Digging Deeper – Evidence on the Effects of Macroprudential Policies from a New Database

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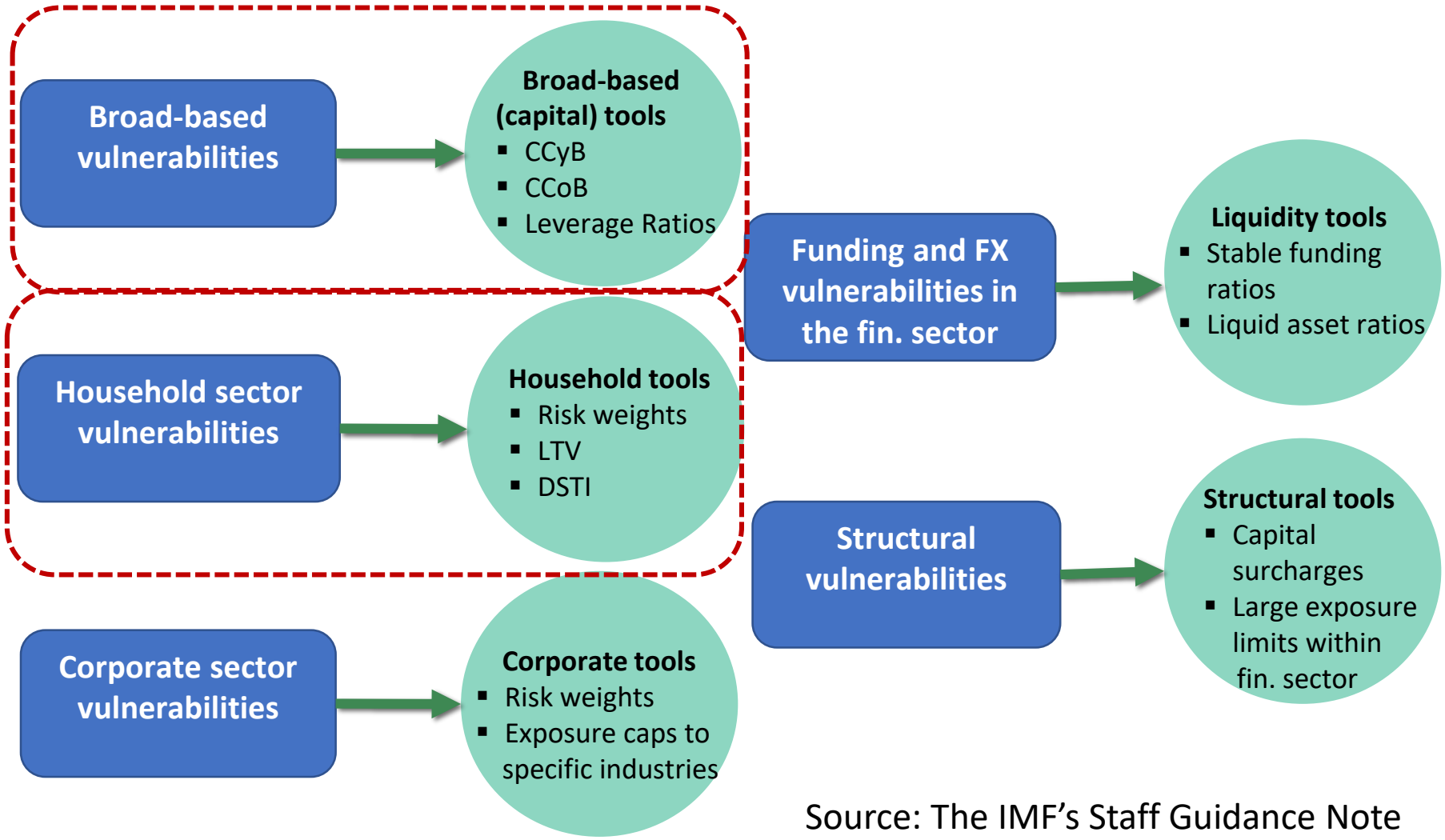
Definition and rationale

- **Macroprudential policy is the use of primarily prudential tools to limit systemic risk (IMF, 2013).**
  - the risk of disruptions to the provision of financial services that is caused by an impairment of all or parts of the financial system, and can cause serious negative consequences for the real economy (IMF, FSB and BIS, 2009).
  - By mitigating systemic risks, macroprudential policy aims ultimately to reduce the frequency and severity of financial crises.

Three intermediate objectives

- **Macroprudential policy pursues three interlocking intermediate objectives (IMF, 2013).**
  - Increase the resilience of the financial system to aggregate shocks
    - by building buffers that help maintain the ability of the financial system to provide credit to the economy under adverse conditions.
  - Contain the build-up of systemic vulnerabilities over time
    - by reducing procyclical feedback between asset prices and credit, and containing unsustainable increases in leverage and volatile funding.
  - Control structural vulnerabilities within the financial system
    - by managing risks from interlinkages that can render individual institutions "too important to fail."

Mapping Assessment to Policy Tools



Source: The IMF's Staff Guidance Note

What do we know about policy effects?

- **Significant effects on credit and house price growth**
  - Effects vary across instruments
- **Modest side effects on macro economy**
  - Negative effects on real GDP
- **Cross-boarder spillover effects**
  - Increased cross-boarder lending when domestic macropru is tightened
- **Some evidence on …**
  - Resilience of the financial system (e.g., probability of default)
  - Probability of a crisis

Reference: IMF-FSB-BIS (2016), Galati and Moessner (2018), Alam et al. (2019)

Loan-targeted instruments contains credit and house price growth

- **Considerable evidence on effectiveness for loan-to-value (LTV) and debt-service-to-income (DSTI) limits**
  - Numerous studies, including Lim et al. 2011, Kuttner and Shim 2016, Akinci and Olmstead-Rumsey 2017, Cerutti et al. 2017
- **Some evidence for other loan-targeted measures**
  - **Loan-loss provisioning** (e.g., Jimenez et al. 2017, Kuttner and Shim 2016, Akinci and Olmstead-Rumsey 2017)
  - **Limits on credit growth and FX loans** (e.g., Lim et al. 2011)
- **Mixed results for capital requirements**
  - They often intend to strengthen the resilience of the financial system
  - Effects differs across countries (e.g., Crowe et al. 2013, IMF 2014, Vandenbussche et al. 2015, and Akinci and Olmstead-Rumsey 2017)

Challenges in the literature

- Fragmented evidence
  - Different coverages/definitions
- Most results are qualitative rather than quantitative
  - Dummy-type policy action indicators
- Endogeneity concerns
  - Typical "timing assumption" (Appendix 1)

→ We tackle these challenges

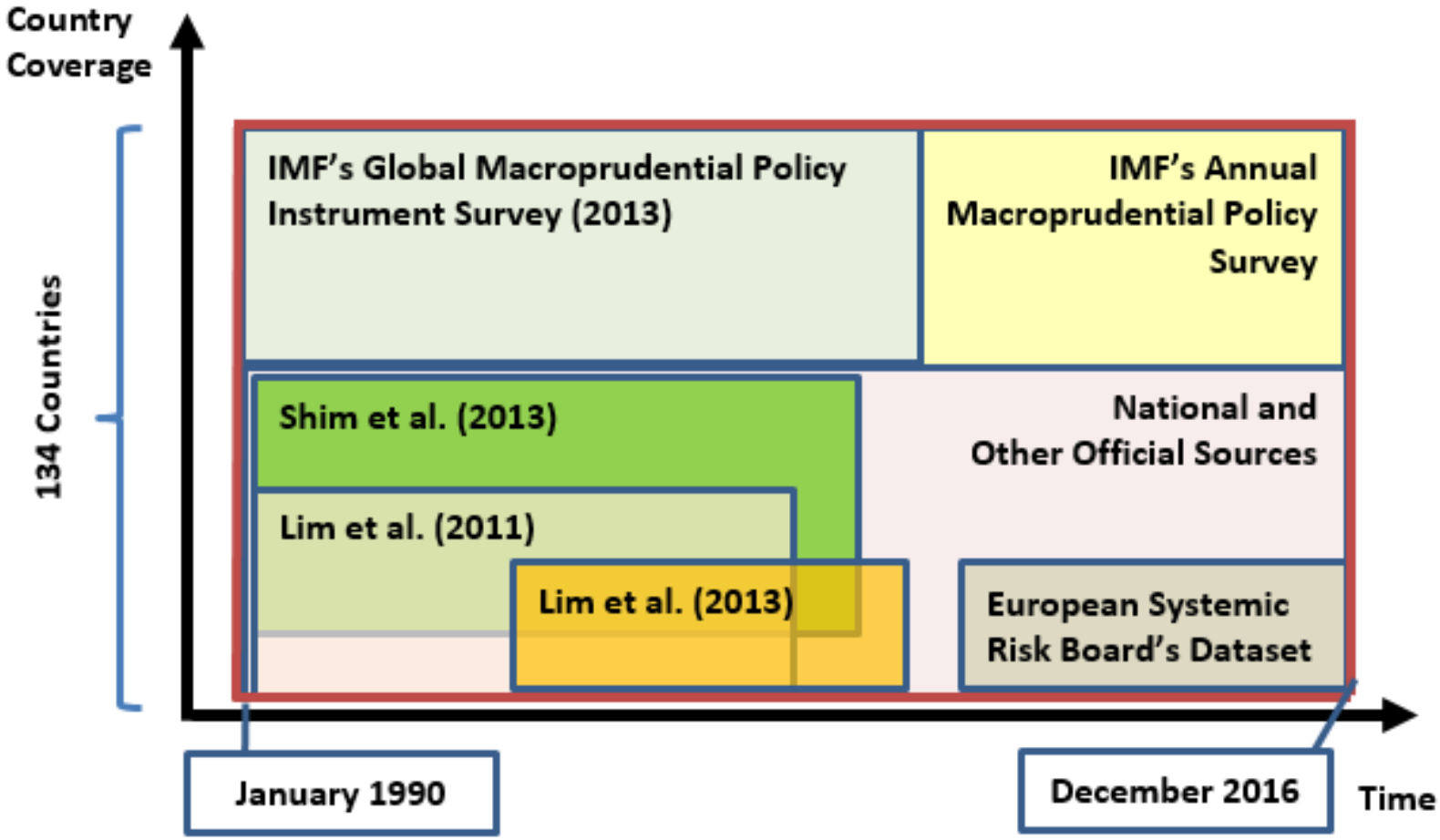
What's new?

1) Introduce a **new comprehensive database of macroprudential policies (iMaPP)**

2) Confirm findings in the literature with new data

3) Use novel numerical information of regulatory LTV limits to quantify the effects of changes
   - Use a propensity-score-based method to address endogeneity issues
   - Find strong and nonlinear effects of LTV limits
   - Find initial LTV levels seem to matter

The iMaPP database



www.imf.org/iMaPP

Advantages of the iMaPP database

1. **Comprehensive database**
   - **Wide coverage:** 17 instruments (dummy-type-indices), 134 countries, 1990M1-2016M12
   - **Subcategories:** Household, corporate, general, and FX instruments
2. **Average LTV limit**
   - 66 countries, 2000M1-2016M12
   - Simple average of regulatory LTV limits of all categories (Appendix 2)
   - Most other databases only offer dummy-type policy action indicators
   - A few databases offer "intensity-adjusted" policy action indicators (Vandenbussche et al. 2015, and Richter et al. 2018)
3. **Regular updates by the IMF** using the IMF's Annual Macroprudential Policy Survey

IMF's Annual Macroprudential Policy Survey

- **Launched in 2018** (IMF 2018, Appendix 3)
- **Framing:** macroprudential policy
  - "use of primarily prudential tools to contain systemic risk" (IMF 2013, IMF-FSB-BIS 2016)
- **Granular list of (69) measures** (IMF 2014a, b)
  - Respondents are asked to "tick" yes/ no
  - Respondents to provide more detailed description of design, calibration and timing (announcement and effective dates)
- **Back data** on measures taken since 2011
- Also: basic information on institutional arrangements

IMF's Annual Macroprudential Policy Survey

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MACROPRUDENTIAL POLICY SURVEY

Home | Data and Reports | Methodology | At A Glance | Information

The Macroprudential Policy Survey database contains information on measures that may be taken with the objective of containing systemic risk, in line with the definition of macroprudential policy—"the use of primarily prudential tools to limit systemic risk" (see further IMF 2013 and IMF-FSB-BIS 2016). In addition, the database contains information on the institutional aspects of the macroprudential policy framework in member countries.

The database is intended to fill an important data gap for researchers and policymakers. The database can be used to support research in this emerging area (for example impact of measures on credit and asset prices). It will also allow policymakers to learn about policy measures taken elsewhere.

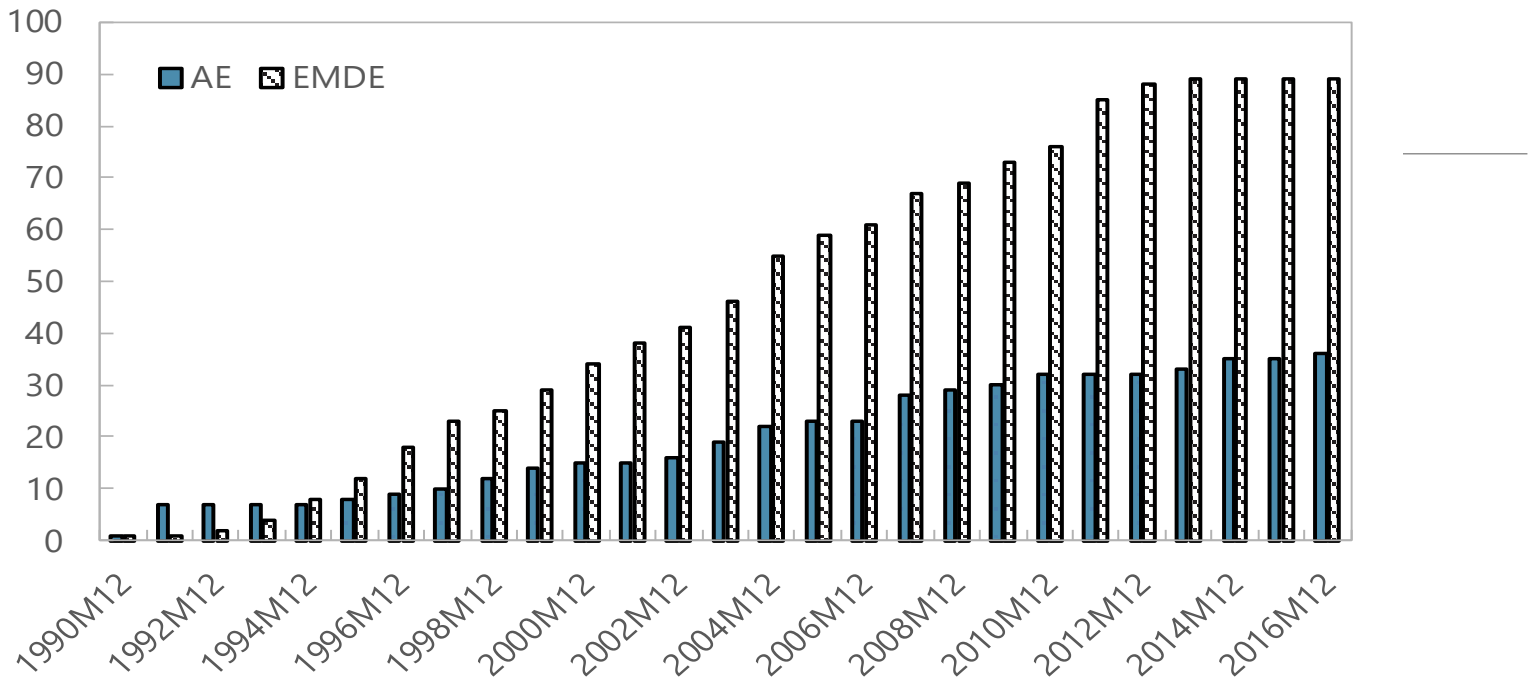
The database is compiled exclusively from information provided by IMF member countries. Hence, a policy tool's inclusion in or absence from this database does not represent a judgment or decision by the IMF on whether a particular tool is macroprudential.

The information in this database includes measures that have been in place or were changed in 2017 and in some cases includes changes in the measures as early as 2011. This new Macroprudential Policy Survey database is expected to be updated on an annual basis. Eventually, this database will provide users with information over time and across countries for research purposes and to inform policy decisions.

Under the Data and Reports tab, the data can be searched across years, countries, and specific categories. Separate chapters for individual countries and

www.elibrary-areaer.imf.org/Macroprudential/Pages/Home.aspx

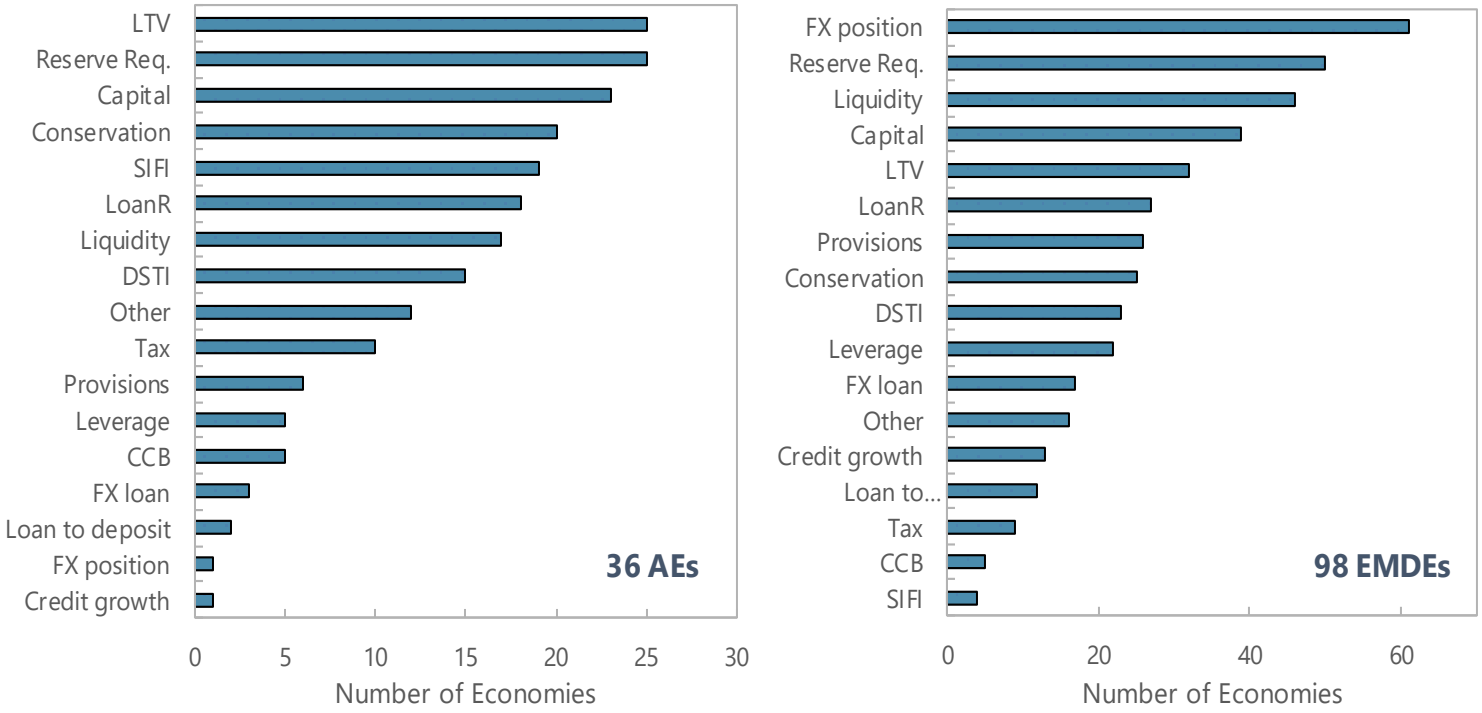
Macroprudential policy has been increasingly used



Note: The figure shows the number of economies that have used any macroprudential policy instrument (except for reserve requirements) at least once in the sample period. There are total 134 economies (36 AEs and 98 EMDEs) in the iMaPP database.

- Over 90 percent of the sample economies had used at least one such tool by end-2012.

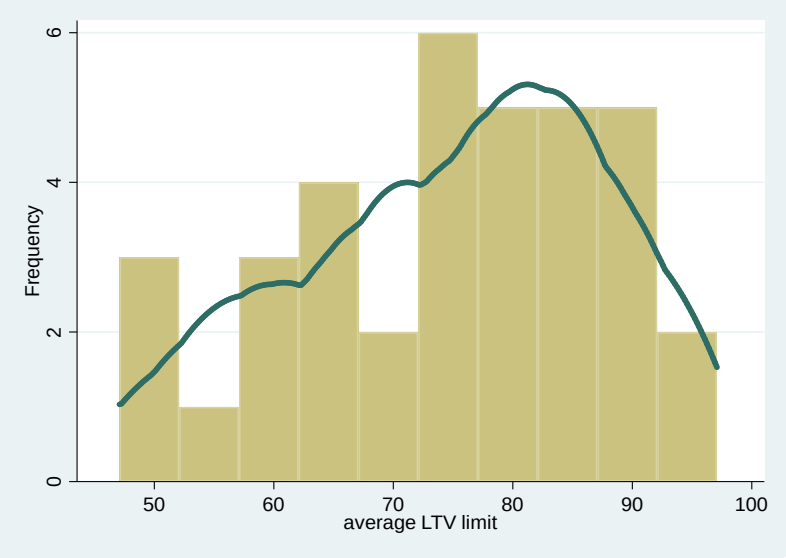
Various instruments have been used

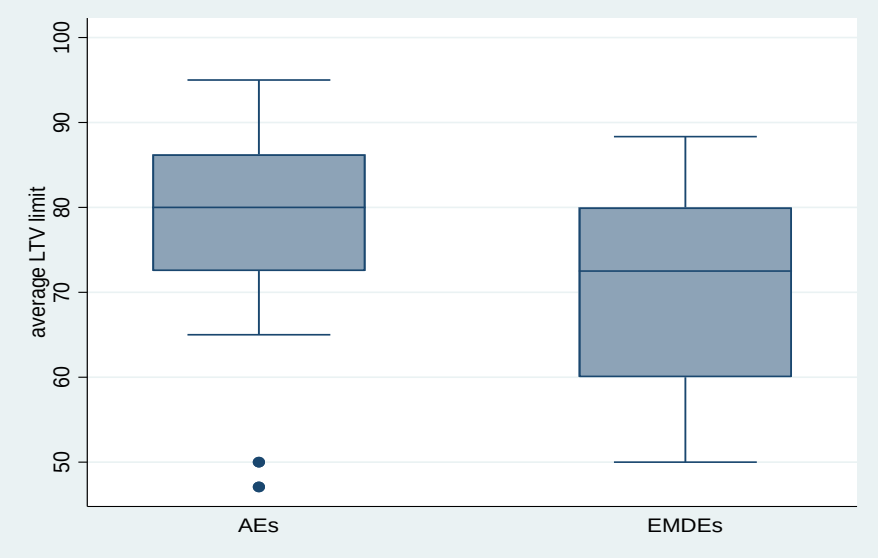


Notes: The figure shows the number of economies that have used the specified instrument as of December 2016. AE = advanced economies; and EMDE = emerging market and developing economies.

Most used instrument: LTV limits in AEs and limits on FX position in EMDEs, likely reflecting their concerns

Average LTV limit – distribution in Dec 2016 –

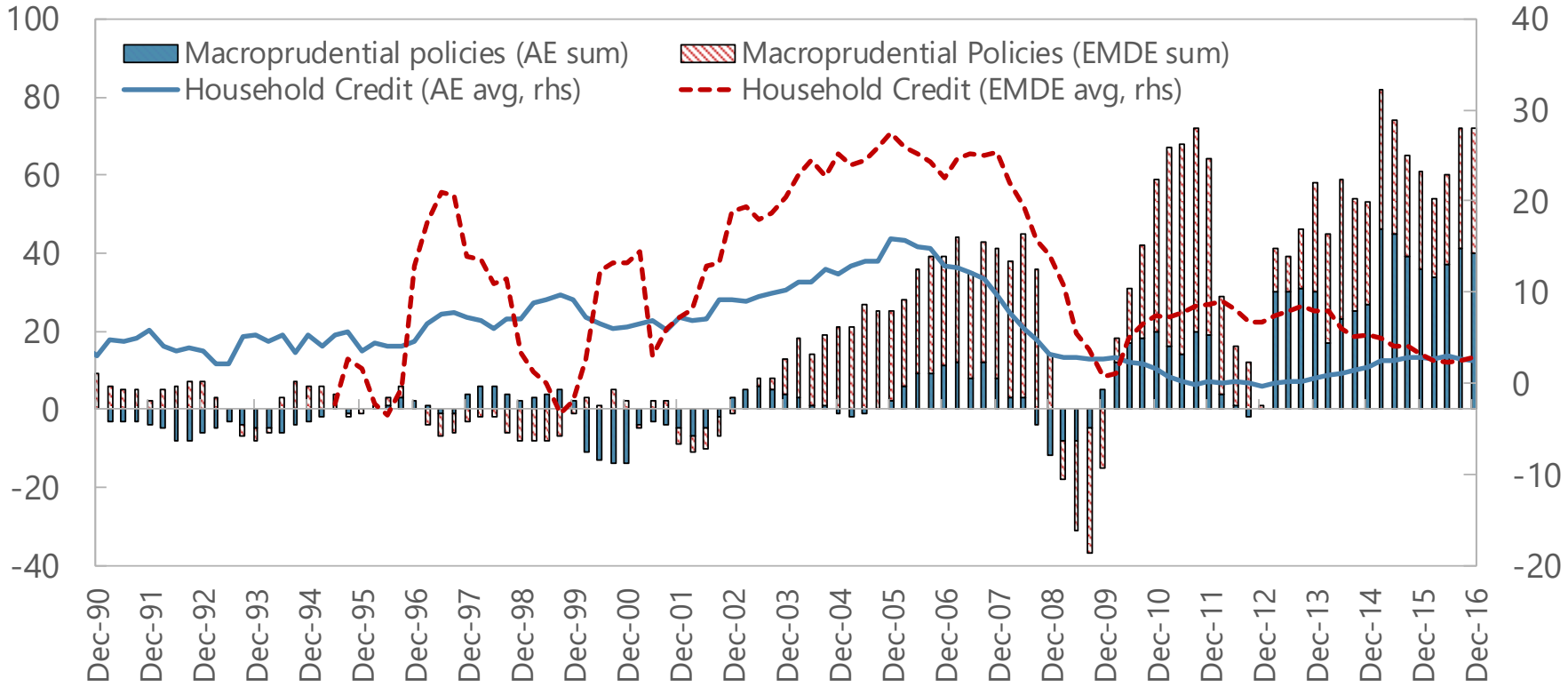




Notes: The left panel shows the histogram of the average LTV limit of less than 100 percent, together with its kernel density estimate. The right panel shows the distributions for AEs and EMs. The box represents the inter-quartile interval, the inner line represents the median, and the outer lines represent the minimum and the maximum values. The dots represent outliers.

- Wide range of values (left)
- Tighter limits among EMDEs (right)
- … while many countries still do not have it yet

Macroprudential policy and credit growth



Notes: **A set of 63 countries** with available household credit at quarterly frequency is considered. Each group-specific macroprudential index is the cumulative sum over the past 4 quarters across all countries and all 17 macroprudential tools.

- Macroprudential policy tends to be tightened when credit increases
  - Reverse causality needs to be addressed in estimation

Revisit: standard regressions with comprehensive data

$$\Delta_4 C_{i,t} = \rho \Delta_4 C_{i,t-1} + \beta MaPP_{i,t-1} + \boldsymbol{\gamma X_{i,t-1}} + \alpha_i + \mu_t + \epsilon_{i,t}$$

1. Real HH **credit** growth (y-o-y)
or
2. Real **consumption** growth (y-o-y)

Policy action indicator in the past 4 quarters
+1: tightening
-1: loosening
0: no action

Macro controls

β : Effects per policy action of an instrument or a group of instruments

$\boldsymbol{X}_{i,t-1}$: Real GDP growth and real interest rates (lagged)

α_i : Country fixed effects

μ_t : Time fixed effects

Identification by the "timing assumption" as in previous studies (Appendix 1)

Robustness checks: system GMM, panel quantile regressions

Loan-targeted instruments reduce credit growth, but also curb consumption growth

	Real Household Credit (Effects)			Real Consumption (Side-effects)		
	ALL	AE	EM	ALL	AE	EM
Loan-tageted	-1.883***	-1.043**	-2.925***	-0.999***	-0.888**	-0.914
Demand	-1.994***	-0.607	-4.926***	-0.649*	-0.527*	-0.607
Supply - Loans	-2.931***	-3.028**	-3.005**	-2.006**	-2.707**	-1.370
Supply - General	-0.602	0.958	-1.354*	0.359	0.998*	0.0276
Supply - Capital	-1.009	0.221	-1.959*	-0.137	-0.0225	-0.453
MaPP All Tools	-0.842***	-0.257	-1.388***	-0.150	-0.170	-0.197
N (countries)	63	34	29	55	31	24

Notes : The "Loan-targeted" group comprises loan "Demand"- and "Supply-Loans" instruments. "Demand": LTV and DSTI. "Supply-loans": limits to credit growth, loan loss provisions, loan restrictions, limits to the loan to deposit ratio, and limits to foreign currency loans. "Supply-general": reserve req., liquidity req., and limits to FX positions. "Supply-capital": leverage limits, countercyclical buffers, conservation buffers, and capital requirements.

1. A tightening action of loan-targeted instruments…
   - Reduces HH credit growth by 2 ppts (**effects**)
   - Reduces consumption growth by 1 ppts (**side-effects**)
2. **Broadly consistent** with other studies

New: the effects and the side-effects of a one ppt change in the LTV limit

Fixed-Effect (FE) estimation:

$$\Delta_4 C_{i,t} = \rho \Delta_4 C_{i,t-1} + \sum_{s=1}^{4} \beta_s \Delta LTV_{i,t-s} + \boldsymbol{\gamma X_{i,t-1}} + \alpha_i + \mu_t + \epsilon_{i,t}$$

1. Real HH **credit** growth (y-o-y)
or
2. Real **consumption** growth (y-o-y)

Change in the Average LTV limit

Macro controls

β_s : Effects of a one percentage point change in the LTV limit

$\boldsymbol{X}_{i,t-1}$: Real GDP growth and real interest rates

α_i : Country fixed effects

μ_t : Time fixed effects

Identification by the "timing assumption" as in previous studies (Appendix 1)

Addressing issues of reverse causality

Typical “timing assumption” likely does not hold:

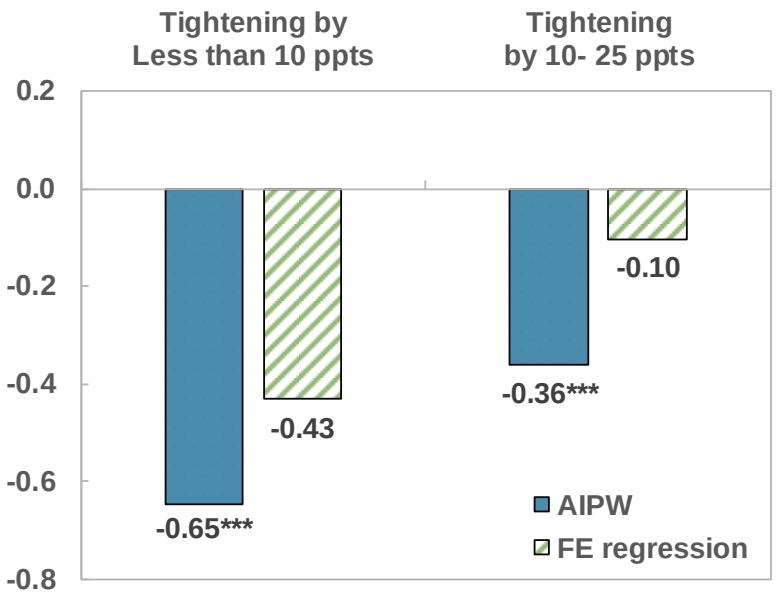
Reverse causality => Attenuation bias

Use the **augmented inverse propensity-score weighted** (AIPW) estimator (Appendix 4)

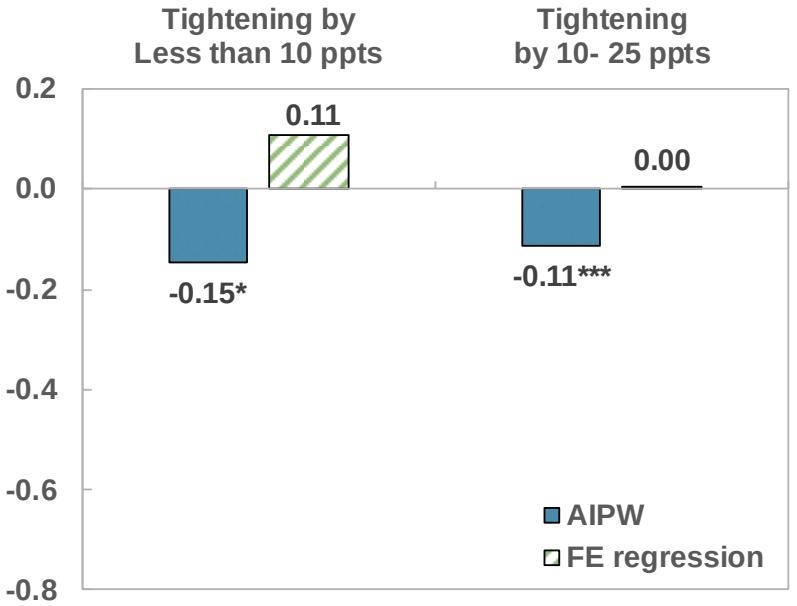
Identifies causal effects of macroprudential policy by ‘**predicting**’ unobserved outcomes, and **penalizing** those observations that are likely to be affected by reverse causality

Causal effects of one-ppt tightening in LTV limits

1. Real Household Credit Growth



2. Real Consumption Growth

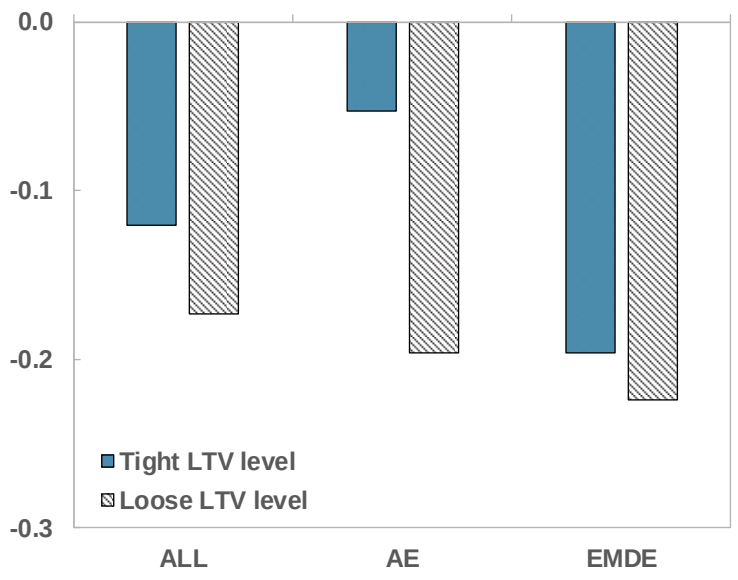


Notes: The figure reports the cumulative effects of a one-ppt LTV tightening after 4 quarters, obtained by the augmented inverse propensity-score weighted ("AIPW") estimation and the fixed effects estimation with the timing assumption ("FE regression"). Observations with ΔLTV less than or equal to -25 ppts are excluded for the estimation to mitigate the influence of outliers. Confidence levels: *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered by country.

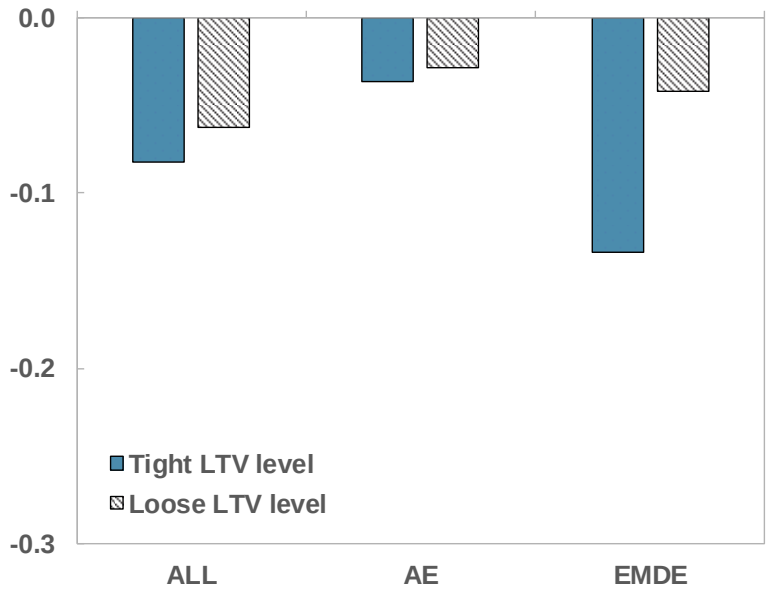
- **Strong and nonlinear effects** (AIPW estimates):
  - HH credit growth falls by **0.7 ppts** for less-than-10 ppts tightening measures
  - Per-unit effects are smaller for larger adjustments, probably due to leakage effects
- **Smaller and less robust side-effects** on consumption growth
- **Correction of the attenuation bias in FE estimates**

Do initial LTV limits matter?

1. Real Household Credit Growth



2. Real Consumption Growth



Note: The figure shows the cumulative effects of **1-ppt** LTV tightening after four quarters, conditioning on the initial LTV level, estimated by the fixed effects estimation with **the timing assumption**. The "loose LTV level" refers to the LTV limits greater or equal to 100 percent and 90 percent in AEs and EMs, respectively. The "tight LTV level" refers those levels below the latter thresholds.

When LTV is already tight, effects on credit growth are **smaller** but side-effects on consumption growth are **larger**

Conclusions

Summary:

1. **Construct a new comprehensive database** (iMaPP)
2. **Revisit** the standard regressions with the comprehensive data
3. **Quantify** the effects and the side-effects of a one ppt change in the LTV limit using granular data and methods to address endogeneity problem.
4. **Key findings**:
    1. Strong and nonlinear effects of LTVs on household credit growth
    2. Modest side-effects on consumption growth
    3. Tradeoff appears severer when LTV is already tight

Thank you!

Appendix 1: "Timing assumption" and attenuation bias

Typical approach in the literature:

- Regress credit growth (C_t) on the lag of macroprudential policy ($MaPP_{t-1}$), controlling other factors.
  - To avoid endogeneity from contemporaneous reverse causality (between C_t and $MaPP_t$)

- This approach is valid if there is no contemporaneous policy effects (the "timing assumption").

- Otherwise, the coeff. of $MaPP_{t-1}$ will be biased toward zero (i.e., the attenuation bias) in the presence of reverse causality.

- The bias is severer if …
  - Contemporaneous policy effects are stronger (i.e., faster transmission)
  - Reverse causality is stronger (i.e., quicker policy formulation upon developments)

Appendix 2: Average LTV limit data

Table 1: An illustration

	1. Without the treatment			2. With the treatment		
	Mortgages for luxury houses	Mortgages for other houses	Average LTV limit	Mortgages for luxury houses	Mortgages for other houses	Average LTV limit
Nov-99	70		70	70	100	85
Dec-99	70		70	70	100	85
Jan-00	70	80	75	70	80	75
Feb-00	70	80	75	70	80	75

- **Simple average of regulatory LTV limits** in a given country
- **When there is no LTV limit**, set the value at 100 (i.e., no down payment requirement)
- **When a limit is introduced** for a new loan category, set the value at 100 for the periods prior to the introduction so that the average LTV limit suggest a correct direction (see the illustration)

Appendix 2 (Cont.): How to use the iMaPP database

1. Download data (**zip**)
   - www.imf.org/iMaPP or here

2. Excel file (**iMaPP_database -- 2019-03-05.xlsx**)
   - Table of Contents: TOC sheet
   - Text info of policy actions: Yellow tab sheets
   - Indicators: LTV_average, MaPP, MaPP_T, and MaPP_L sheets

3. Stata do file (**iMaPP_load.do**)
   - Save indicators in the Stata format (iMaPP_M.dta; iMaPP_Q.dta)
   - Please feel free to customize it

Appendix 3: IMF's Annual Macroprudential Policy Survey - History -

- **IMF-FSB-BIS 2016**
  - stocktaking of experiences and lessons
    - But: no consistent and regularly updated source of information on macroprudential measures
- **G20:** important **data gap** also for policymakers and researchers
- **IMF** to develop an **annual** and **global survey**, in collaboration with FSB and BIS.
  - To be sent to all (189) members every year, as part of the AREAER updates
- **Launched in 2018** (IMF 2018)

Appendix 4: Augmented Inverse-Propensity-Score-Weighted (AIPW) Estimation

First stage (treatment model):

- Group changes in LTV into 4 buckets.
- Estimate ordered logit model to obtain propensity score – the probability of changing the LTV limit.
- Dependent variable: ordered indicator taking values {-20, -10, 0, 10}, (buckets).
- Regressors: macro variables that may influence policy actions.

Second stage (outcome model):

- Predict outcomes (e.g. credit growth) for each bucket of ΔLTV using macroeconomic variables (to correct for unobserved outcomes)

- **Third stage:**
  - Estimate the average treatment effect (ATE) on outcome (e.g., credit growth) using (1) the predicted outcomes; and (2) the inverse propensity-score to give more (less) weight to observations that are less (more) likely to be affected by reverse causality.
  - To obtain the effect of a 1 ppt change in LTV limit, estimated ATE is rescaled by average ΔLTV for each bucket.

References

- Nier, Erlend, 2011, "Macroprudential Policy - taxonomy and challenges"
- IMF, 2013, "Key Aspects of Macroprudential Policy"
- IMF, 2014, Staff Guidance Note on Macroprudential Policy
  - Main note
  - Detailed Guidance on Instruments
  - Considerations for Low Income Countries
- IMF-FSB-BIS, 2016, Elements of Effective Macroprudential Policy
- The IMF's Annual Macroprudential Survey
  - Survey database
  - Objectives, Design and Country Responses
- The IMF's historical iMaPP database
  - iMaPP database
  - Alam and others (2019)