NPL Developments, Macroeconomic and Financial Stability Implications

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ADB Virtual Training Course on NPL Resolution
20 May 2021

Outline

1. **NPL Developments in Asia**

2. **Macroeconomic and Financial Stability Implications of NPLs**

    1. Transmission Channels

    2. Empirical Analyses - Literature Overview

    3. Empirical Work for Asia

    4. Empirical Work for Europe

3. **Conclusions**

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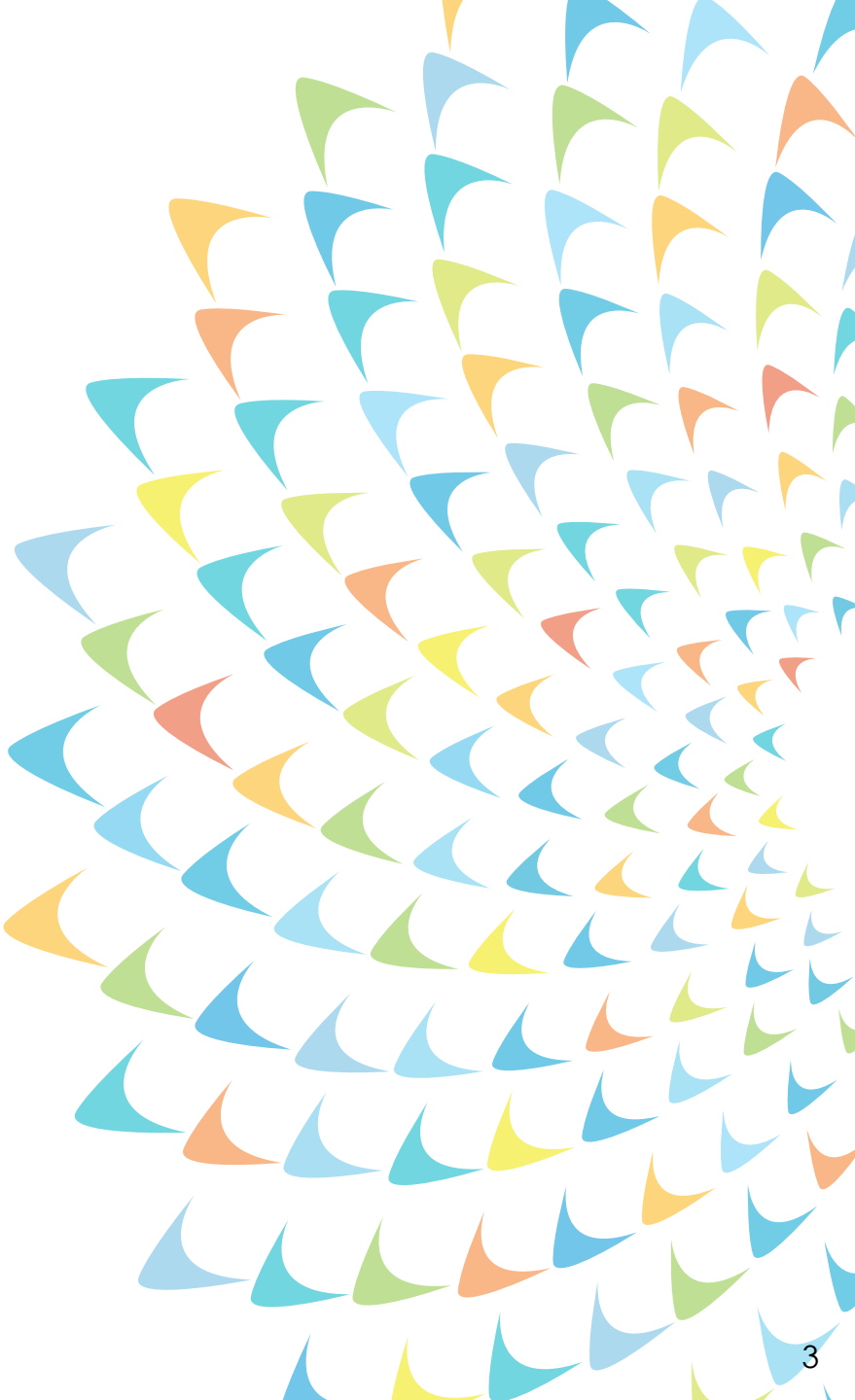
1. NPL DEVELOPMENTS IN ASIA



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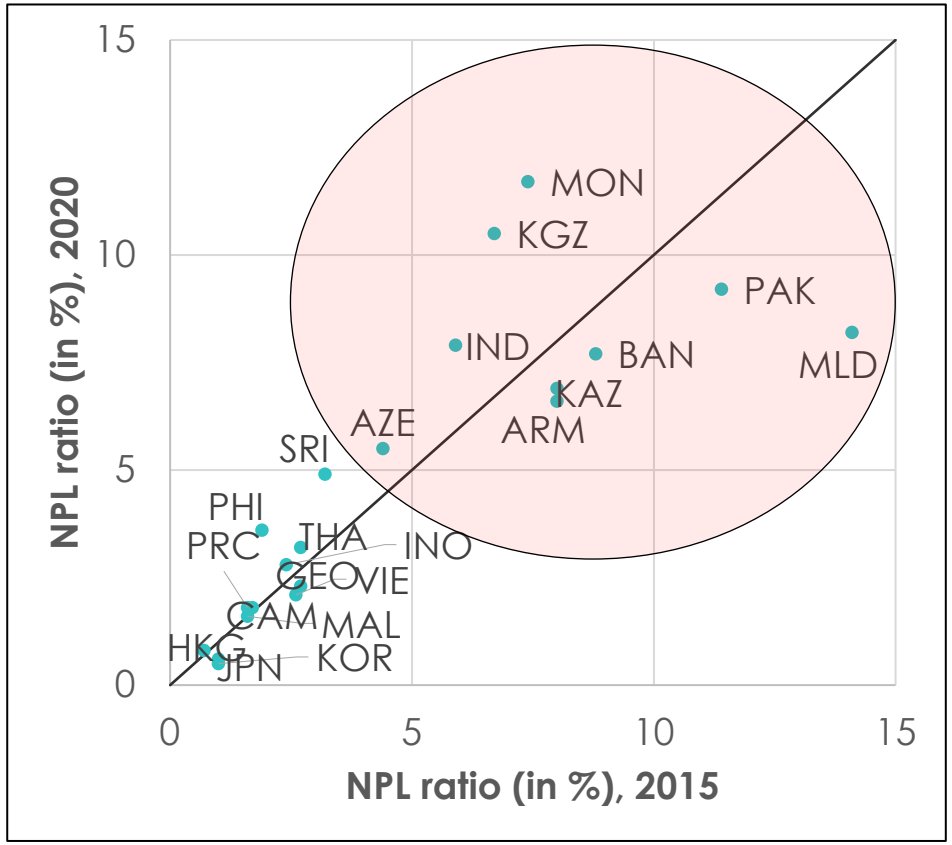
Rising NPLs have the potential to derail COVID-19 recovery and undermine stability

- In some Central, East, and South Asian economies NPL ratios are elevated and have been rising recently
- Fiscal stimulus has helped prevent corporate defaults, while regulatory forbearance has relieved pressure from banks in addressing NPLs
- Lifting of temporary measures can lead to corporate defaults, exposing banks to rising NPLs, with harmful macrofinancial feedback effects.
- Growing interconnectedness of Asian and global financial markets highlight risks of cross-border spillovers and contagion effects

Development of NPL Ratios in Asia, 2015 vs. 2020



Note: Data for Japan as of 2019.
Source: ADB calculations using data from Bank of Mongolia; CEIC Database; International Monetary Fund Financial Soundness Indicators. https://data.imf.org/; and World Bank World Development Indicators. http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators (accessed May 2021).

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Evolution of NPLs in Asia

Evolution of Bank Nonperforming Loans in Asia (% of gross loans)

Economy	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Central Asia																								
Afghanistan														49.9	4.7	5.0	4.9	7.8	12.1	11.1	12.2	8.9	14.5	15.7
Armenia		6.0	8.0	17.5	24.4	9.9	5.4	2.1	2.0	2.4	2.4	4.3	4.9	3.0	3.4	3.7	4.5	7.0	8.0	6.7	5.4	4.8	5.5	6.6
Azerbaijan						28.0	21.5	15.1	9.5	7.2				3.5	4.7	6.0	5.7	4.5	4.4	5.3	13.8	12.2	8.3	5.5
Kazakhstan						11.9	8.4	4.3	3.3	2.4	2.7	7.1	18.9	20.9	20.7	19.4	19.5	12.4	8.0	6.7	9.3	7.4	8.1	6.9
Kyrgyz Republic		10.1	30.9	30.9	13.4	13.3	11.2	8.0		6.2	3.6	5.3	8.2	14.8	9.4	6.6	5.1	4.2	6.7	8.5	7.4	7.3	7.7	10.5
Tajikistan				5.2	3.0	5.1	5.2	3.6	3.3	1.1	0.7	2.3	44.3	7.6	6.8	6.4	8.6	11.6	17.2	26.6	21.6	21.2	27.0	23.8
East Asia																								
Korea, Rep. of					2.8	1.9	2.0	1.6	1.0	0.7	0.6	0.9	0.8	1.1	0.9	1.0	1.2	1.0	1.0	1.1	0.9	0.7	0.6	0.5
Mongolia	19.7	31.0	50.5	21.9	6.7	5.1	4.8	6.4	5.8	4.9	3.3	7.2	17.4	11.5	5.8	4.2	5.3	5.0	7.4	8.5	8.5	10.4	10.1	11.7
PRC			28.5	22.4	29.8	26.0	20.4	13.2	8.6	7.1	6.2	2.4	1.6	1.1	1.0	1.0	1.0	1.2	1.7	1.7	1.7	1.8	1.9	1.8
South Asia																								
Bangladesh		40.7	41.1	34.9	31.5	28.1	22.1	17.5	13.2	12.8	14.5				5.8	9.7	8.6	9.4	8.4	8.9	8.9	9.9	8.9	7.7
India	14.4	14.7	12.8	11.5	10.4	9.1	7.2	4.9	3.3	2.5	2.3	2.5	2.3	2.2	2.7	3.4	4.0	4.4	5.9	9.2	10.0	9.5	9.2	7.9
Maldives																20.9	17.6	17.5	14.1	10.6	10.5	8.9	9.4	8.2
Pakistan	24.0	23.0	26.0	24.0	23.0	22.0	17.0	12.0	9.0	7.3	7.4	9.1	12.2	14.8	16.2	14.5	13.0	12.3	11.4	10.1	8.4	8.0	8.6	9.2
Southeast Asia																								
Cambodia	7.2	16.2	14.5	12.4	8.4	14.8	13.9	10.3	7.8	9.9	3.4	3.7	4.8	3.1	2.3	2.2	2.3	1.6	1.6	2.1	2.1	2.0	1.6	1.8
Indonesia		48.6	32.9	34.4	31.9	24.0	6.8	4.5	7.3	5.9	4.0	3.2	3.3	2.5	2.1	1.8	1.7	2.1	2.4	2.9	2.6	2.3	2.4	2.8
Malaysia	4.1	18.6	16.6	15.4	17.8	15.9	13.9	11.7	9.4	8.5	6.5	4.8	3.6	3.4	2.7	2.0	1.9	1.7	1.6	1.6	1.6	1.5	1.5	1.6
Philippines	4.7	12.4	14.6	24.0	27.7	14.6	16.1	14.4	10.0	7.5	5.8	4.6	3.5	3.4	2.6	2.2	2.4	2.0	1.9	1.7	1.6	1.7	2.0	3.6
Thailand		42.9	38.6	17.7	11.5	16.5	13.5	11.9	9.1	7.8	7.6	5.6	5.2	3.9	2.9	2.4	2.3	2.3	2.7	3.0	3.1	3.1	3.1	3.2

PRC = People's Republic of China.
Notes: White cells denote nonperforming ratio less than 5%, yellow between 5% and 10%, and orange higher than 10%. Blank cells mean data is not available.

Source: ADB calculations using data from Bank of Mongolia; Central Bank of Afghanistan; European Banking Federation; CEIC Database; International Monetary Fund Financial Soundness Indicators. https://data.imf.org/; DA Afghanistan Bank Monthly Report December 2020 and January 2021 https://dab.gov.af; Maldives Monetary Authority Monthly Statistics December 2020 http://www.mma.gov.mv; National Bank of Tajikistan Indicators of Banking System Financial Stability December 2019 and December 2020 https://www.nbt.tj; and World Bank World Development Indicators. http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators (accessed May 2021)

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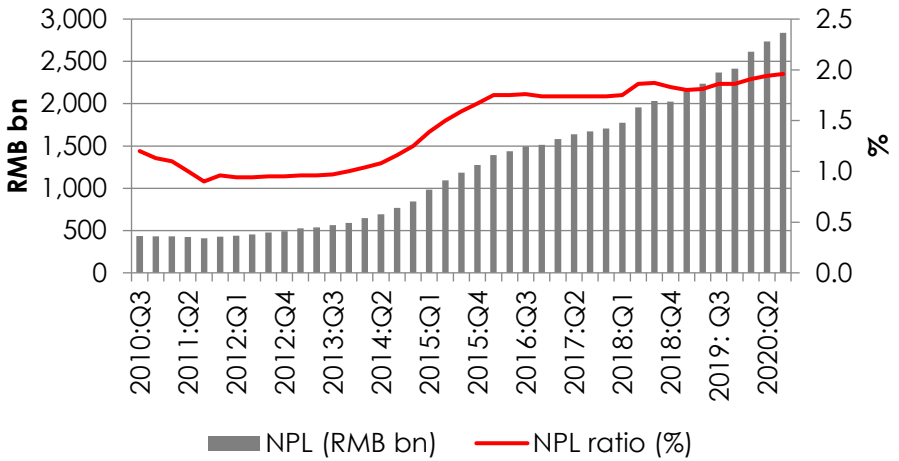
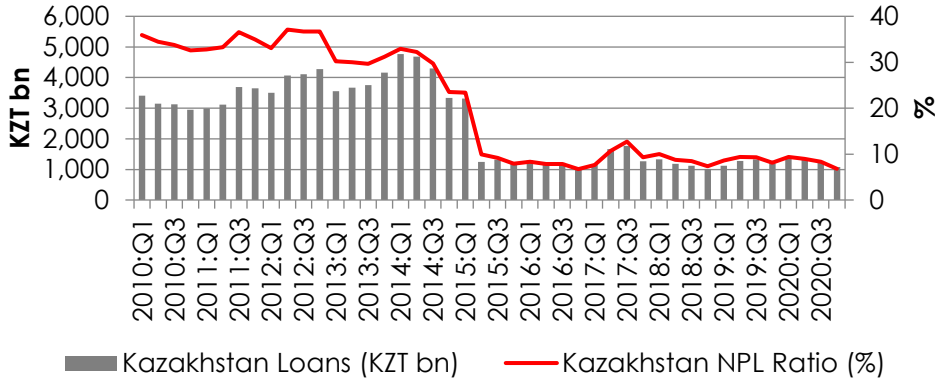
NPL Developments for Selected Asian Economies

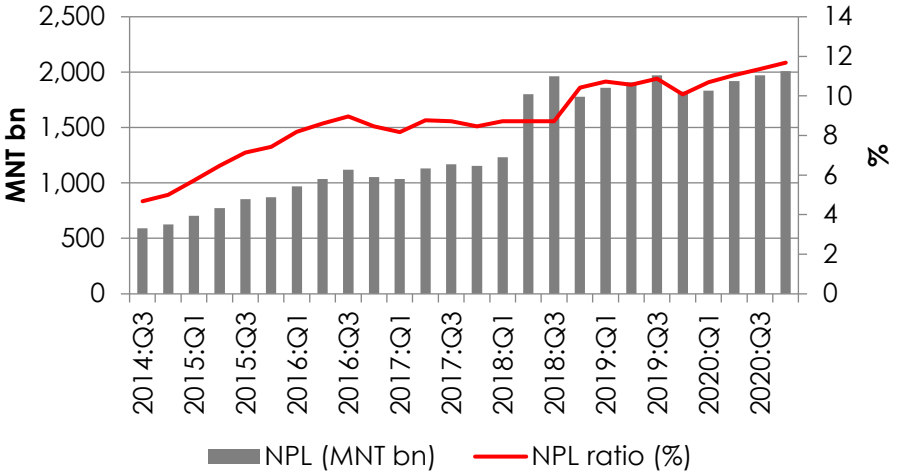
People's Republic of China



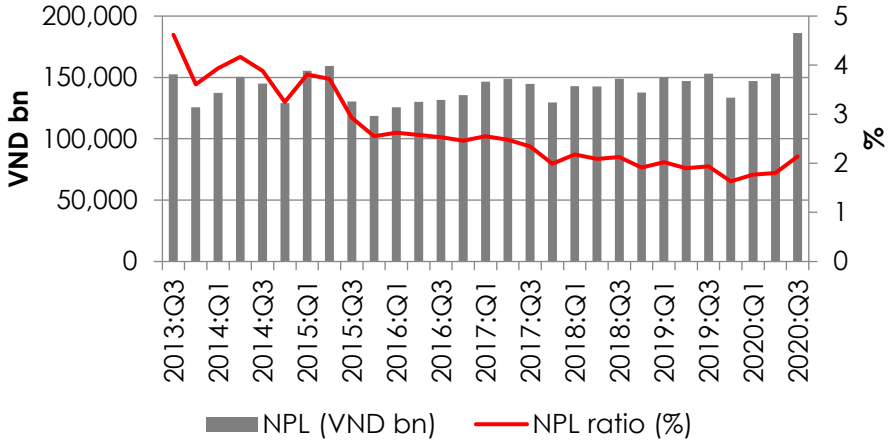
Kazakhstan



Mongolia



Viet Nam



Source: ADB calculations using data from CEIC and Haver Analytics (2019).

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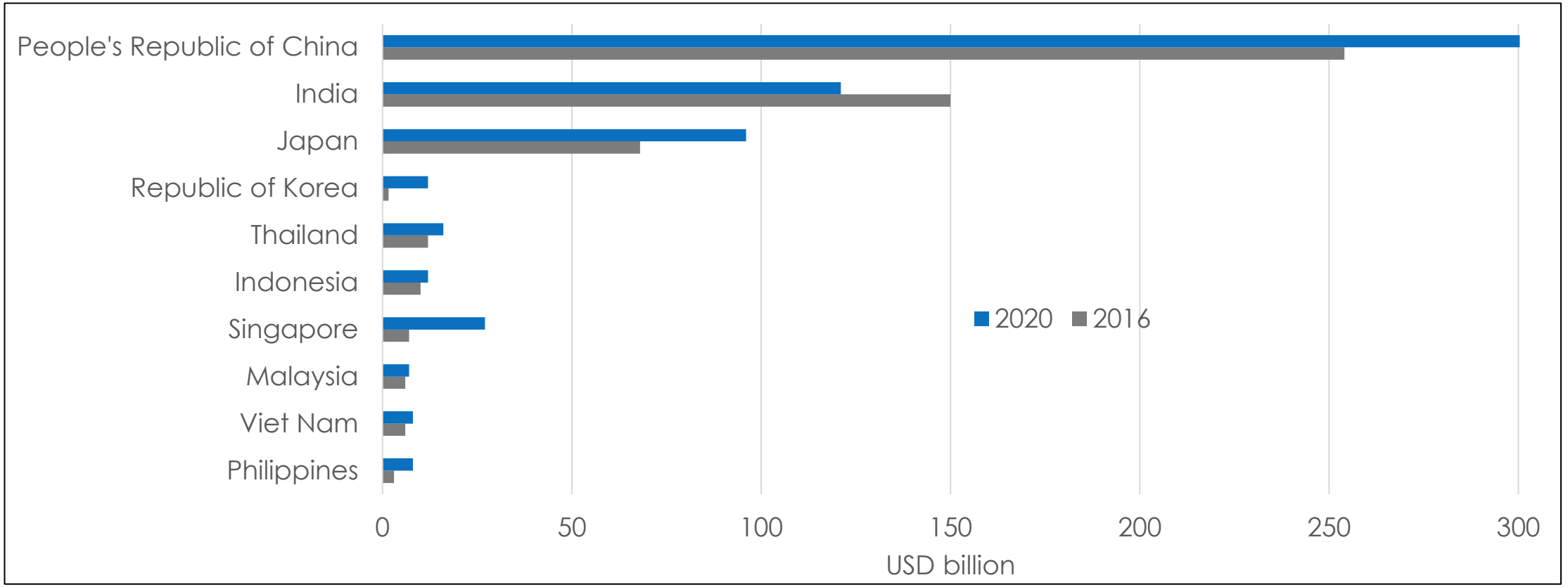
Outstanding NPLs of Asian banks are considerable and growing

NPLs held by banks in selected Asian economies, 2016 and 2020 ($ billion)



NPL = nonperforming loan.
Note: 2016 NPL data was based on 2017 data for the People's Republic of China and the Republic of Korea.
Sources: Data is from Deloitte (2018, 2021).

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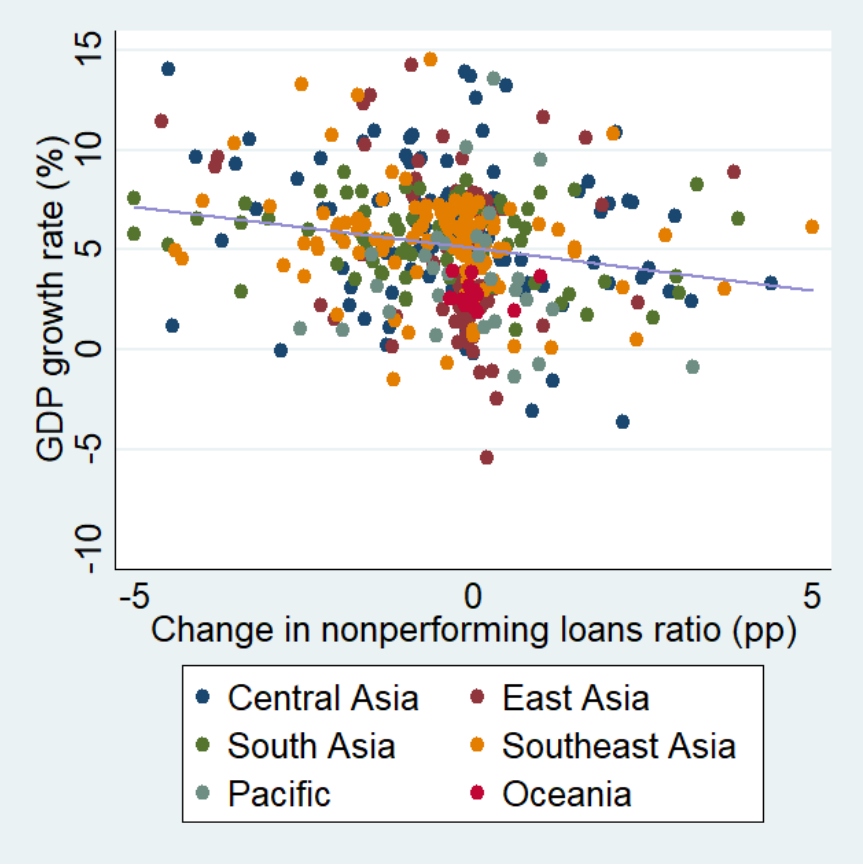
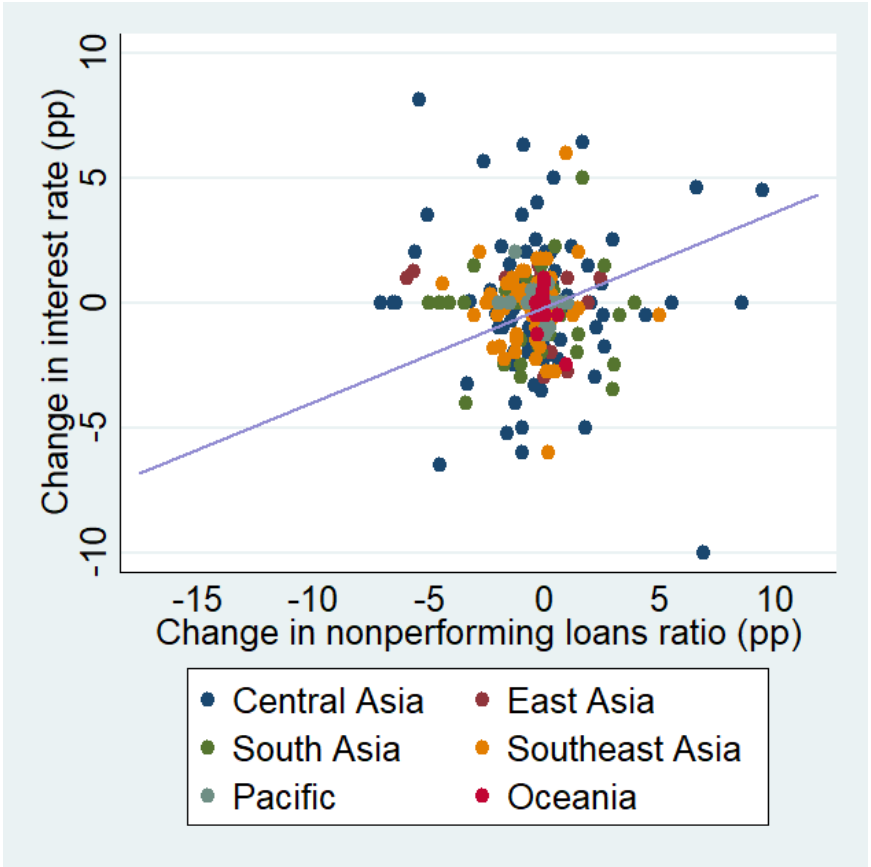
NPL ratios are negatively correlated with GDP growth and positively correlated with interest

NPL ratios, GDP growth, and interest rates in Asia, 1997–2019





GDP = gross domestic product; pp = percentage points.
Note: Interest rates refer to central bank policy rates.
Sources: Asian Development Bank calculations using data from the Bank of Mongolia; CEIC Database; International Monetary Fund Financial Soundness Indicators. https://data.imf.org/; State Bank of Viet Nam; and World Bank World Development Indicators. http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators (accessed September 2020).

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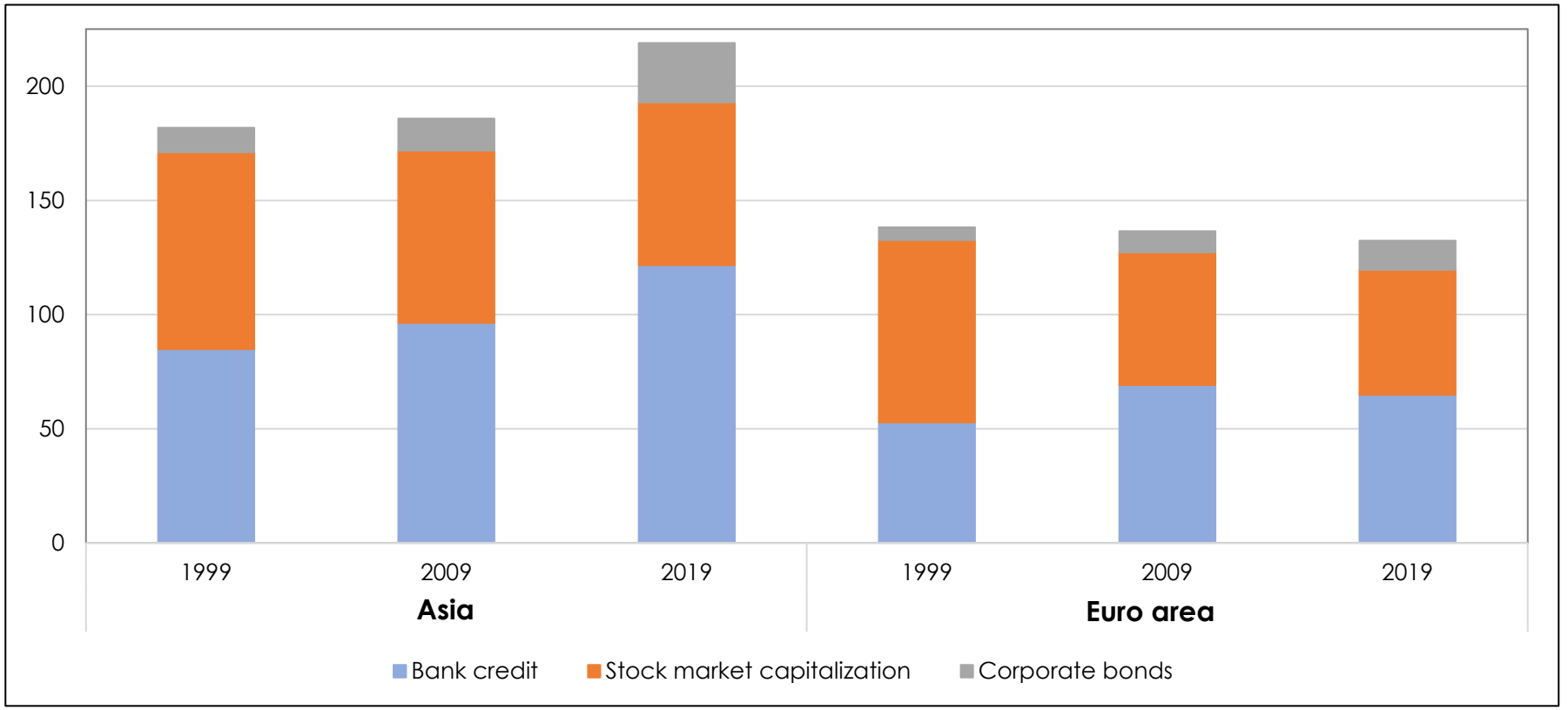
2. NPL AND MACROECONOMIC DEVELOPMENT

Banks are the main providers of corporate finance, both in Asia and in the euro area

Corporate Financing Euro Area and Asia (% of GDP)



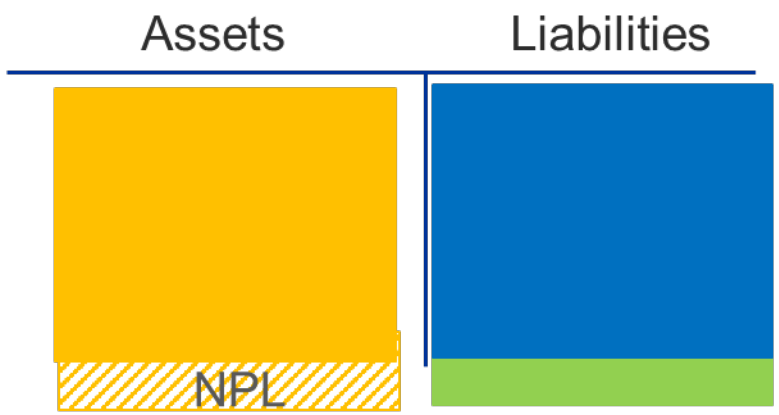
Notes:
(i) Asia includes Australia, People's Republic of China, India, Indonesia, Japan, Republic of Korea, Malaysia, Philippines, Thailand, and Viet Nam;
(ii) The euro area includes Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovak Republic, Slovenia, and Spain.
(iii) 1999 corporate bond data as of 2000 for Republic of Korea, Malaysia, Philippines, Thailand, and Viet Nam. 1999 stock market capitalization data as of 2000 for Viet Nam; as of 2003 for the People's Republic of China and India. 1999 bank credit data as of 2000 for Japan; as of 2001 for the Philippines; as of 2002 for Australia; as of 2003 for Indonesia and Thailand.
(iv) 2009 corporate data as of 2010 for India. 2009 stock market capitalization data as of 2010 for Indonesia.
Sources: *AsianBondsOnline;* CEIC; Haver Analytics; European Central Bank Statistical Data Warehouse; national sources (accessed September 2020).

Transmission Channels

Four Main Channels are at Play

1 Lower bank profitability
- Provisioning and write-offs

2 Higher vulnerability of banks
- Impact on funding costs
- Difficulty to generate capital from internal or external sources
- Contingent state liability



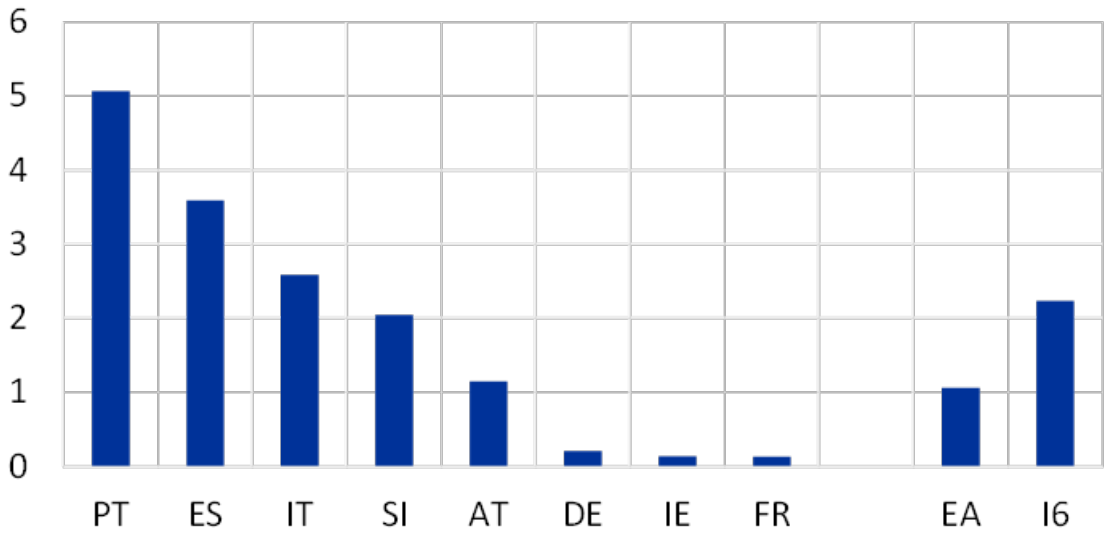
3 Impact on bank debtors
- Deteriorating viability of distressed debtors
- Weaker payment culture

4 New lending held back
- Delays economic recovery
- Weakens monetary transmission

Transmission Channels

Replacement of NPLs by performing assets may significantly improve profitability

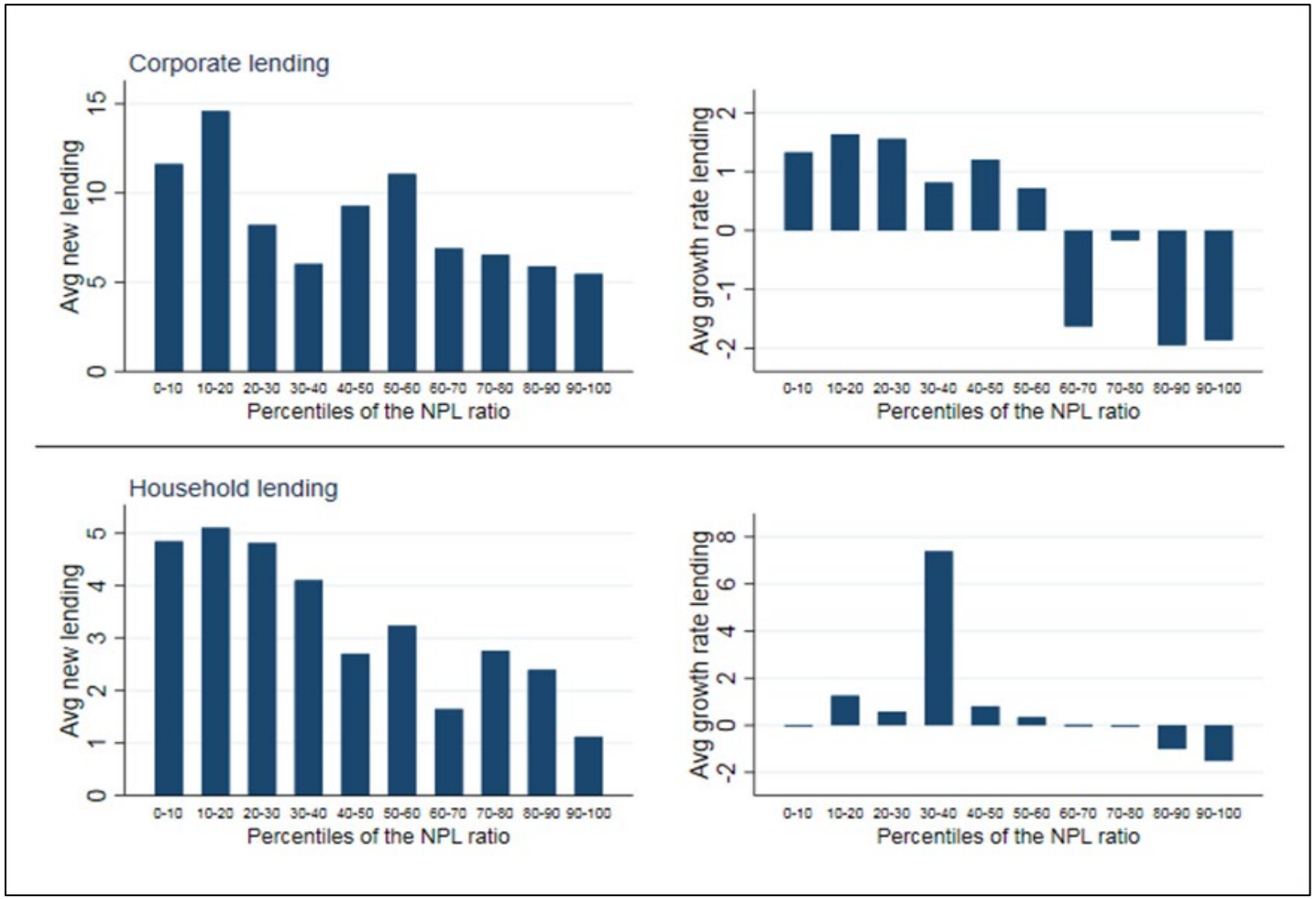
Aggregate ROE in the euro area over a 3-year horizon may improve by about 1 pp



Note: The simulation assumes that NPL would be gradually replaced over the 3-year period by performing assets, with the same composition and rates as projected under the baseline scenario of the 2016 EU-wide stress test. For some EA countries, cures of NPL would yield a negative impact on ROE given the higher interest rate accrued on NPL than on performing assets. Results are only showed for countries with positive impact on ROE.
Source: ECB and ECB calculations.

Transmission Channels

Euro Area banks with more NPLs lent less during the recovery of 2014-2018

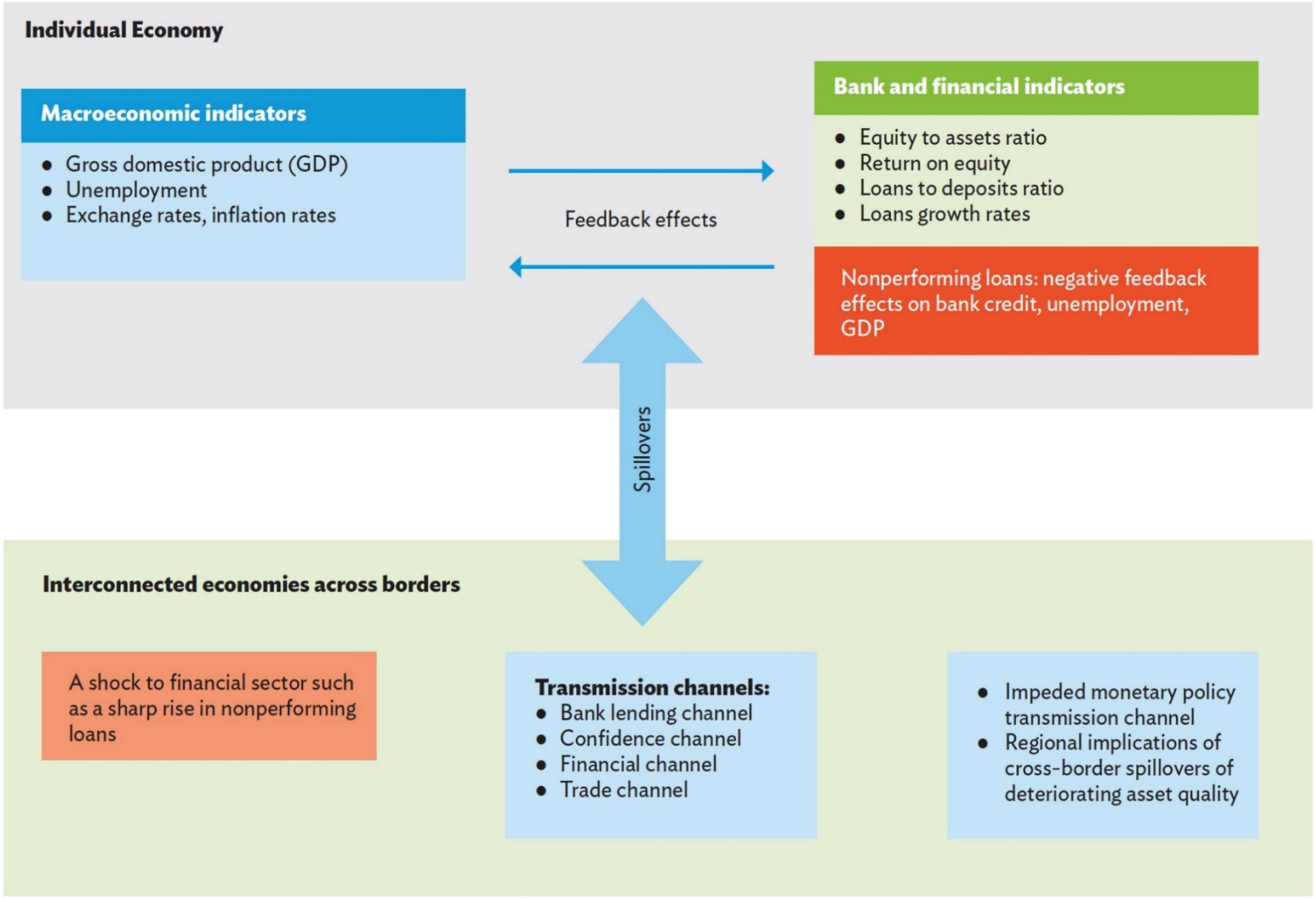


Transmission Channels

Cross-border spillovers

- High NPL levels, despite being present only in a subset of EU countries, were an issue for the entire EU / euro area
- This is due to a number of important cross-border spillovers:
  - Bank lending channel: impact on cross-border lending flows
  - Confidence channel: negative market sentiment about national banking systems may impact other banks or sovereigns
  - Wealth channel: losses on bank debt and equity
  - Trade channel: deterioration of macro conditions in high-NPL countries impacts other countries through lower import demand
- Transmission channels may be less pronounced in Asia due to less integrated financial markets; channels still likely to be present and gaining in relevance

Macrofinancial impacts of nonperforming loans



Source: ADB (2017)

Empirical analyses - Literature overview

Financial and banking sector conditions affect the real economy:

- *"Financial accelerator": Shocks in financial markets can propagate and amplify real economic shocks (Bernanke et al. (1996, 1999), Kiyotaki & Moore (1997))*

Three strands of empirical literature on NPLs

1) Determinants of NPLs

- **Bank level drivers**
  - *Exogenous factors (sudden economic stop)*
  - *Poor management (seen as most prominent driver)*
  - *Low capitalisation and more risk taking*
  - *Scarcity of resources to underwrite / monitor loans*
- **Industry-level drivers**
  - *Impact of competition on risk-taking; no consensus in the literature*
- **Macroeconomic drivers** (e.g., Anastasiou / Tsionas 2016)
  - *Improved economic conditions, higher inflation and lower IR positive*
  - *ER depreciations negative for FX loans*

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Empirical analyses - Literature overview

2) Impact of NPLs on the real economy (mainly bank lending and economic activity)

- Balgova, Nies, Plekhanov (2016)
  - Global sample of 100 countries. Reduced NPL ratios result in faster credit and GDP growth.
  - "Active" countries do significantly better than "procrastinating" ones.

- Accornero et al. (2017), based on Italian data
  - Level of NPL ratios does not per se influence bank lending but bank lending impaired by exogenous accumulation of new NPLs.

3) Feedback loops between NPLs and the real economy

- Tries to capture dynamic interaction and feedback between changes in NPLs, banking and macroeconomic variables.

- Klein (2010), Nkusu (2011) and Espinoza, Prasad (2010), De Bock and Demyanets (2012), and Lee and Rosenkranz (2020) construct VAR models for country groups

- All these studies find that an increase in NPLs leads to a reduction in credit and has a negative impact on the macroeconomy.

Empirical work for Asia

Nonperforming Loans in Asia: Determinants and Macrofinancial Linkages, Lee and Rosenkranz (2020)

1. **Assessment of the determinants of NPLs in Asia using individual banks' balance sheets data**

   - Dynamic panel model with 17 emerging Asian economies from 1994-2014
   - Finding: Both macroeconomic indicators as well as bank-level variables play a key role in explaining the evolution of banks' NPL ratio

2. **Analysis of macrofinancial linkages and feedback effects of NPLs in Asia**

   - Panel vector autoregressive model with 32 emerging Asian economies from 1994-2014
   - Finding: Increasing NPL levels reflect weak macroeconomic conditions; and they have harmful feedback effects on the overall economy.

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Data for dynamic panel analysis

Bank-level variables

- **NPL ratio** (ratio of impaired loans to gross loans)
- **equity-to-assets ratio**
- **return on equity** (ratio of net income to average equity)
- **loans-to-deposits ratio** (ratio of gross loans to deposits)
- **loans growth rate** (year-on-year growth rate of loans)

Bank-level data consists of **165 commercial banks in 17 economies** in emerging Asia

The dataset covers more than 60% of the banking sector's assets in most of the economies in the sample

Macroeconomic variables

- **real gross domestic product growth rate**
- **unemployment rate**
- **exchange rate** (value of local currency per US dollar; increase indicates depreciation of the local currency)
- **inflation rate**
- **VIX index,** capturing financial volatility

Notes: Bank-level data were taken from Bankscope. Macroeconomic variables all taken from CEIC. The VIX is taken from Bloomberg.

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Estimation Results Dynamic Panel (1995-2014)

Fixed Effects Estimation (Dependent variable NPL ratio)

Model	(1)	(2)
Bank-level variables		
NPL ratio (lagged)	**0.689*** **	**0.697*** **
Equity-to-assets ratio (lagged)	**–0.004***	–0.005
Return on equity (lagged)	**–0.001***	**–0.002***
Loans-to-deposits ratio (lagged)	**0.001*** **	**0.001*** **
Loans growth rate (lagged)	**0.0005*** **	**0.0004*** **

Model	(1)	(2)
Macroeconomic variables		
Change in unemployment rate	**0.129*** **	**0.129*** **
Inflation (lagged)	**0.010****	**0.010****
Exchange rate	0.000	0.000
Change in real GDP (lagged)	**–0.017*** **	**–0.017*** **
Volatility Index	**0.007*** **	**0.006*** **
Asian financial crisis dummy		**0.383*** **

Notes: *** = significant at 1%, ** = significant at 5%, * = significant at 10%. Full results available in the appendix. Note that models 1 and 2 correspond to models 2 and 3 in the full results.
Source: Author's calculations using data from Bankscope database (accessed February 2016), CEIC database (accessed October 2017), and Bloomberg (accessed May 2016).

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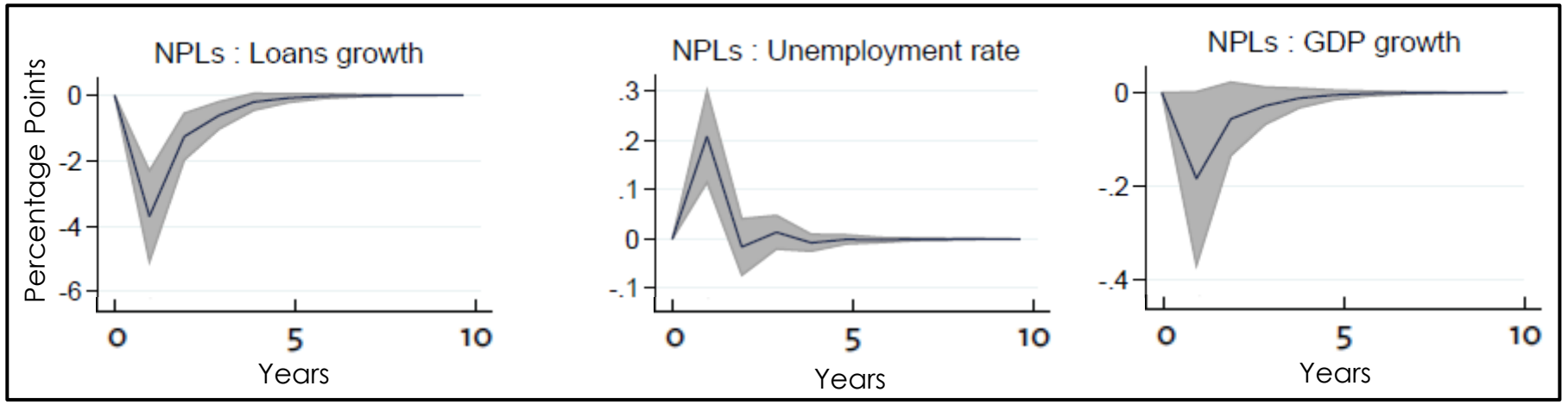
Buildup of NPLs can affect real sector and spill over through macrofinancial linkages

- **Macrofinancial feedback effects:** Empirical findings show that an increase in NPLs leads to a reduction in credit supply, a rise in unemployment, and slowdown in overall economic activity

Estimated Impulse Response Functions to a Shock in the NPL Ratio



Source: Lee and Rosenkranz (2020)

Cross-border implications of NPLs

The Impact of Nonperforming Loans on Cross-Border Bank Lending: Implications for Emerging Market Economies, Park and Shin (2020)

- Emerging market borrowers could suffer a significant increase in capital outflows if the NPL ratios of both lenders and borrowers rise.
- International banks withdraw funds from emerging economies in response to the increase in the NPL ratios of either advanced or emerging economies, or both.
- Buildup in NPLs can heighten global banking instability amid increasingly connected financial markets

Impact of Nonperforming Loans on Banking Outflows from Emerging Market Economies
(LBS total cross-border foreign claims; Dependent variable growth rate of banking outflows)

Variables	(1)	(2)	(3)	(4)	(5)
NPL ratio lender	0.851***	0.909***	0.688***	0.875***	0.696***
	[0.088]	[0.114]	[0.118]	[0.119]	[0.121]
NPL ratio borrower		0.519***	0.481***	0.587***	0.495***
		[0.044]	[0.045]	[0.051]	[0.049]
Year fixed effects	No	No	Yes	No	Yes
R-squared	0.008	0.03	0.084	0.049	0.111
Observations	11,113	6,176	6,176	4,428	4,428

Notes: The dependent variable is the growth rate of banking outflows calculated using LBS total cross-border foreign claims. Columns (1)-(5) are estimated by pooled ordinary least squares. Year fixed effects are added in columns (3) and (5) but the coefficients are not reported. Columns (4) and (5) include the following non-reported additional regressors: Increase in current account; Real exchange rate change; Increase in credit; Reserve/M2; GDP growth; Inflation; and Rule of law. The sample period is from 2000–2017. Numbers in brackets are robust standard errors. The asterisks denote significance levels. *** at 1% ** at 5% and * at 10%.
Source: Park and Shin (2020)

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Empirical work for Europe

Do NPLs matter for bank lending and the business cycle in euro area countries?, Huljak, Martin, Moccero and Pancaro (2020)

- Bayesian panel VAR approach with country-specific dynamics
- Quarterly panel over 12 years (2006-2017) for 12 euro area countries (AT, BE, CY, EE, FR, GR, IE, IT, LT, NL, PT, ES).
- Inclusion of a large set of variables including e.g. distinction between NFC and household lending and spreads
- Use of Bayesian model due to (1) the relatively short data series for NPL and (2) the relatively large number of parameters included
- Model captures a common component across countries while allowing for cross-country heterogeneity in response to shocks – appropriate set up for analyzing deeply integrated (euro area) economies

Empirical work for Europe – Methodology

The identification scheme

- Choleski decomposition (e.g., De Bock / Demyanets 2012) to estimate the impact of changes in NPL ratios
- Variables earlier in the ordering considered relatively more exogenous than variables appearing later
  - Rate of change of bank lending (NFC and mortgages)
  - Change in NPL ratio
  - Macroeconomic variables (GDP growth and inflation)
  - Real estate prices
  - Bank lending spreads (for NFC and mortgages)
  - Bank capital and reserves
  - Monetary policy rate
- Similar ordering as in Hancock et al. (1995), Klein (2013) and De Bock and Demyanets (2012)

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Empirical work for Europe – Results

Four sets of results presented in the paper

- Impulse response functions to a shock in NPL ratios
- Out-of-sample structural conditional forecast
- *Share of forecast error variance, i.e. to what extent is the variable driven by the NPL shock (see Annex and paper)*
- *Robustness checks (see Annex and paper)*

Empirical work for Europe – Results

Impulse response analysis

- One standard deviation shock to the change in the NPL ratio

- Main impacts:
  - *Decline in bank lending – stronger for NFC lending (up to 1.7 pp) than for mortgages (up to 1 PP)*
  - *Widening in bank lending spreads*
  - *Decline in residential property prices (up to -3.4 pp)*
  - *Decline in GDP growth in most countries (up to 1 pp)*

- Significant heterogeneity across countries, with high NPL countries being (not surprisingly) being more strongly affected

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Empirical work for Europe – Results

Structural out-of-sample analysis

- Focus of the analysis in on the six most relevant variables and the six 'high NPL' countries; 'forecast' covers eight quarters

- Two scenarios (for details see the Annex):
  - *Baseline: Change in NPL ratio assumed to be in line with last four quarters (green)*
  - *Adverse: Change in NPL ratio assumed to be zero (red)*

- Results show – as expected – positive effects of a further reduction of NPL ratios on macroeconomic and banking variables
  - *Higher growth of mortgage lending (+1.4 to 2.9 pp)*
  - *Higher growth of NFC lending (+0.9 to 4.4 pp)*
  - *Higher residential real estate prices (+1.6 to 6.7 pp)*
  - *Higher GDP growth (+0.5 to 1.6 pp)*

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Main empirical findings

- Both macroeconomic indicators and bank-level variables explain the evolution of banks' NPL ratio
- An exogenous increase in the NPL ratio negatively impacts financial and macroeconomic conditions
  - It depresses bank lending volumes, widens bank lending spreads and leads to a fall in real GDP growth and residential real estate prices
- Findings suggest that reducing banks' NPL ratios can produce significant benefits in terms of improved macroeconomic and financial conditions
- Analysis for Asia also show that the evolution of NPLs can yield cross-border implications

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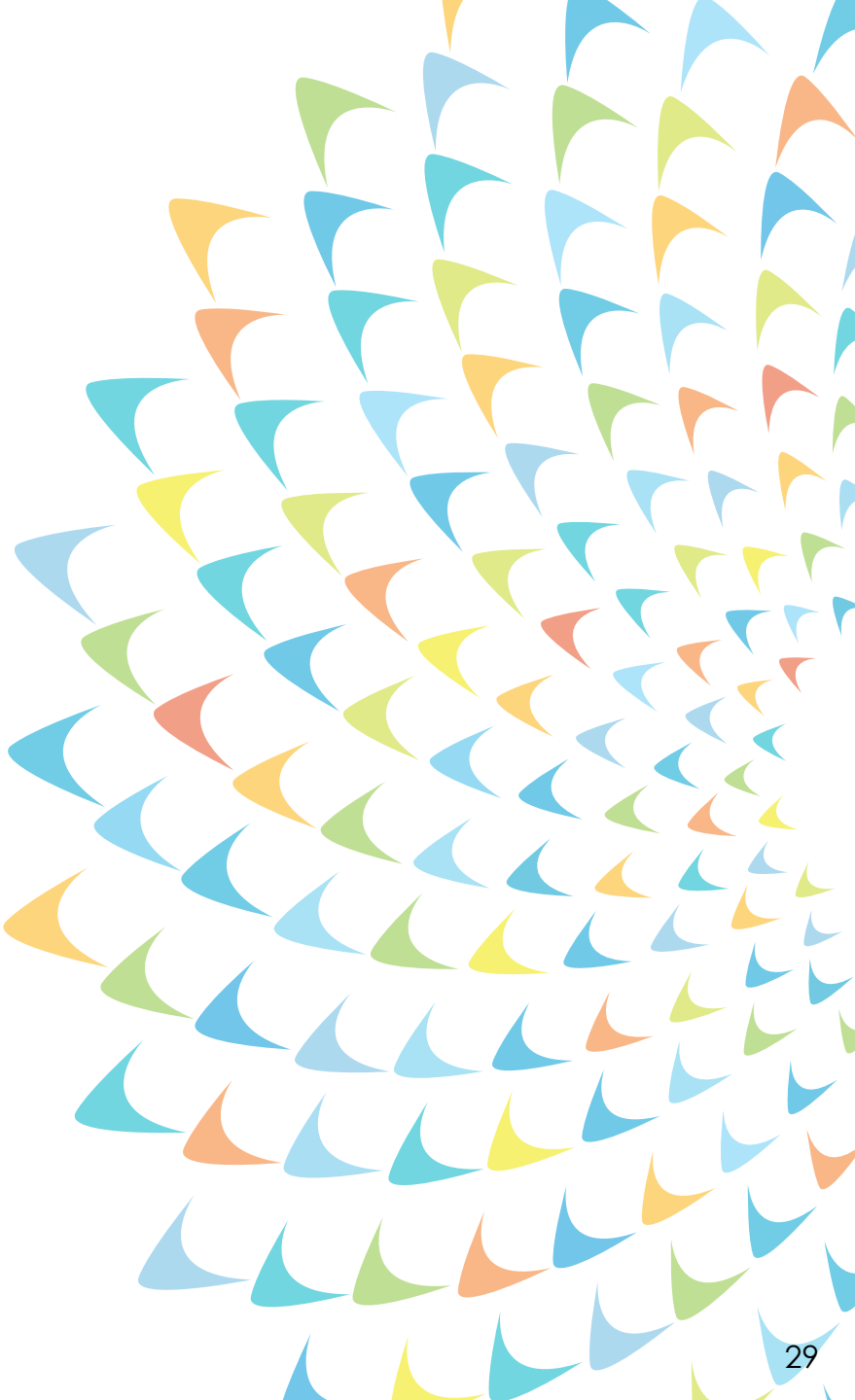
3. CONCLUSIONS



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Key Messages

- Past regional financial and economic crises severely affected Asian (and global) financial markets.
- The Asian financial crisis (AFC) triggered an increase in NPLs, particularly in East and Southeast Asia
- Since then, NPL levels have come down substantially and mostly remain moderate.
- Recent rise in NPLs in some Asian economies, as well as the ongoing COVID-19 pandemic, calls for close monitoring.
- Meanwhile, financial markets have become more interconnected, which also entails some potential risks—such as increased risk of financial contagion and financial market volatilities.
- Empirical findings show macrofinancial feedback effects of NPLs:
  - Both macroeconomic conditions and bank-specific factors contribute to an NPL buildup
  - An increase in NPLs likewise affects financial and macroeconomic conditions

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Thank you for your attention!

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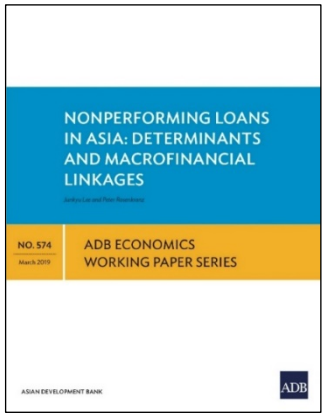
ADB Economics Working Paper

Nonperforming Loans in Asia: Determinants and Macrofinancial Linkages



ADB Brief

The Impact of Nonperforming Loans on Cross-Border Bank Lending: Implications for Emerging Market Economies

ADB-ECB Workshop on NPL Resolution in Asia and Europe

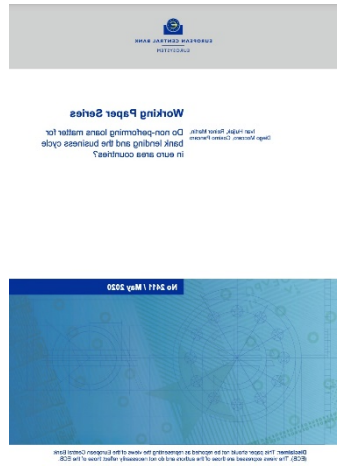
10-11 February 2020

Asian Development Blog

Pandemic Highlights the Need to Manage Asia's Debt Problem

ECB Working Paper

Do non-performing loans matter for bank lending and the business cycle in euro area countries?



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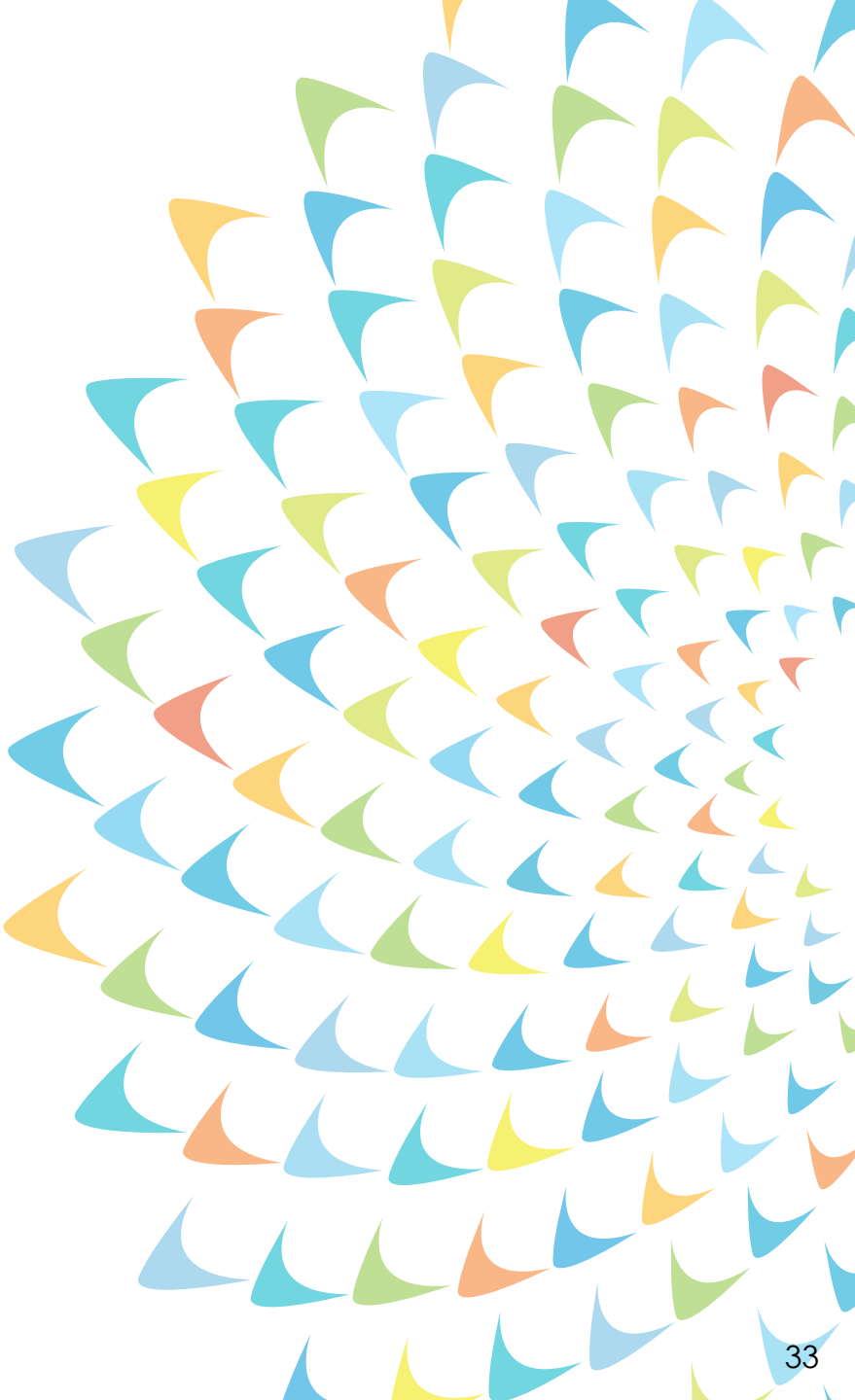
ANNEX SLIDES



Additional literature on NPLs (Asia)

- **Macroeconomic determinants**
  - Roy (2014) investigates the drivers of NPL ratio in **India** using panel data for 5 bank groups from 1995-2012
  - Ha, Trien, and Diep (2014) analyze the macroeconomic determinants of the NPL ratio in **Viet Nam** using panel data for 8 commercial banks from 2008Q4-2013Q2
- **Bank-specific determinants**
  - Hassan, Ilyas, and Rehman (2015) test the importance of bank-specific variables along with social factors (e.g. political interference, management competence) in driving NPLs in **Pakistan's** banking sector
  - Karim, Chan, and Hassan (2010) test the bad management hypothesis proposed by Berger and DeYoung (1997) using data from **Malaysian and Singaporean** banks

Data (Lee and Rosenkranz 2020, Dynamic Panel)

- This paper uses panel data of **individual banks' balance sheets** from *Bankscope* and macroeconomic indicators from CEIC
- The sample covers **annual data for 1995-2014**. Bank-level data consists of **165 commercial banks in 17 economies** in Emerging Asia
- The dataset covers more than 60% of the banking sector's assets in most of the economies in the sample

Number of Banks in Sample and Their Share in Commercial Bank Total Assets

Country	Banks (number)	% of Total Assets
Bangladesh	20	78.32
Georgia	8	91.13
Hong Kong, China	3	58.28
India	14	71.96
Indonesia	12	71.10
Japan	13	56.30
Kazakhstan	8	71.39
Korea, Republic of	12	72.43
Kyrgyz Republic	2	43.15
Malaysia	14	89.66
Pakistan	9	79.16
Philippines	5	67.62
PRC	9	52.42
Singapore	2	53.83
Sri Lanka	9	86.97
Thailand	15	85.70
Viet Nam	10	63.73

PRC = People's Republic of China.
Source: Authors' calculations using data from Bankscope database (accessed February 2016).

Dynamic panel data (DPD) model

- We estimate the following DPD model:

$$y_{i,t} = \rho y_{i,t-1} + \alpha B_{i,t-1} + \beta C_{i,t} + \gamma G_t + \varepsilon_{i,t},$$
$$\varepsilon_{i,t} = u_i + e_{i,t},$$

where the dependent variable $y_{i,t}$ denotes the **logit transformation of the NPL ratio** for bank i at year t

- The regressors: $B_{i,t-1}$ denotes the vector of **lagged bank-level variables** $(earatio,\ roe,\ ldratio,\ \Delta loans)$; C_t denotes the vector of **country-specific macroeconomic indicators** $(\Delta unemprate,\ inf, exrate,\ \Delta gdp)$; and G_t represents the vector of **global variables** $(vix, dummy\_afc)$ where $dummy\_afc$ is an event dummy variable to control for the **Asian financial crisis in 1998**
- The term $\varepsilon_{i,t}$ denotes the composite error term consisting of bank fixed effects, u_i, and the idiosyncratic term, $e_{i,t}$

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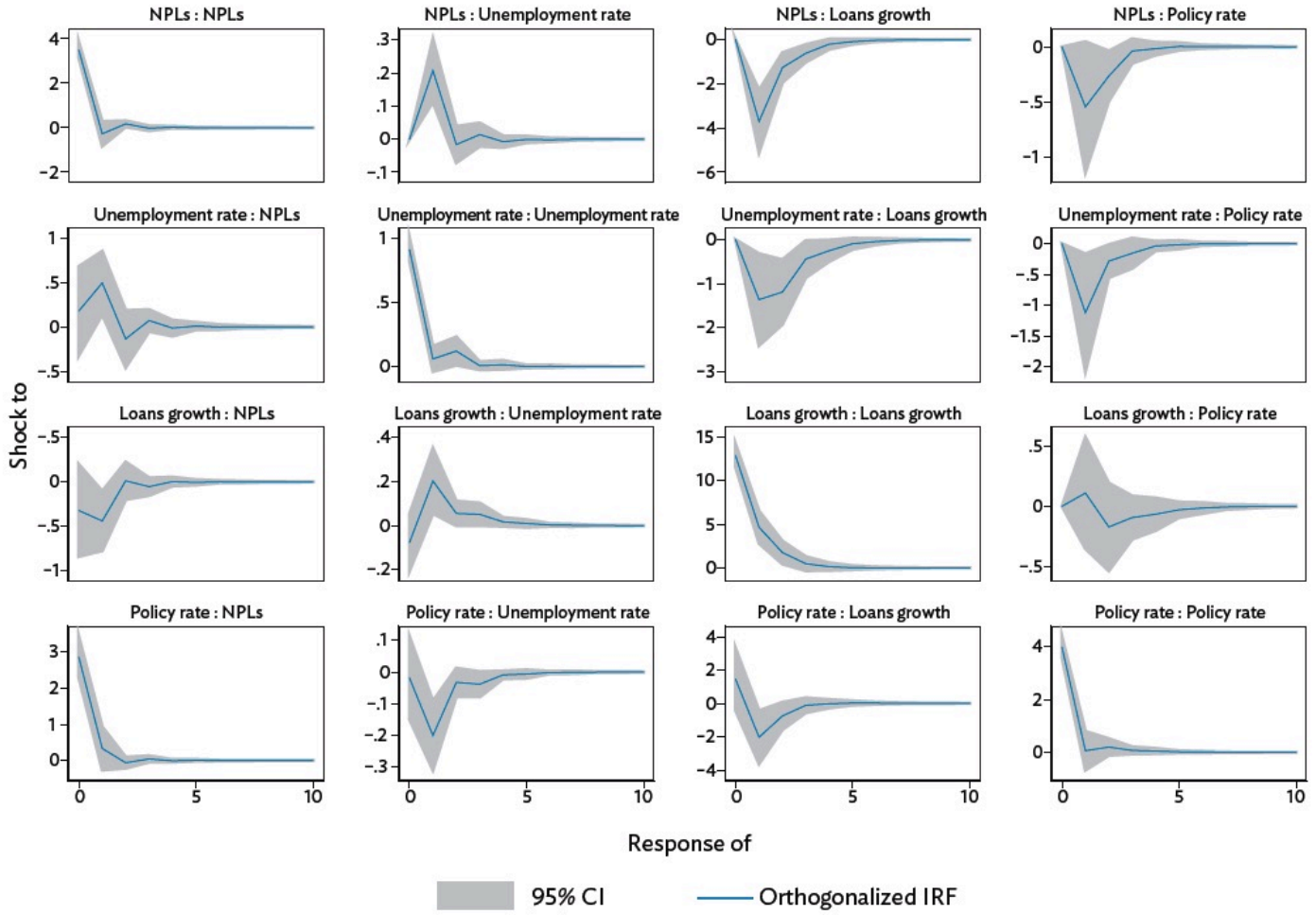
Macrofinancial feedback effects of NPLs in Asia: Panel VAR analysis

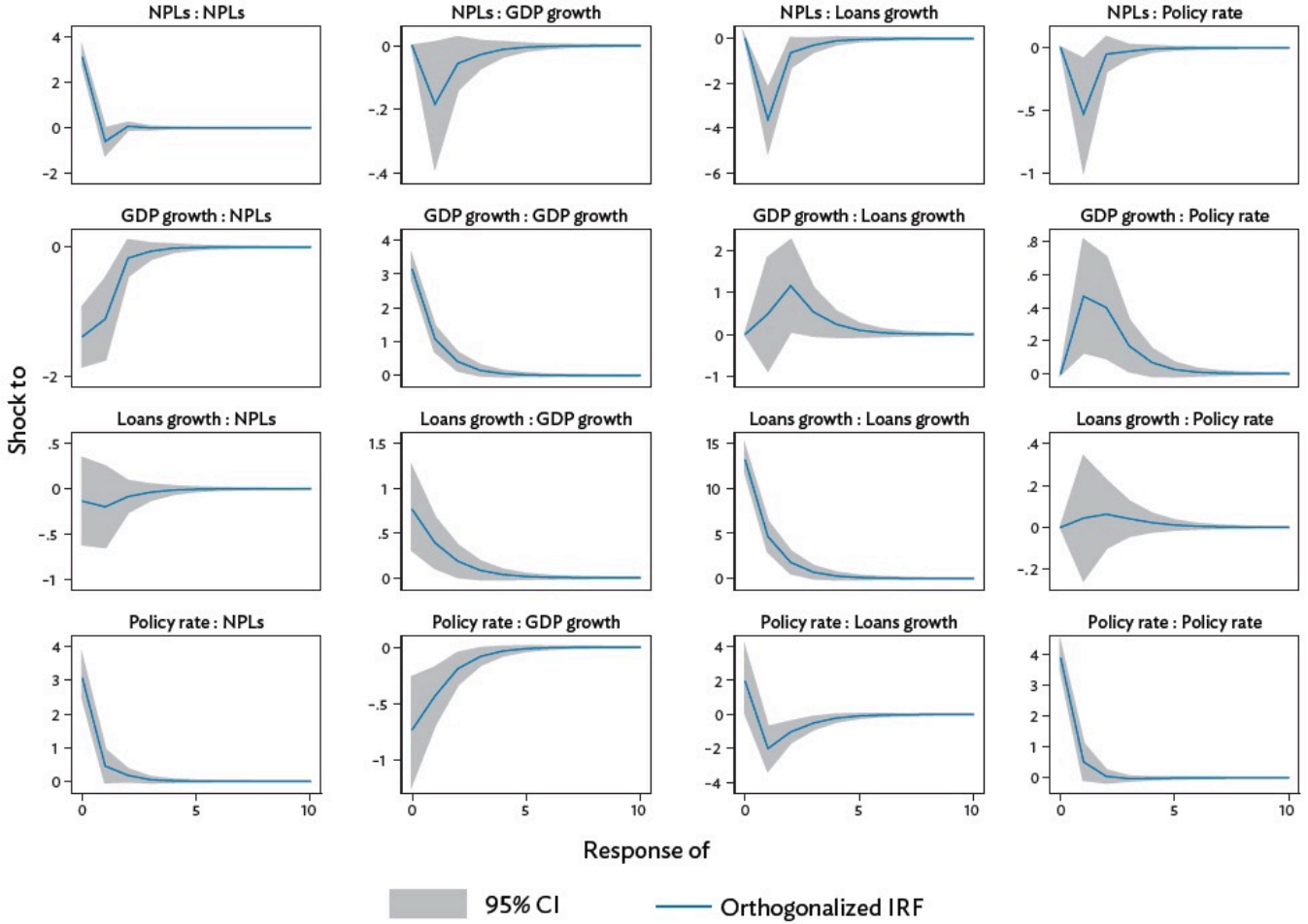
- Panel data of annual macroeconomic and financial indicators covering 32 EAEs from 1994-2014
- **Variables in model:** policy rate, loan growth rate, unemployment rate, GDP growth, and NPL ratio
  - Panel vector autoregression (PVAR) model
  - Impulse response analysis to estimate effects of an exogenous shock to NPLs
  - Identification: Choleski decomposition, recursive ordering

PVAR Asia: Orthogonalized Impulse Response Functions, Baseline Model



CI = confidence interval, GDP = gross domestic product, IRF = impulse response function, NPL = nonperforming loan.
Notes: 95% confidence intervals are generated by 5,000 Monte Carlo draws. Empirical results have been derived using Stata 13 software.
Source: Author's calculations using data from Bankscope database (accessed February 2016) and CEIC database (accessed October 2017).

PVAR Asia: Orthogonalized Impulse Response Functions, Specification 2



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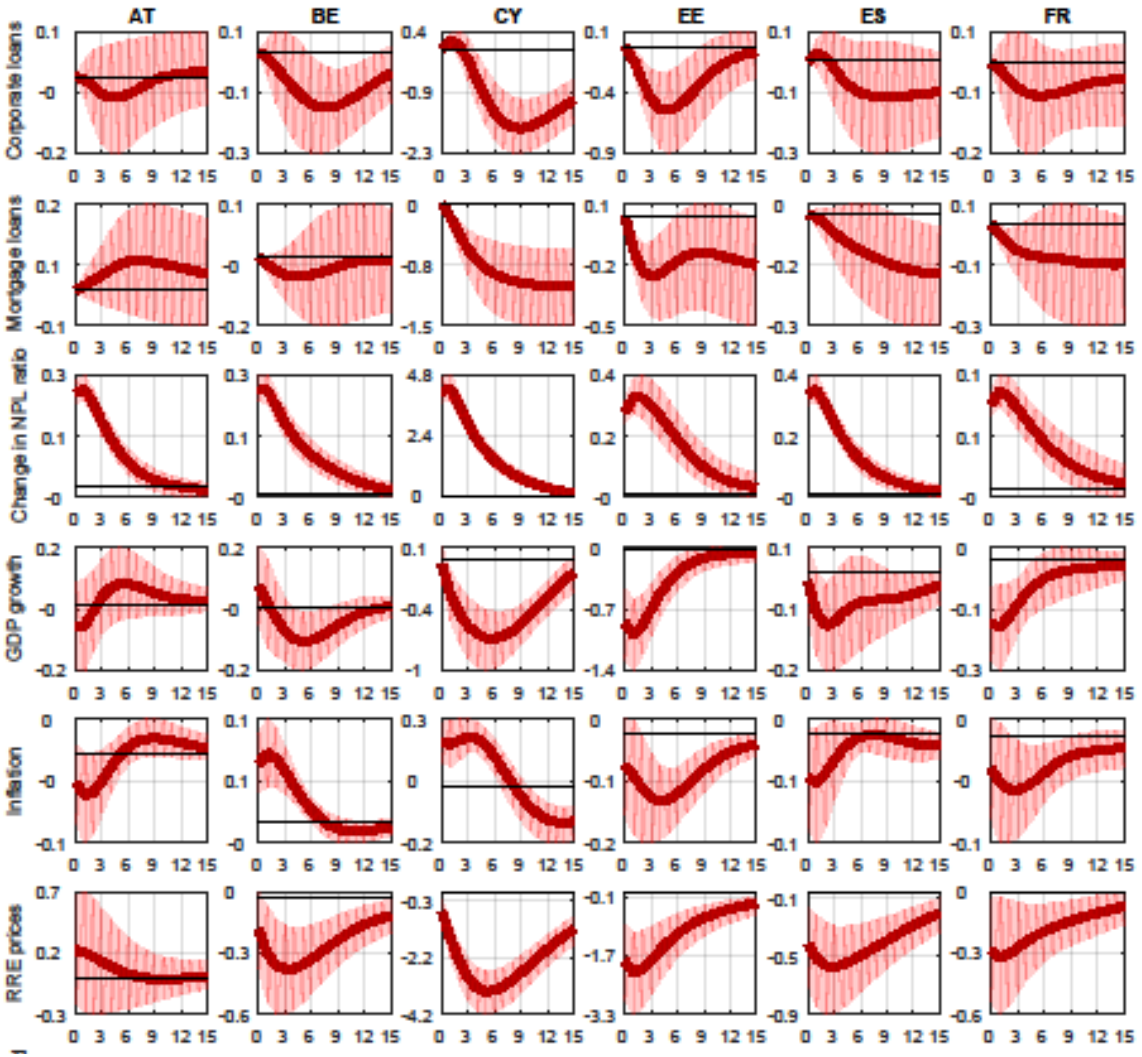
Empirical work for Europe – Data

Included variables

- Annual change in NPL ratio, p.p. (IMF FSI, national sources, bank level data).
- Policy interest rate: Eonia (ECB).
- Economic activity: Y-o-Y growth rate of real GDP (Eurostat).
- Inflation: Y-o-Y growth rate core HICP (Eurostat).
- Residential real estate prices (Eurostat)
- Bank lending volumes: Y-o-Y growth rate in lending to *non-financial corporations* and *households for house purchases* (BSI).
- Bank lending spreads: difference between bank lending rates and Euribor (to NFCs and for mortgages (MIR)).
- Capital ratio: capital and reserves to asset ratio (BSI).

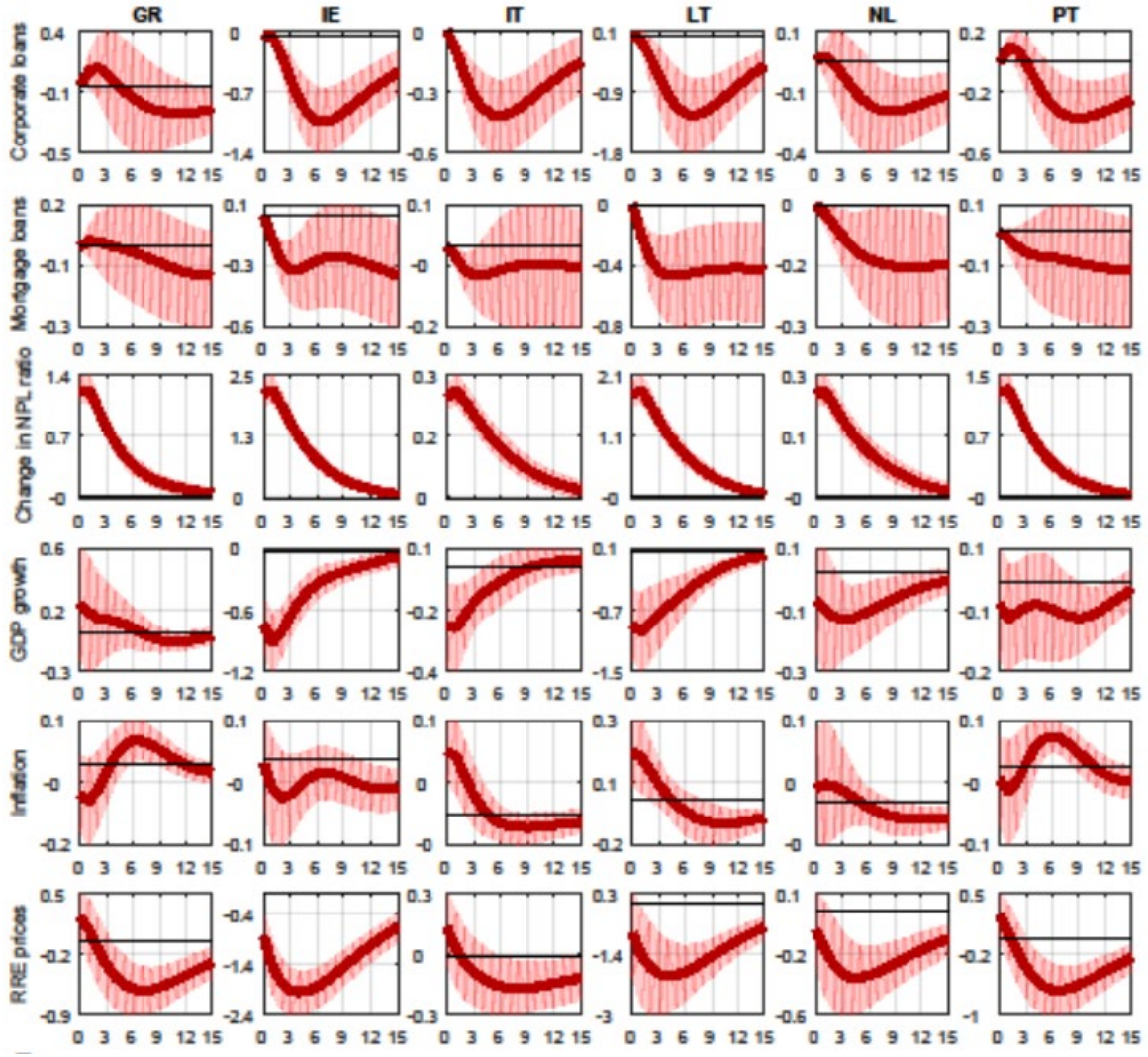
Empirical work for Europe – Results

Impulse response analysis (2)



Empirical work for Europe – Results

Impulse response analysis (3)



Empirical work for Europe – Results

Forecast error variance decomposition

- Analysis shows share of forecast error variance explained by exogenous shocks to other variables

- Shock to the change in the NPL ratio explains non-negligible share of most variance included in the VAR:
  - *Sizeable drivers of real GDP growth, although with significant cross-country heterogeneity*
  - *Explained share of variance larger for NFC lending than for mortgages*
  - *In some countries, significant shares of variance in residential real estate prices*

- Again, there is significant heterogeneity across countries, with high NPL countries being more strongly affected

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Empirical work for Europe – Results

Structural out-of-sample analysis (2)