



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

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* Joint work with Zohair Alam, Adrian Alter, Jesse Eiseman, Gaston Gelos, Heedon Kang, Erlend Nier, and Naixi Wang. The views expressed here are those of the authors and do not necessarily represent the views of the IMF, its Executive Board, or management.

What are the effects and the side-effects of macroprudential policy?

- Macroprudential policy can contain credit and house price growth with modest side effects on macro economy

Akinci and Olmstead-Rumsey (2018), Cerutti et al. (2017), Elliott et al. (2013), Igan and Kang (2011), IMF (2012), Poghosyan (2019), Kuttner and Shim (2016), Richter et al. (2019) and others

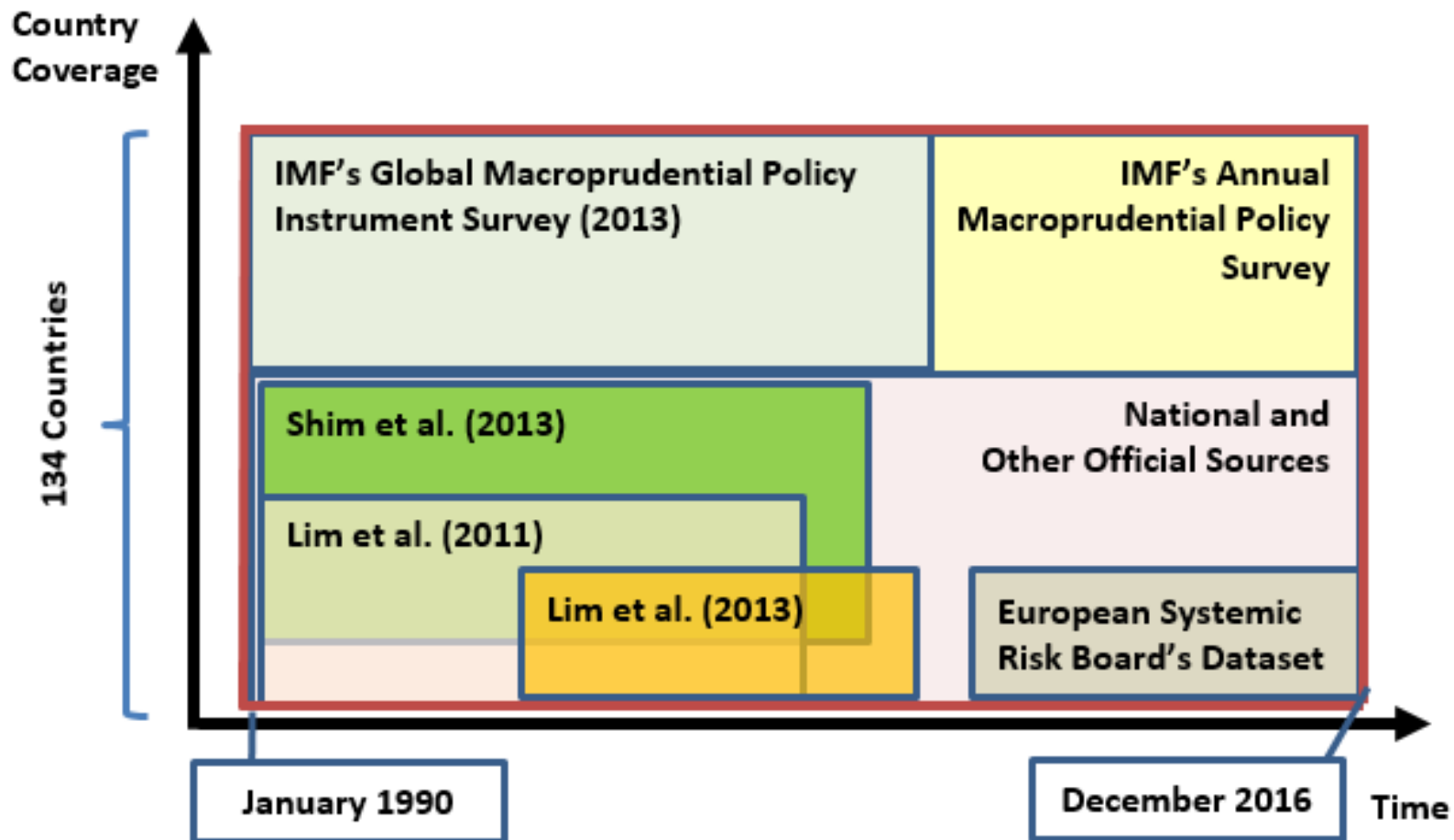
- But open issues remain
 - **Fragmented** evidence due to different coverages/definitions
 - Most results are **qualitative** rather than quantitative due to the use of dummy-type policy action indicators
 - **Endogeneity** concerns—the typical “timing assumption” (Appendix 1)

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 Integrated Macroprudential Policy (iMaPP) Database

The iMaPP database



www.imf.org/iMaPP

Advantages of the iMaPP database

1. Comprehensive database

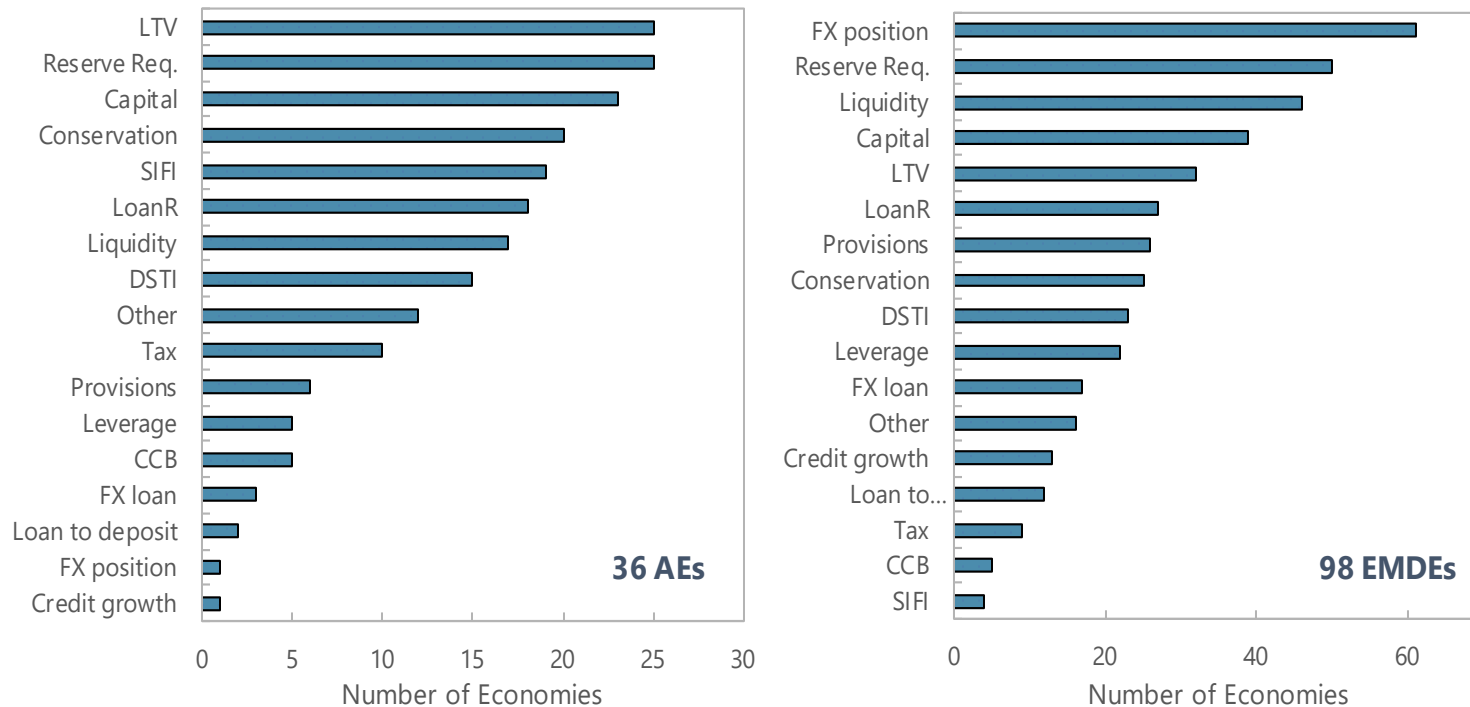
- **Wide coverage:** 17 instruments (dummy-type-indices), 134 countries, 1990M1-2016M12
- **Subcategories:** Household, corporate, general, and FX instruments

2.

3.

Advantage 1: Comprehensive dataset

Use of Instruments as of December 2016



Source: The iMaPP database. 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.

- Top used instruments are LTV limits (AEs) and FX position limits (EMDEs)
- Some are used widely in both groups (e.g., LTV limits, capital requirements)

Advantages of the iMaPP database

1. Comprehensive database

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- **Subcategories:** Household, corporate, general, and FX instruments

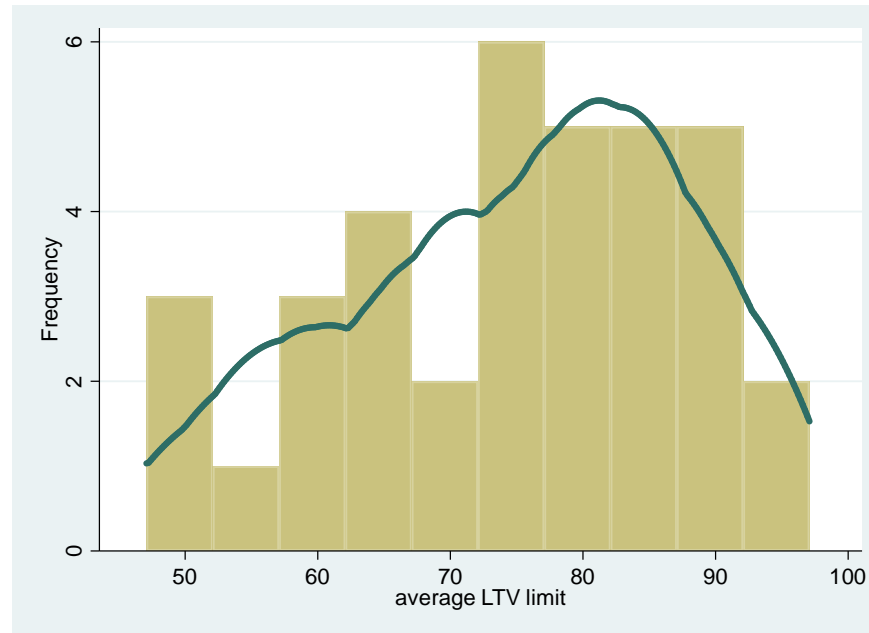
2. Average LTV limit

- 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. 2019)

3.

Advantage 2: Average LTV limit data

Average LTV limit – distribution in Dec 2016 –



Source: The iMaPP database. Notes: The figure shows the histogram of the average LTV limit of less than 100 percent, together with its kernel density estimate.

- iMaPP database is **unique** in providing this numerical indicator
- Average LTV limits take a wide range of values

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3. Regular updates by the IMF using the [IMF's Annual Macroprudential Policy Survey](#) (Appendices 3-4)

Advantage 3: Regular updates by the IMF

MACROPRUDENTIAL POLICY SURVEY

Home **Data and Reports** ▾ Methodology ▾ At A Glance Information ▾



The Macroeprudential 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 Macroeprudential 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.

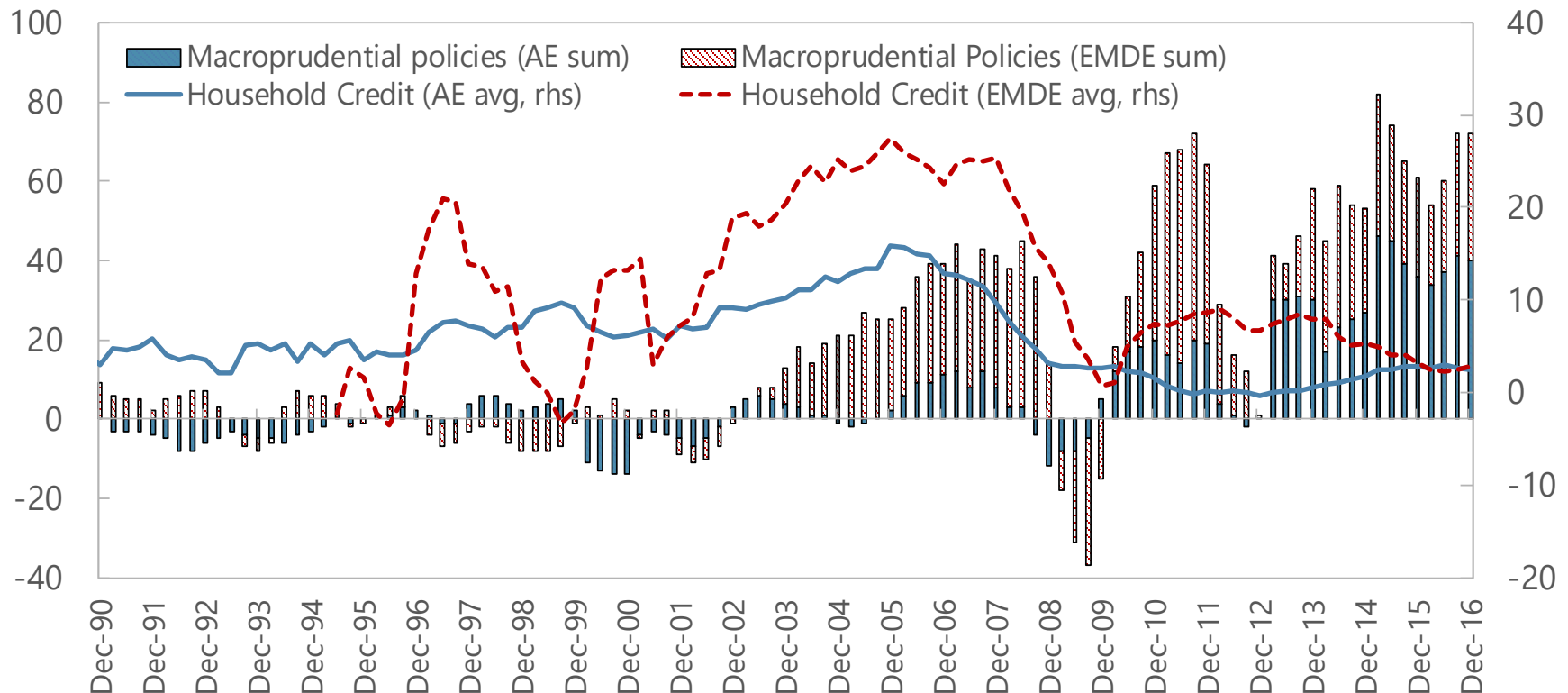
Under the [Data and Reports](#) tab, the data can be searched across years, countries, and specific categories. Separate chapters for individual countries and

Empirical Analysis

- Revisit the Causal Effects **per Action** -

Background: Macroprudential policy is endogenous

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



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.

Revisit: standard regressions with comprehensive data

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

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

$X_{i,t-1}$: 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-targeted	-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 ppt (side-effects)**
2. **Broadly consistent** with previous studies

Going beyond the Per-Action Effects

- Causal Effects of LTV limits **per Unit** -

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

Fixed-Effect (FE) estimation:

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

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

$X_{i,t-1}$: 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 weighting** (AIPW) estimator

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

AIPW estimator with a continuous treatment

	Ordered Policy Action Indicator (z)	Group
Large tightening	-20	$-25 < \Delta\text{LTV} \leq -10$
Moderate tightening	-10	$-10 < \Delta\text{LTV} < 0$
Control (no change)	0	$\Delta\text{LTV} = 0$
Moderate loosening	10	$0 < \Delta\text{LTV} < 10$
Large loosening	20	$10 \leq \Delta\text{LTV}$

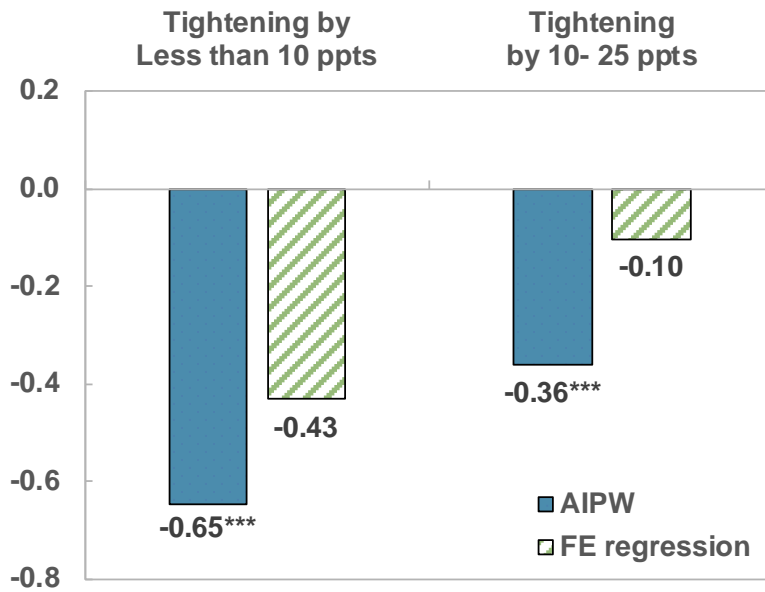
Average treatment effect (ATE) for treatment j and horizon h :

$$\widehat{ATE}_j^h = \underbrace{\frac{1}{NT} \sum \left[\left(\frac{D_{j,it}}{\hat{p}_{j,it}} \right) (\Delta^h y_{it} - \hat{m}_{j,it}^h) + \hat{m}_{j,it}^h \right]}_{\text{Treatment (j)}} - \underbrace{\frac{1}{NT} \sum \left[\left(\frac{D_{0,it}}{\hat{p}_{0,it}} \right) (\Delta^h y_{it} - \hat{m}_{0,it}^h) + \hat{m}_{0,it}^h \right]}_{\text{Control (0)}}$$

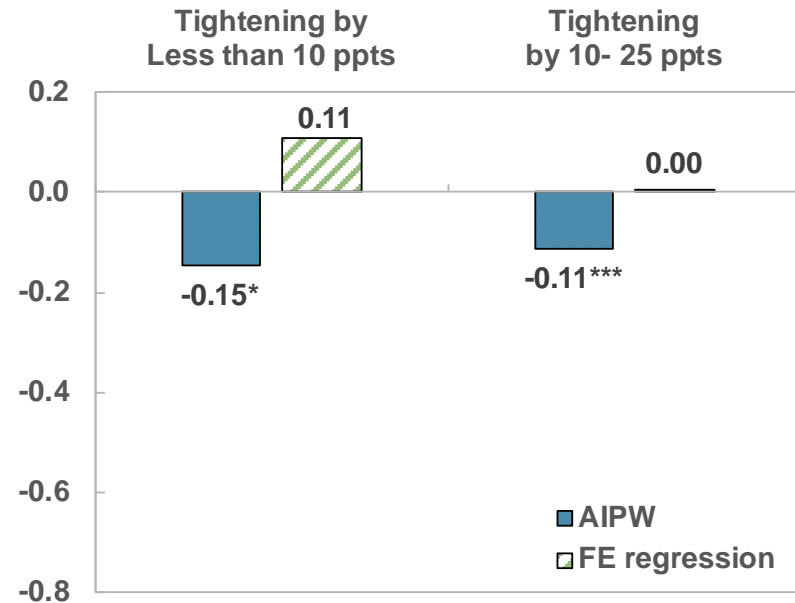
- **Treatment model** ($\hat{p}_{j,it}$): Ordered logit model, using z and macro variables
- **Outcome models** ($\hat{m}_{j,it}^h$): Regressions on macro variables for each group
- To obtain the effect of a 1 ppt change in LTV limit, the estimated ATE is **rescaled** by the average ΔLTV in each group

Causal effects of one-ppt tightening in LTV limits

1. Real Household Credit Growth



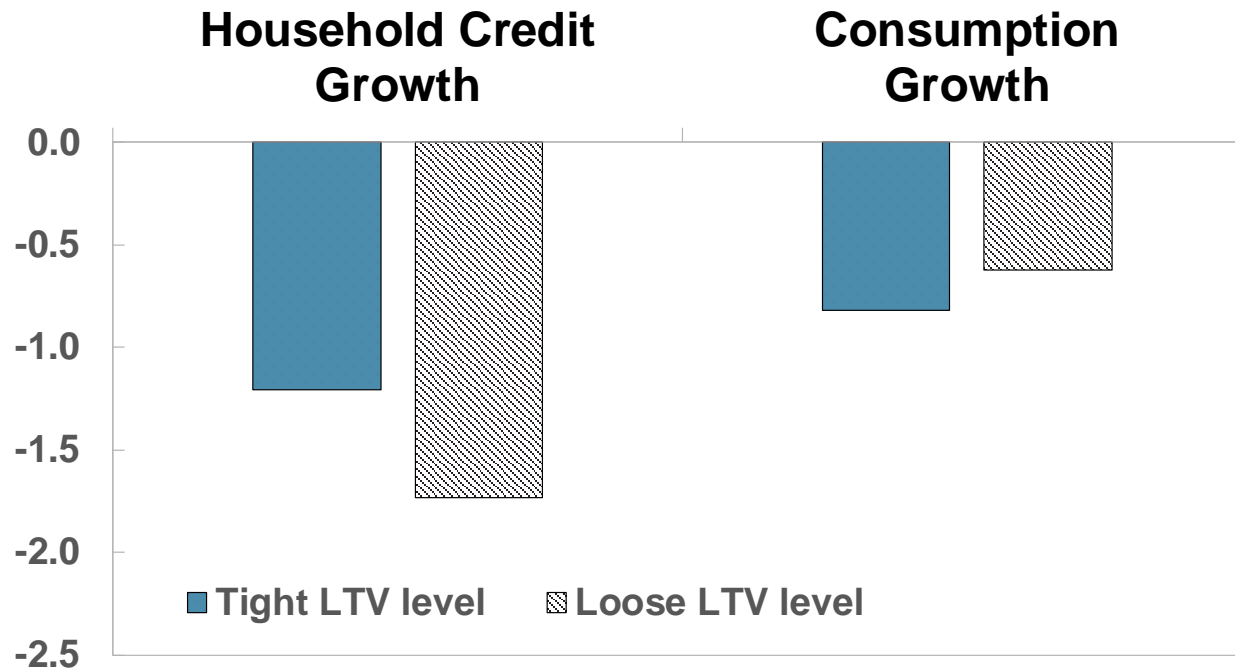
2. Real Consumption Growth



Notes: The figure reports the cumulative effects of a one-ppt LTV tightening after 4 quarters, obtained by the augmented inverse propensity-score weighting (“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?



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 (Tight)” LTV level refers to the LTV limits greater or equal to (less than) the sample median (100 percent).

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 stronger when LTV is already tight

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 for 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 more severe 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

An illustration: how the average LTV limit is constructed

	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 correctly recognizes it as a tightening (see the illustration above)

Appendix 3: How to use the iMaPP database

- Download data (**zip**)
 - www.imf.org/iMaPP or [here](#)
 - Going forward, the updated versions will be posted at: www.elibrary-areaer.imf.org/Macroprudential/Pages/Home.aspx

Contents of the zip file:

- Excel file (**iMaPP_database -- 2019-03-05.xlsx**)
 - Table of Contents: TOC sheet
 - Text info of policy actions: sheets with a yellow tab
 - Indicators: sheets “LTV_average”, “MaPP”, “MaPP_T”, and “MaPP_L”
- 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 4: 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 (cont.): IMF's Annual Macroprudential Policy Survey

- Contents -

- **Framing:** macroprudential policy
 - “use of primarily prudential tools to contain systemic risk” ([IMF 2013](#), [IMF-FSB-BIS 2016](#))
- **Granular list of (73) 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