     |     |     |     |     |
| Source Loan-to-Value Cap | 0.05 | 0.21 | 0   | 0  | 0  | 0   | 0   | 0   | 0   | 1   | 1   | 3,518 |
| Source FX Reserve   | 0.01 | 0.13 | -1  | 0  | 0  | 0   | 0   | 0   | 0   | 1   | 1   | 8,155 |
| Borrower PruC6 Macropru | 0.05 | 0.26 | -1  | 0  | 0  | 0   | 0   | 0   | 0   | 1   | 1   | 8,155 |
| Stringency          |      |      |     |    |    |     |     |     |     |     |     |     |

**Macro controls:**

| Source Policy Interest Rate | Mean | S.D. | Min | p1 | p5 | p25 | p50 | p75 | p95 | p99 | Max | N   |
|-----------------------------|------|------|-----|----|----|-----|-----|-----|-----|-----|-----|-----|
| Source Real GDP Growth      | 1.57 | 1.90 | -5.96 | -2.69 | -1.30 | 0.39 | 1.61 | 2.45 | 5.01 | 7.06 | 7.99 | 8,155 |
| Source - Borrower Exchange Rate | -0.67 | 9.37 | -33.30 | -25.58 | -17.28 | -4.70 | 0   | 3.16 | 13.72 | 26.24 | 67.95 | 8,155 |

#### Panel B: IMF iMapp Database 2012 Q2 - 2014 Q4

| Mean | S.D. | Min | p1 | p5 | p25 | p50 | p75 | p95 | p99 | Max | N   |
|------|------|-----|----|----|-----|-----|-----|-----|-----|-----|-----|
| 1.19 | 49.84| -103.60 | -103.60 | -103.60 | -18.36 | -0.03 | 18.91 | 105.00 | 105.00 | 105.00 | 6,304 |

**Dependent variable:**
Total Currency-specific Cross-border Lending Flows

**Regulatory measures:**

| Source              | Mean | S.D. | Min | p1 | p5 | p25 | p50 | p75 | p95 | p99 | Max | N   |
|---------------------|------|------|-----|----|----|-----|-----|-----|-----|-----|-----|-----|
| PruC6 Macropru      | 0.00 | 0.19 | -1  | -1 | 0  | 0   | 0   | 0   | 0   | 1   | 1   | 6,304 |
| Stringency          |      |      |     |    |    |     |     |     |     |     |     |     |
| Source Loan-to-Value Cap | 0.00 | 0.14 | -1  | 0  | 0  | 0   | 0   | 0   | 0   | 1   | 1   | 6,304 |
| Source FX Reserve   | 0.00 | 0.06 | -1  | 0  | 0  | 0   | 0   | 0   | 0   | 0   | 0   | 6,304 |
| Borrower PruC6 Macropru | 0.02 | 0.20 | -1  | 0  | 0  | 0   | 0   | 0   | 0   | 1   | 1   | 6,304 |
| Stringency          |      |      |     |    |    |     |     |     |     |     |     |     |
| Δ Source Real GDP Growth | 1.97 | 1.73 | -3.59 | -2.02 | -0.91 | 1.11 | 2.05 | 2.71 | 5.08 | 7.06 | 7.99 | 6,304 |
| Δ Source - Borrower Exchange Rate | -0.23 | 10.12 | -33.30 | -25.58 | -17.38 | -4.98 | 0   | 4.22 | 16.35 | 27.57 | 67.95 | 6,304 |

**Macro controls:**

| Source Policy Interest Rate | Mean | S.D. | Min | p1 | p5 | p25 | p50 | p75 | p95 | p99 | Max | N   |
|-----------------------------|------|------|-----|----|----|-----|-----|-----|-----|-----|-----|-----|
| Source Real GDP Growth      | 1.75 | 2.23 | -14.78 | -5.31 | -1.45 | 0.42 | 1.73 | 2.82 | 6.02 | 7.40 | 7.90 | 6,304 |
| Source - Borrower Exchange Rate | -0.23 | 10.12 | -33.30 | -25.58 | -17.38 | -4.98 | 0   | 4.22 | 16.35 | 27.57 | 67.95 | 6,304 |
### Dependent variable:
Total Currency-specific Cross-border Lending Flows

|                      | 0.34 | 49.31 | -103.60 | -103.60 | -103.60 | -18.97 | -0.19 | 18.63 | 105.00 | 105.00 | 105.00 | 10,794 |
|----------------------|------|-------|----------|----------|----------|--------|-------|-------|--------|--------|--------|---------|

### Regulatory measures:

#### Source PruC6 Macropru Stringency
-0.01 0.22 -1 -1 0 0 0 0 0 0 0 9,967

#### Source Loan-to-Value Cap
0.00 0.14 -1 0 0 0 0 0 0 0 0 9,967

#### Source FX Reserve
0.00 0.05 -1 0 0 0 0 0 0 0 0 9,967

#### Borrower PruC6 Macropru Stringency
0.03 0.22 -1 -1 0 0 0 0 0 0 0 9,967

### Macro controls:

#### Δ Source Policy Interest Rate
-0.03 0.37 -1.25 -0.70 -0.38 -0.05 0 0 0.15 1 5.5 10,794

#### Source Real GDP Growth
1.93 1.83 -5.40 -2.89 -0.91 1.06 1.94 2.68 5.32 7.60 8.30 9,954

#### Borrower Real GDP Growth
1.78 2.32 -17.16 -5.40 -1.45 0.57 1.73 2.85 6.15 7.40 7.90 9,891

#### Δ Source - Borrower Exchange Rate
0.65 11.54 -48.30 -26.31 -17.66 -4.98 0 6.09 20.18 38.92 76.08 9,878

---

*Panel C: IMF iMapp Database 2012 Q2 - 2016 Q4*
Table 6: Selected specifications: Source Loan-to-Value Cap Stringency

| Model                                | [1] | [2] | [3] | [4] | [5] | [6] |
|--------------------------------------|-----|-----|-----|-----|-----|-----|
| Database                             | IBRN| IMF iMapp| IMF iMapp| IMF iMapp| IMF iMapp| IMF iMapp| IMF iMapp| IMF iMapp| IMF iMapp| IMF iMapp| IMF iMapp| IMF iMapp| IMF iMapp| IMF iMapp|
| Time period                          | 2012 Q2 - 2014 Q4 | 2012 Q2 - 2014 Q4 | 2012 Q2 - 2014 Q4 | 2012 Q2 - 2014 Q4 | 2012 Q2 - 2016 Q4 | 2012 Q2 - 2016 Q4 |
| ΣΔ Source Loan-to-Value Cap Stringency (t-1 to t-4) | 17.16 | 18.43 | -7.698 | -14 | 0.787 | -1.2 |
|                                      | [6.405]*** | [8.363]** | [11.69] | [9.242] | [18.81] | [19.43] |
| ΣΔ Shadow Interest Rate (t-1 to t-4)  | -1.079 | -22.14 | -1.389 | -1.389 | -1.389 | -1.389 |
|                                      | [5.808] | [4.571]** | [2.15] | [2.15] | [2.15] | [2.15] |
| ΣΔ Source Loan-to-Value Cap Stringency * ΣΔ Shadow Interest Rate (t-1 to t-4) | 15.27 | 16.23 | 49.56 | 44.12 | 33.48 | 21.77 |
|                                      | [8.548]* | [7.533]** | [12.46]** | [15.56]** | [18.88]* | [26.57] |
| Constant                             | 6.506 | -11.51 | -7.055 | -7.923 | 12.33 | 3.509 |
|                                      | [5.567] | [2.629]** | [2.13]** | [2.748]* | [1.227]** | [1.368]** |
| Source Macro Controls                | Yes | Yes | Yes | Yes | Yes | Yes |
| Borrower Macro Controls              | Yes | n/p | Yes | n/p | Yes | n/p |
| Source Fixed Effects                 | Yes | Yes | Yes | Yes | Yes | Yes |
| Time Fixed Effects                   | Yes | -- | Yes | -- | Yes | -- |
| Borrower Fixed Effects               | Yes | -- | Yes | -- | Yes | -- |
| Currency Fixed Effects               | Yes | -- | Yes | -- | Yes | -- |
| Source * Borrower Fixed Effects      | No | No | No | No | No | No |
| Borrower * Time Fixed Effects        | No | No | No | No | No | No |
| Source * Time Fixed Effects          | No | No | No | No | No | No |
| Currency * Time Fixed Effects        | No | Yes | No | Yes | No | Yes |
| R - squared                          | 0.07 | 0.15 | 0.08 | 0.14 | 0.07 | 0.13 |
| Number of Observations               | 3,796 | 3,785 | 5,440 | 5,440 | 10,076 | 10,076 |

Economic significance: Difference (in percentage points) in the impact of a 100 basis point change in the short-term shadow interest rate associated with the currency of lending, originating from a source lending system with easing Loan-to-Value cap rules (at the 1st percentile of the Source Loan-to-Value cap index) vs a source banking system with tightening Loan-to-Value cap rules (at the 99th percentile).
| Model                                                                 | Database | [1]  | [2]  | [3]  | [4]  | [5]  | [6]  |
|----------------------------------------------------------------------|----------|------|------|------|------|------|------|
|                                                                    | IBRN     | IMF iMapp |
| **ΣΔ Source Macropru Stringency {t-1 to t-4}**                      |          | 24.25| 23.62| 23.52| -13.71| -12.19| -36.92|
|                                                                    |          | [7.916]** | [12.86]* | [15.08] | [13.03] | [15.91] | [29.86] |
| **ΣΔ Shadow Interest Rate {t-1 to t-4}**                            |          | 5.686 |      |      | -25.92 |          |        |
|                                                                    |          | [5.854] |          |        | [10.61]** |        |        |
| **ΣΔ Source Macropru Stringency * ΣΔ Shadow Interest Rate {t-1 to t-4}** |          | 24.78 | 26.29 | 26.28 | 31.66 | 34.74 | 7.64 |
|                                                                    |          | [7.782]** | [10.73]** | [10.21]** | [12.76]** | [7.471]** | [9.817] |
| **ΣΔ Borrower Macropru Stringency {t-1 to t-4}**                     |          | -9.557 |      |      |          | -25.15 |        |
|                                                                    |          | [9.157] |          |        | [20.7] |        |        |
| **ΣΔ Shadow Interest Rate* ΣΔ Source Macropru Stringency {t-1 to t-4}* ΣΔ** Borrower Macropru Stringency {t-1 to t-4} |          | 17.53 |      |      |          | 88.11 |        |
|                                                                    |          | [45.67] |          |        | [54.88] |        |        |
| Constant                                                            |          | 3.23  | 0.859 | 0.504 | -7.004 | -2.291 | -5.423|
|                                                                    |          | [4.571] | [9.275] | [5.175] | [9.666] | [4.015] | [9.676] |
| Source Macro Controls                                                | Yes      | Yes  | Yes  | Yes  | Yes  | Yes  | Yes  |
| Borrower Macro Controls                                             | Yes      | n/p  | Yes  | n/p  | Yes  | Yes  | Yes  |
| Source Fixed Effects                                                | Yes      | Yes  |      |      | Yes  |      |      |
| Time Fixed Effects                                                  | Yes      | --   | --   | --   | Yes  |      |      |
| Borrower Fixed Effects                                              | Yes      | --   | --   | --   |      | Yes  |      |
| Currency Fixed Effects                                              | Yes      | --   | --   | --   |      |      | Yes  |
| Source * Borrower Fixed Effects                                     | No       | No   | Yes  | No   | Yes  | No   | Yes  |
| Borrower * Time Fixed Effects                                       | No       | Yes  | No   |      | Yes  | No   |      |
| Source * Time Fixed Effects                                         | No       | No   | No   | No   | No   | No   |      |
| Currency * Time Fixed Effects                                       | No       | Yes  | Yes  | Yes  | No   | Yes  |      |
| R - squared                                                         | 0.11     | 0.18 | 0.11 | 0.10 | 0.19 | 0.12 |        |
| Number of Observations                                              | 2,787    | 2,784| 2,787| 2,787| 2,784| 2,787|        |

Economic significance: Difference (in percentage points) in the impact of a 100 basis point change in the short-term shadow interest rate associated with the currency of lending, originating from a source lending system with easing source macroprudential stringency (at the 1st percentile of the Source Macropru Stringency) vs a source banking system with tightening macroprudential rules (at the 99th percentile).
Table 5: Selected specifications: Borrower Macroprudential Stringency

| Model          | [1] | [2] | [3] | [4] | [5] | [6] |
|---------------|-----|-----|-----|-----|-----|-----|
| **Database**  | IBRN | IMF iMap | IMF iMap | IMF iMap | IMF iMap | IMF iMap |
| **Time period** | 2012 Q2 - 2014 Q4 | 2012 Q2 - 2014 Q4 | 2012 Q2 - 2014 Q4 | 2012 Q2 - 2016 Q4 | 2012 Q2 - 2016 Q4 |
| **ΣΔ Borrower Macropru Stringency {t-1 to t-4}** | -0.019 | -0.578 | -15.05 | -15.17 | -11.07 | -10.42 |
|               | [2.914] | [5.000] | [14.05] | [13.36] | [11.43] | [11.93] |
| **ΣΔ Shadow Interest Rate {t-1 to t-4}** | -3.692 | -6.466 | -8.77 | 2.145 |
|               | [2.610] | [4.315] | [3.567] | |
| **ΣΔ Borrower Macropru Stringency * ΣΔ Shadow Interest Rate {t-1 to t-4}** | 8.326 | 9.788 | -8.77 | 2.145 |
|               | [4.513] | [6.042] | [14.51] | [14.80] | [12.30] | [10.67] |
| **Constant**  | 0.21 | 0.788 | -7.372 | -2.893 | 11.26 | 5.33 |
|               | [2.386] | [0.964] | [3.660] | [1.804] | |
| **Source Macro Controls** | Yes | n/p | Yes | n/p | Yes | n/p |
| **Borrower Macro Controls** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Source Fixed Effects** | Yes | -- | Yes | -- | Yes | -- |
| **Time Fixed Effects** | Yes | -- | Yes | -- | Yes | -- |
| **Borrower Fixed Effects** | Yes | Yes | No | Yes | No | Yes |
| **Currency Fixed Effects** | Yes | -- | Yes | -- | Yes | -- |
| **Source * Borrower Fixed Effects** | No | No | No | No | No | Yes |
| **Borrower * Time Fixed Effects** | No | No | No | No | No | No |
| **Source * Time Fixed Effects** | No | Yes | No | Yes | No | Yes |
| **Currency * Time Fixed Effects** | No | Yes | No | Yes | No | Yes |
| **R - squared** | 0.06 | 0.12 | 0.08 | 0.12 | 0.08 | 0.12 |
| **Number of Observations** | 9,173 | 9,173 | 5,440 | 5,440 | 10,076 | 10,089 |

Economic significance: Difference (in percentage points) in the impact of a 100 basis point change in the short-term shadow interest rate associated with the currency of lending, to borrowers in a Borrower country with easing macroprudential rules (at the 1st percentile of the Borrower Macropru Stringency index) vs a Borrower country with tightening macroprudential rules (at the 99th percentile).

|          | [1] | [2] | [3] | [4] | [5] | [6] |
|----------|-----|-----|-----|-----|-----|-----|
|          | 24.98 | 29.36 | -17.54 | -19.86 | 8.719 | 10.61 |
|          | [13.54] | [18.13] | [29.02] | [29.60] | [24.59] | [21.33] |