National Bank of Ukraine

Estimating the Optimal Capital Adequacy Level for Ukrainian Banking Sector

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Yuliya Bazhenova

National Bank of Ukraine

The views expressed in this study are solely those of the author and do not necessarily reflect those of the National Bank of Ukraine. The results of this study were published in Bazhenova, Y. (2026). Estimating the optimal capital adequacy level for Ukrainian banking sector. Baltic Journal of Economics, 26(1), 52–82. https://doi.org/10.1080/1406099X.2026.2668211

Introduction

How much bank capital is enough?

- **More capital makes banks safer**
  Greater loss-absorbing capacity and resilience
- **But resilience comes at cost**
  Higher funding costs and potentially weaker lending and economic activity
- **The key challenge: finding the optimal balance**
  Between financial stability gains and macroeconomic costs of higher capital
- **Ukraine provides an important case**
  Severe past banking crises, followed by a strengthening of capital requirements

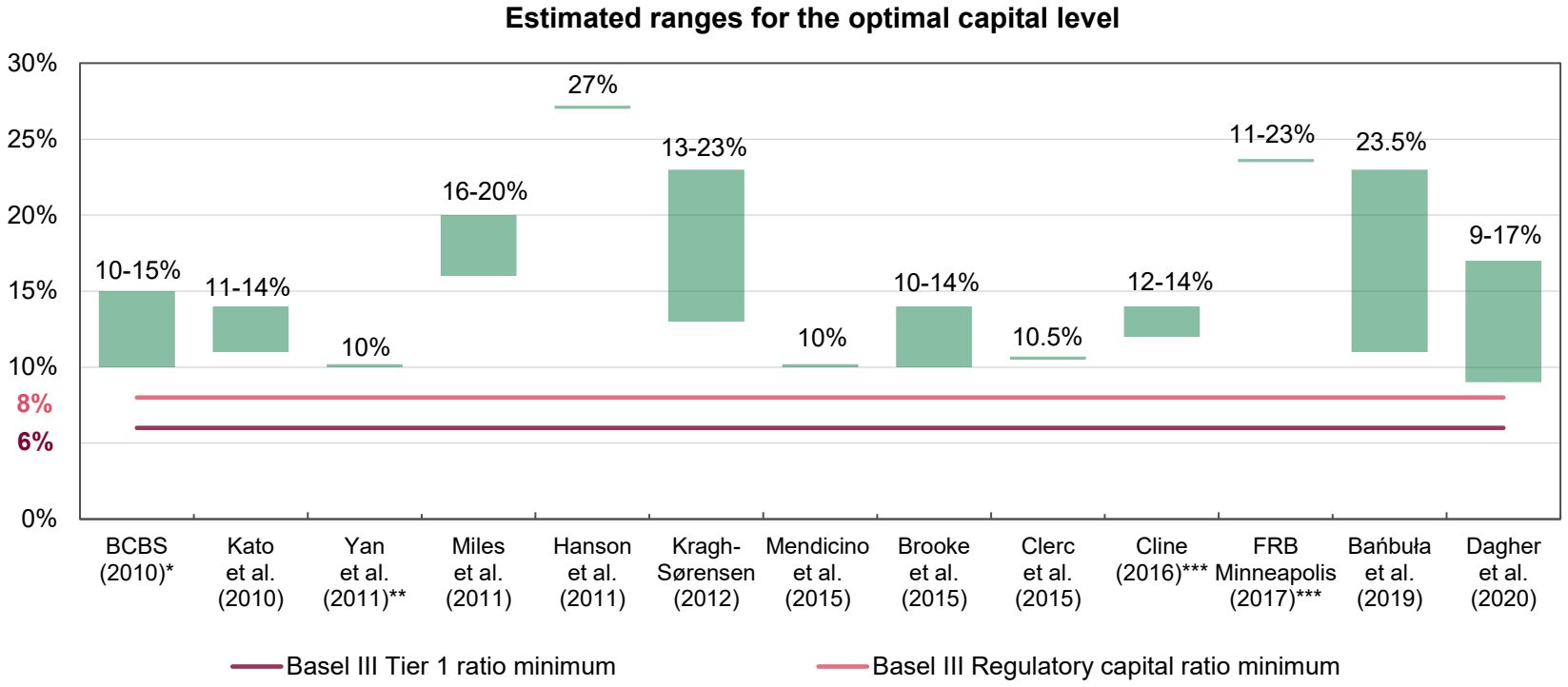
Research questions

- **What is the net effect of higher bank capital requirements on the economy?**
- **What level of capital is sufficient to absorb crisis losses while avoiding significant costs to the economy?**

Related literature

- **Cost-benefit approach**
  - **The impact of capital requirements on the probability of banking crises**
    - *reduced-form models*: Barrell et al. (2009), BCBS (2010), Kato et al. (2010), Brooke et al. (2015), Firestone et al. (2017), Bańbuła et al. (2019), Lang et al. (2019); *portfolio models*: Tarashev and Zhu (2008), BCBS (2010); *stress-testing models*: Gauthier et al. (2012)
  - **Expected output loss associated with a crisis**
    - *temporary output loss*: Hoggarth et al. (2001), Bordo et al. (2001), Hutchison and Noy (2005), Cecchetti et al. (2009), Haugh et al. (2009), Reinhart and Rogoff (2009), Laeven and Valencia (2020); *permanent output loss*: Abiad et al. (2009), Barrell et al. (2009), Furceri and Zdzienicka (2010), Boyd et al. (2005)
  - **The impact of an increase in capital ratios on output**
    - *DSGE models*: Van den Heuvel (2008), Meh and Moran (2010), Dellas et al. (2010); *semi-structural models*: Locarno (2011); *VAR/VECM*: Wong et al. (2010), Yan et al. (2012), Bańbuła et al. (2019)
- **Macrofinancial models**: *DSGE models*: Clerc et al. (2015), Mendicino et al. (2015); *semi-structural models*: Beneš et al. (2023), Budnik et al. (2023)

Recent studies find optimal capital above Basel minimum



Note: Tier 1 to risk-weighted assets (RWA) ratio unless indicated. * – Tangible common equity to Basel II RWA; ** – Tangible common equity to Basel III RWA ; *** – CET1 to Basel III RWA. Source: own elaboration based on the literature.

What we do

We answer research questions using a **cost-benefit approach**:

- The **benefit** of the high capitalization of the banking system is a reduction in the probability of a crisis.
- In contrast, **macroeconomic costs** arise because stricter capital requirements may slow down lending and real GDP growth.
- The **net economic effect** is calculated as the difference between the expected benefits and costs of higher capitalization and is measured in terms of GDP.
- Finally, the marginal net effect is used to identify the **optimal capital range**.

		Expected benefits				Expected costs
Net effect of higher capital	=	**Reduced crisis probability**	x	**GDP loss related to crisis**	–	**Lower GDP growth due to slower lending**

Benefits: Crisis probability estimation

- **Model**: We estimate the probability of a crisis for various Tier 1 capital adequacy ratios from a regulatory minimum of 7% to 35% by applying **panel logit models**:

$$y_{it}^{*} = \beta_0 + \sum_{k=0}^{K} \beta_k Tier1_{i,t-k} + \sum_{m=0}^{M} \delta_m X_{i,t-m} + \gamma' W_{it} + \mu_i$$

$$\Pr(y_{it} = 1) = \Lambda(y_{it}^{*}) \qquad y_{it} = \begin{cases} 1, y_{it}^{*} > 0 \\ 0, y_{it}^{*} \leq 0 \end{cases}$$

- **Data**:
  - Quarterly from Q1 2000 to Q4 2020
  - Country-level data for **39 countries**, including members of the OECD
  - Two samples: the first – OECD and other countries, and the second – Ukraine's peer countries

- **Banking crisis variable**:
  - Databases of Lo Duca et al. (2017), Laeven and Valencia (2020), Reinhart and Rogoff (2014), Iacovone and Zavacka (2009)
  - OECD and other countries: **40 banking crises** across 39 countries, Ukraine's peer countries – **18 banking crises** across 14 countries

Logit models estimation results

	OECD and other countries			Peer countries		
	Estimate	z-value	Pr(>|z|)	Estimate	z-value	Pr(>|z|)
Tier 1 ratio$_t$	-23.589	-5.299	0.000***	-26.718	-2.993	0.003***
	(4.452)			(8.928)		
Tier 1 ratio$_{t-1}$	-6.308	-1.846	0.065*	-11.530	-2.281	0.023**
	(3.417)			(5.056)		
Credit-to-GDP gap$_t$	-5.268	-3.743	0.000***	-3.121	-2.032	0.042**
	(1.407)			(1.536)		
VIX$_t$	0.058	5.598	0.000***			
	(0.010)					
Fixed effects	No			No		
Random effects	No			No		
Number of observations	1286			551		
Number of crisis observations	282			113		
Number of unique countries	28			11		
Pseudo-R^2 (McFadden)	0.21			0.16		
AIC	1084.85			467.75		

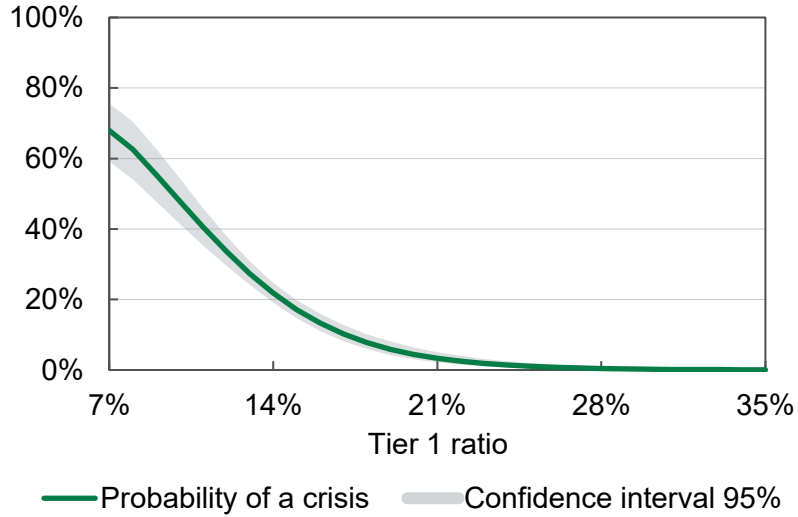
Notes: Significance codes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors are shown in parentheses. The intercept is estimated, but not shown to preserve the place. For the sample of OECD and other countries, a one percentage point increase in the Tier 1 ratio reduces the odds of a crisis by 23.6%, while for the sample of peer countries the odds decrease by 37.8%.

Source: own calculations.

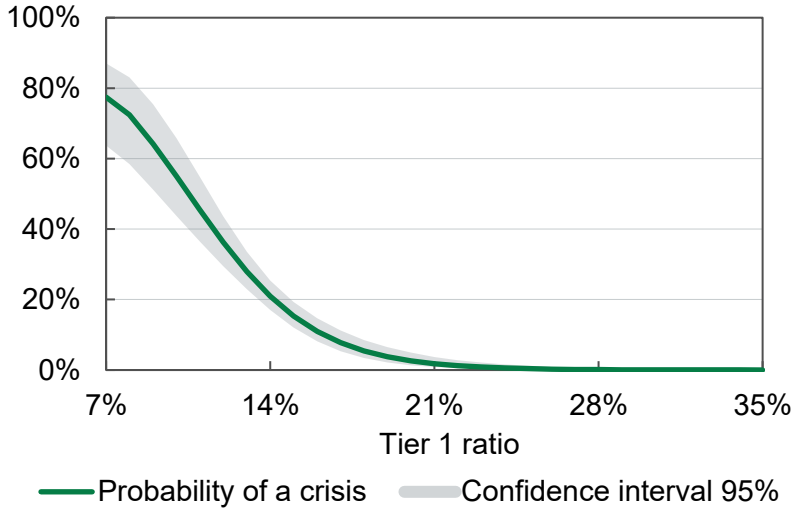
Higher capitalization reduces the probability of crisis

- Beyond the **Tier 1 ratio of 20%**, the predicted probability of a crisis approaches zero and further increases in capital ratios generate only negligible improvements in financial stability.
- At the minimum regulatory capital level of 7%, the predicted crisis probability reaches 0.68 for the sample of all countries and 0.78 for the peer-country sample.

Probability of a banking crisis for various levels of Tier 1 ratio



(a) OECD and other countries



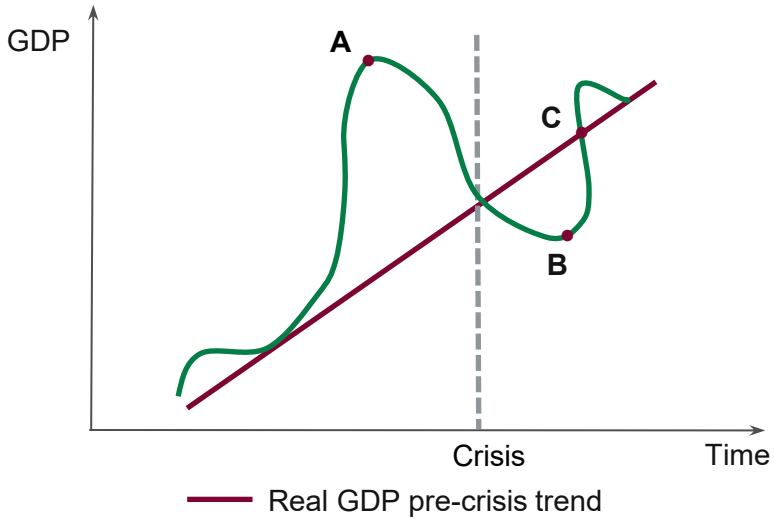
(b) Peer countries

Source: own calculations.

Benefits: GDP loss associated with banking crisis

- Based on the data on the three Ukrainian crises during 2008–2021, an average level of GDP decline was calculated, which is equal to **9.8%** of the pre-crisis level of real GDP.

Schematic view of the GDP level and fall associated with a banking crisis



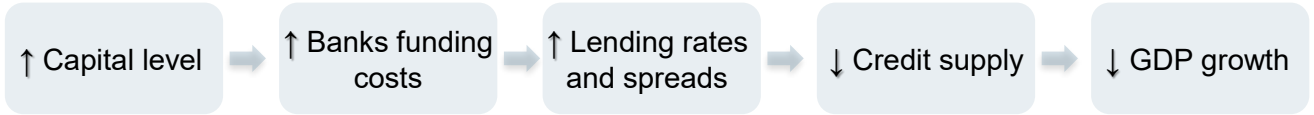
Output losses associated with crises calculated on Ukrainian data

Output loss indicator	Real GDP annual growth, 2016=100		
Crisis	2008-09	2014-16	2020-21
The difference between the peak level of output and trough: **between A and B**	-15.0%	-15.7%	-4.0%
The difference between the peak level of output and level of the period until the growth rate recovers to the pre-crisis trend: **between A and C**	-11.7%	-8.5%	-4.0%
Average		**9.8%**	

Note: Point A – the peak pre-crisis level of annual real GDP; point B – the minimum level of real GDP during the crisis; point C – the level of real GDP when it recovers to its pre-crisis trend. Source: own calculations.

Costs: GDP response to capital shock

- We look at the interlinkages between shocks to bank capital and the current state of the economy.



- For this purpose, **structural vector autoregression (SVAR)** models were employed for the Ukrainian aggregate level quarterly data for the period from Q4 2005 to Q4 2021.
- An underlying structural system of equations in the reduced form is the following:

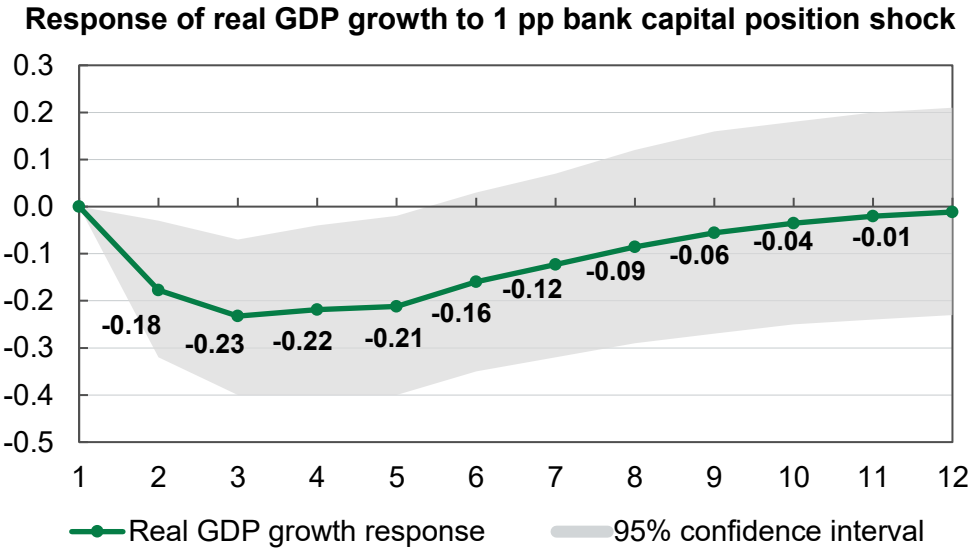
$$y_t = A^{-1}C(L)y_t + A^{-1}Bu_t$$

$$\varepsilon_t = A^{-1}Bu_t$$

- In addition to **Tier1 ratio as capital variable**, we examine models with the **bank capital position**, which is score of the impact of the bank's capitalization on changes in standards for approval of corporate loan applications (NBU Bank Lending Survey).

Costs: GDP response to capital shock

- The results show that a 1 pp increase in capital adequacy slows real GDP growth by **0.31 pp** cumulatively over five years.
- Model variables: Real GDP growth, new loans, lending rate, lending standards, bank capital position.



Note: Responses of real GDP growth are shown on the vertical axis in percentage points. The horizontal axis is the forecast horizon in quarters, which is equal to five years, however, to preserve place we depict only three years. Source: own calculations.

Calculation of net effect of higher capital

- Macroeconomic benefits and costs are calculated cumulatively over a five-year horizon, taking into account time discounting, due to the prolonged effects of higher capitalization.
- Following Bańbuła et al. (2019), the **discounted expected benefits** for each capital level from 7% to 35% is calculated as follows:

$$\begin{matrix}\text{Expected} \\ \text{benefits}\end{matrix} = \begin{matrix}\text{Reduced crisis} \\ \text{probability}\end{matrix} \times \begin{matrix}\text{Discounted output} \\ \text{loss related to crisis}\end{matrix} = \sum_{t=1}^{T} \frac{(p^{CAR_{min}} - p^{CAR_{level}}) \cdot L}{(1+i_1)(1+i_2)\cdot\ldots\cdot(1+i_T)}$$

- In turn, **cumulative expected costs** associate with discounted reduced output linked to higher capital level as is in:

$$\text{Expected costs} = \begin{matrix}\text{Discounted reduced output} \\ \text{related to capital increase}\end{matrix} = \sum_{t=1}^{T} \frac{GDP_t - (1+g-g_t^{SVAR}) \cdot GDP_{t-1}}{GDP^B \cdot (1+i_1)(1+i_2)\cdot\ldots\cdot(1+i_T)}$$

What is the optimal capital level?

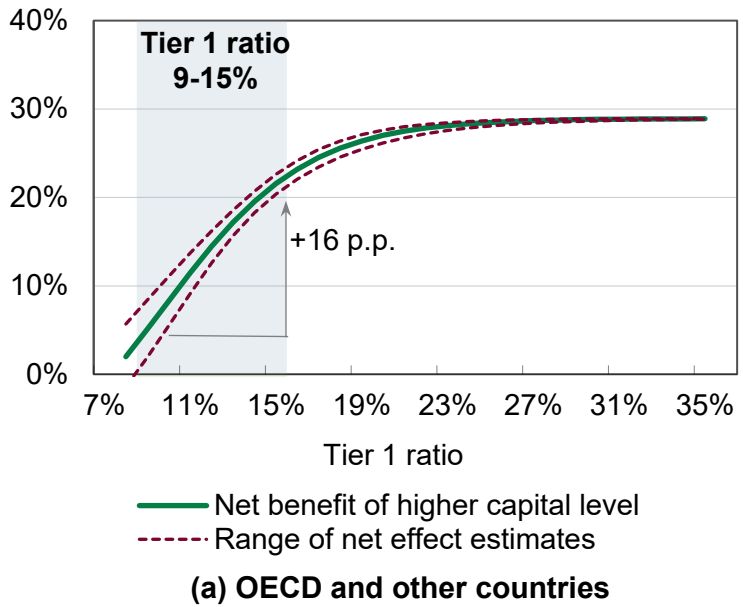
- We accept as **optimal the Tier 1 ratio for Ukrainian banks**, at which the net benefit rise from this level of capital compared to previous is more than **10% threshold**.

- The choice of the 10% threshold is motivated by the need to identify a materially meaningful improvement in net benefits. This approach ensures that increases in the capital ratio are associated with sufficiently strong gains in the cost-benefit balance.

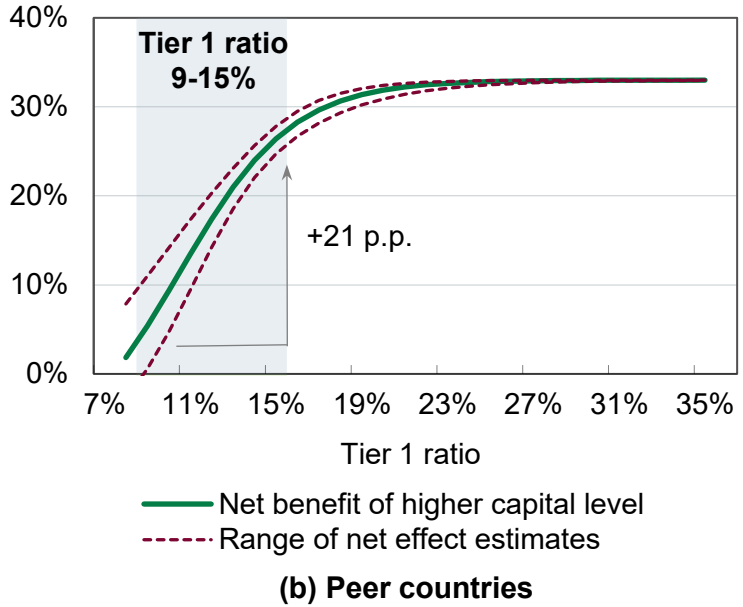
- This optimal level is understood to mean not a regulatory minimum, but rather it represents a certain **capital headroom**, which allows banks to absorb significant losses over the crisis

Optimal capital level

- The estimated **optimal level of aggregate Tier 1 capital** ratio for Ukrainian banks is in the range of **9%–15%**.



(a) OECD and other countries



(b) Peer countries

Source: own calculations.

Concluding remarks I

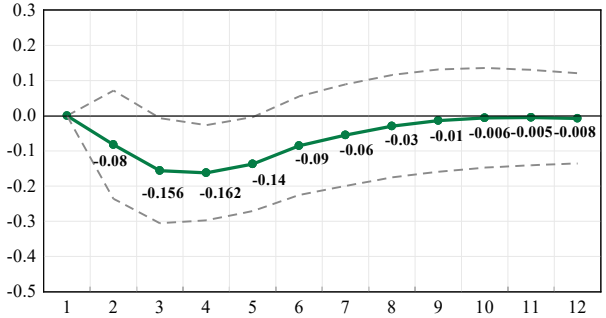
- According to the study's findings, with a Tier 1 capital adequacy ratio of up to 15%, the positive effects on the economy resulting from the enhanced resilience of the financial sector and the reduced probability of crises outweigh the restrictive effects.
- This results provide a quantitative basis for macroprudential policy decisions, – specifically, were used to assess the appropriate timing of capital buffer implementation – and were featured in the NBU Financial Stability Report.
- At present, the Ukrainian banking system is well capitalized, with a Tier 1 ratio of about 17%. Therefore, banks have the necessary cushion. However, the ability of the financial system to withstand shocks is particularly important in the current challenging environment.
- A capital conservation buffer and a systemic importance buffer are currently being introduced in Ukraine, and compliance with elevated capital adequacy ratios (based on SREP results) will become mandatory (planned for 2027–2028).
- Once all planned reforms are implemented, total regulatory capital (which is primarily consists of Tier 1 capital) requirements will increase significantly – from the current 10% to nearly 14% over two years for regulatory capital adequacy.

Concluding remarks II

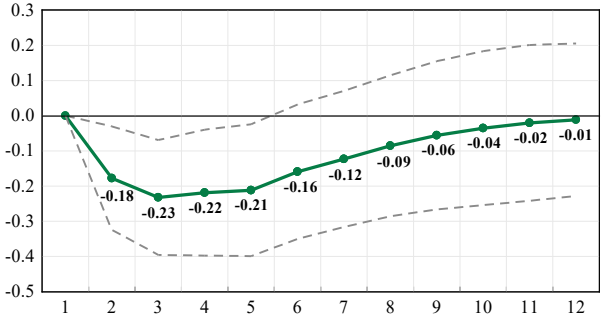
- The optimal capital level methodology, proposed in this study, can be used to evaluate the net effect in the long term for other macroprudential policy instruments such as liquidity requirements etc.
- This approach also allows at each stage of the calculations to flexibly select and synthesize the most appropriate research tools, taking into account the specifics of the country's economic system and the availability of historical data.
- As a further steps, methodology for estimating of optimal capital based on bank-level data can be developed, as well as exploring capital adequacy ratio drivers over different financial cycle phases and estimating related second round effects.

Annexes

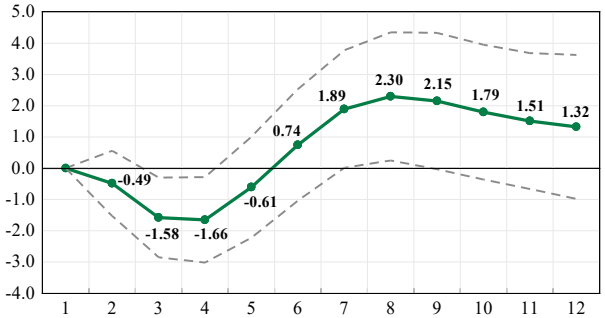
Response of real GDP growth to 1 p.p. capital shock



a. Model variables: Real GDP growth, new loans, money market rate, lending standards, bank capital position



b. Model variables: Real GDP growth, new loans, lending rate, lending standards, bank capital position

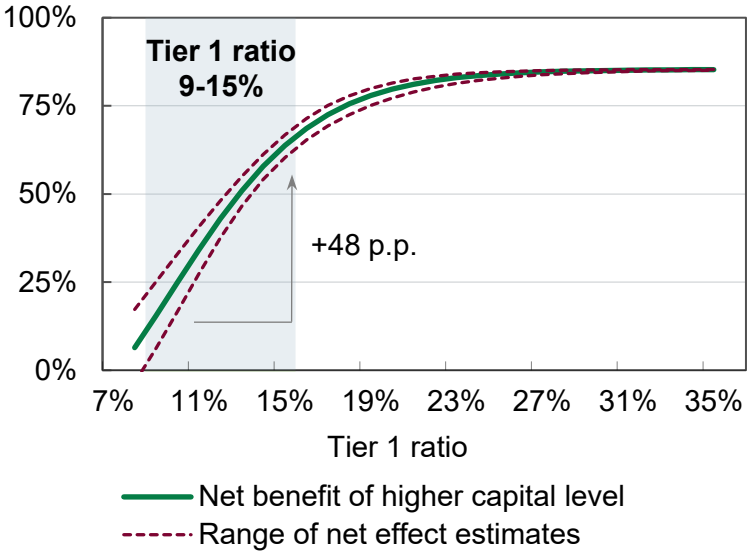


c. Model variables: Real GDP growth, CPI, new loans, lending rate, money market rate, Tier 1 ratio

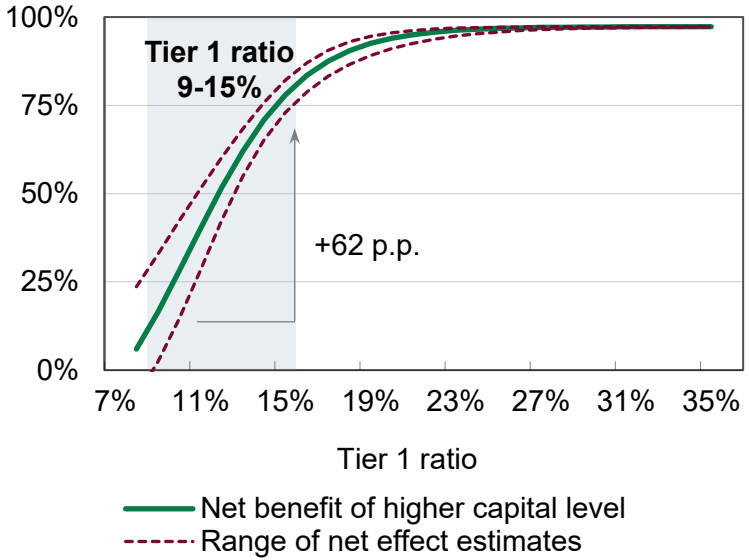
Note: Responses of real GDP growth are shown on the vertical axis in percentage points. The horizontal axis is forecast horizon in quarters. The forecast horizon is five years, however, we depict only three years to preserve a place. Gray dashed lines indicate 95% confidence intervals.
Source: own calculations.

Net benefit depending on the capital level in adverse scenario

- To further explore the policy application of our findings, we examine the GDP decline in 2022 as an extreme stress scenario, reflecting exogenous shocks rather than a standard cyclical downturn. The stress scenario demonstrates that the optimal Tier 1 ratio range of 9–15% remains valid, with higher absolute benefits.



(a) OECD and other countries



(b) Peer countries

Source: own calculations.