

## Banks' complexity-risk nexus and the role of regulation



By Natalya Martynova and Ursula Vogel<sup>1</sup>  
Deutsche Bundesbank

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*This policy brief studies the complexity of banks in Germany, how it relates to banks' risk-taking, and what's the role of regulation for the nexus between bank complexity and bank risk. Bank complexity, an issue not yet well understood, can be measured by how bank organisational structures stretch across countries and industries. We show that bank complexity decreased after the global financial crisis. While more complex banking organizations tend to take on more risk, we show that complexity-risk nexus decreases over time. Announcements of tighter regulations that address systemically important banks in general and complexity more specifically alter banks' choices of complexity and risk. Thereby the post-crisis regulations contributed to reducing banks' complexity-risk nexus.*

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<sup>1</sup> This policy brief is mostly based on [Martynova and Vogel \(2021\)](#). The views expressed in this policy brief are those of the authors and do not necessarily reflect those of the Deutsche Bundesbank or the Eurosystem.

## Introduction

Since the global financial crisis of 2008/2009, regulators have perceived the issue of bank complexity as a feature that impedes bank resolution (Carmassi and Herring 2016) and favors bank risk-taking. Therefore, some provisions of the Basel III package address the issue of too-big-to-fail (TBTf), and some of the capital surcharges increase with peculiarities associated with bank complexity.<sup>2</sup> Yet, despite its application in regulatory policy, the notion of bank complexity remains ambiguous. To determine banks' complexity, studies often follow the concepts of Cetorelli and Goldberg (2014) and Goldberg and Meehl (2020) who argue that bank complexity is adequately captured by measures describing banks' organizational structures as to geographical footprint and the scope of business activities.

Measures of *geographic complexity* capture the number and the cross-country spread of banks' affiliated entities. Affiliates spread among a large number of geographical locations could make it difficult for insiders to manage such a banking organization as well as for outsiders (including investors and supervisors) to evaluate the risks it is undertaking. Positive diversification effects can be reduced further if geographical complexity is used to circumvent some regulations by setting up subsidiaries in the countries with looser regulation. Table 1 shows descriptive statistics of four different measures of geographical complexity: the span of countries where banks' affiliates – banks as well as non-banks – operate (*span\_location*) and the overall number of affiliates abroad (*count\_foreign*), and two similar measures that consider bank affiliates only (*span\_location\_b* and *count\_foreign\_b*).

**Table 1: Bank complexity in Germany**

The table is based on an unbalanced panel of 84 banks in Germany over the years 2005 to 2017 with 945 individual observations in total.

	Complexity measure	Mean	S.D.	Percentiles			
				p25	p50	p75	p95
<b>Geographic complexity</b>	<i>span_location</i>	4.3	8.5	1	1	3	21
	<i>span_location_b</i>	0.4	1.4	0	0	0	2
	<i>count_foreign</i>	21.7	115.6	0	0	3	57
	<i>count_foreign_b</i>	2.3	14.6	0	0	1	5
<b>Business complexity</b>	<i>total_count</i>	63.2	190.7	3	7	24	343
	<i>count_bank</i>	2.8	15.4	0	0	1	7
	<i>count_non_bank</i>	60.4	178.3	3	7	23	336
	<i>count_fs</i>	24.6	101.5	1	3	8	74

Source: Martynova and Vogel (2021).

Measures of *business complexity* capture the range of activities and business lines within a banking organization. Large numbers of business types within a banking organization can raise the difficulty of valuing and managing it and are to be seen alongside possible positive diversification effects. Possible measures for business complexity are the total number of affiliates (*total\_count*), and subsets for bank affiliates (*count\_bank*) and non-bank affiliates (*count\_non\_bank*), as well as the number of affiliates in the financial sector (*count\_fs*).

For all bank complexity measures considered, Table 1 shows that bank complexity exhibits pronounced right skewness, as in all cases the average of a complexity measure is a multiple of its median. Comparatively lower

<sup>2</sup> See BCBS 2010 for the first rules text on the Basel III regulatory framework.

levels of complexity of measures capturing affiliated bank and financial sector entities indicate that bank complexity to a large extent reflects structures outside the banking and financial sector. Beyond that, an investigation of time dynamics shows that all complexity measures keep increasing until the global financial crisis, and then decrease afterwards. This observation may be linked to the overall trend of declining internationalization in banking (see CGFS 2018) or reflect mounting regulatory pressure following the global financial crisis that made banks more sensitive to the costs of managing such vast and complex structures as well as of meeting new regulatory standards.

How banks choose their level of complexity is not yet well understood. In Martynova and Vogel (2021), we argue that banks choose their level of complexity by trading off the associated costs and benefits. While different costs and benefits of complexity exist, we focus on the trade-off between the regulatory costs of complexity and the benefits of bank complexity stemming from organizational and income diversification (Laeven and Levine 2007, Wagner 2010).

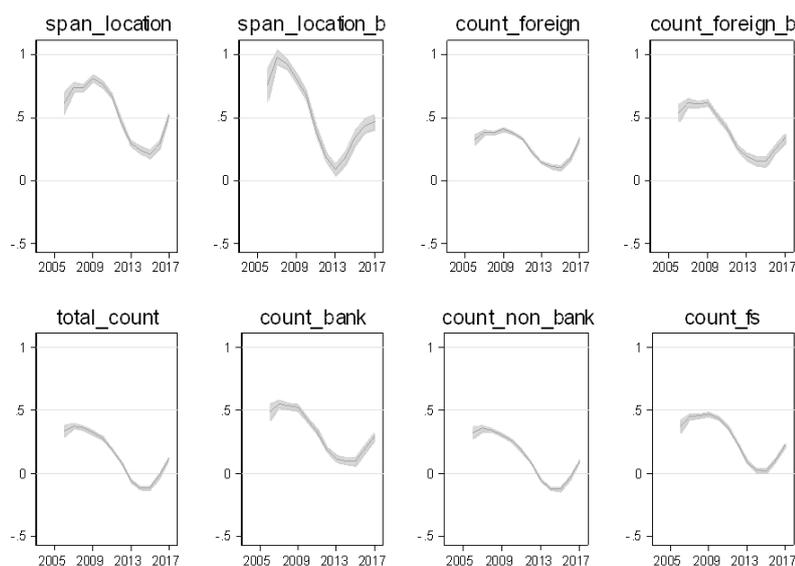
### **Bank complexity and bank risk-taking**

The existing literature is ambiguous on the relationship between bank complexity and bank risk. Some studies suggest that more complex banks can become safer by being able to diversify their activities (Goetz et al. 2016, Cetorelli et al. 2017) or use internal capital markets for efficient liquidity management (Cetorelli and Goldberg 2016). Others show that more complex banks take more risk because of moral hazard problems that arise due to agency problems (Scharfstein and Stein 2000), regulatory arbitrage (Houston et al. 2012) and reduced market discipline (Boot and Schmeits 2000) exacerbated by implicit subsidies from the government (Dam and Koetter 2012).

Hypothesizing that banks strategically choose to be more complex in order to take more risks and hence expecting a positive relationship between the two variables, we explore the empirical relationship between bank complexity and bank risk-taking<sup>3</sup> for a sample of 84 banks in Germany between 2005 and 2017. Using the different measures capturing geographic and business complexity of banking organizations, we find that, for all those measures, higher bank complexity is associated with higher bank risk, i.e. a positive complexity-risk nexus. This result suggests that the diversification motive of complexity is less important than moral hazard that may arise due to agency problems or the lack of market discipline. Yet the strength of this complexity-risk nexus varies over time (see Figure 1). The nexus is most pronounced around the global financial crisis and then is substantially lower for the more recent years that are marked by a comprehensive overhaul of bank regulations, also addressing the TBTF issue and including capital surcharges increasing with bank complexity. The uptick in banks' complexity risk nexus observable for the latest years in the sample stems from more banks showing lower values for risk-taking and thereby aligning lower complexity and lower risk-taking.

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<sup>3</sup> Here bank risk is measured by the natural log of the inverse of the z-score as a measure of idiosyncratic bank risk (Laeven and Levine 2009, Berger et al. 2017), as the z-score is shown to be negatively proportional to the log odds of insolvency (Lepetit and Strobel 2015).

**Figure 1: Time variation of banks' complexity-risk nexus**

The figures show the time variation of banks' complexity-risk nexus per complexity measure. The line represents the time-varying coefficient estimate (y-axis) and the grey-shaded area the 95% confidence intervals. For more information see section 2 of the underlying paper.

Source: Martynova and Vogel (2021).

Noting that the decrease of the nexus coincides with regulatory tightenings in the wake of the global financial crisis of 2008/2009, provides grounds for studying how banks react to the elevated regulatory costs of complexity induced by regulatory changes.

### Regulation and banks' complexity-risk nexus

Since the substantial overhaul of the bank regulatory framework, in particular systemically important banks (SIBs) face higher requirements as well as higher regulatory scrutiny, and capital buffers also increase with bank complexity. More specifically, capital needs are substantial for banks' equity investments as these carry comparatively high risk weights. Regulatory tightenings alter the cost-benefit tradeoff of complexity by raising the regulatory costs of bank complexity. It is therefore important to understand whether regulatory tightenings that address systemic importance and bank complexity, internalize related externalities without impairing the benefits complex banks obtain from diversification.

Bank complexity is a result of longer-term strategic decisions. Therefore, it is likely that it responds to announcements of regulatory changes instead of the actual implementation of regulatory tightenings. Announcements of future regulatory tightenings immediately affect banks' strategic choices, which may have implications for banks' organizational structures as well as banks' risk-taking. Announced increases in capital requirements bring banks below their individual target capital ratio, thus making them immediately more capital-constrained.

After the announcement of regulatory tightenings banks decrease complexity by reducing the number of their affiliates. This significantly lowers risk-weighted asset densities for equity investments, i.e. the regulatory costs of

complexity. Surprisingly the reduction in bank complexity does not lead to a decrease in diversification of banks' business operations and banks' income. What's more, SIBs even increased their organizational diversification. In particular, they reduced the share of their bank entities and non-financial subsidiaries, whereas they increased the share of non-bank financial entities and even managed to expand into new financial business areas. By doing so SIBs could achieve higher income diversification. Other banks pursued a similar strategy by shifting from non-financial business areas and banking towards non-bank financial areas. However, there may be a concern that although organizational diversification becomes higher for SIBs, the similar shift in banks' portfolios can have negative systemic risk implications (Wagner 2010).

Regulatory tightenings may also have changed incentives for banks' risk-taking. On the one hand, banks may have increased their risk-taking in order to compensate higher regulatory costs with higher returns. On the other hand, banks may have reduced their risk, in particular their risk-weighted assets' densities, in order to reduce capital requirements.

We find that banks' risk-taking is unrelated to banks' capital constraints in general, yet SIBs reduce risk significantly in response to regulatory tightenings. This relates well to our previous findings that SIBs reduced complexity and at the same time increased their diversification benefits as this suggests that, on the one hand, SIBs' ability to diversify in combination with increasing capitalization may have played a role in lowering their risk. On the other, this could indicate that extra capital surcharges and other reforms aimed at curbing bank complexity were successful at reducing bank risk. Other banks (Non-SIBs) in contrast did not reduce their overall risk-taking, maybe in order not to harm their profitability. Finally we are able to show that banks' complexity-risk nexus in general is reduced after regulatory tightenings.

## Conclusion

Banks show a positive complexity-risk nexus which means that more complex banks take higher risks. Yet, following the post-crisis regulatory reforms this complexity-risk nexus decreased. This finding bodes well for the efficacy of the post-crisis regulatory changes imposed on banks. Those banks that regulators deem systemically important have reduced complexity and risk-taking, yet without compromising on complexity related benefits. While the impact of changes in regulatory capital requirements goes in the right direction, it remains unclear whether systemic risk externalities stemming from bank complexity have been fully internalized. ■

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## About the authors

**Natalya Martynova** is a senior economist in the Research Centre at Deutsche Bundesbank. Her research interests span the field of financial economics with the special interest in financial intermediation. She works on the design of the financial stability regulation with the topics including CoCos, bank complexity and banking supervision. She holds a PhD from the University of Amsterdam (2015). Before joining the Bundesbank, she worked at the research department of De Nederlandsche Bank and visited CEMFI and BIS.

**Ursula Vogel** is a senior financial economist in DG Financial Stability at Deutsche Bundesbank. She has worked extensively on the design and the evaluation of macroprudential policies. Her research interests include financial stability and macroprudential policy, empirical banking, and real-financial linkages. She holds a PhD from Frankfurt School of Finance & Management (2014). During her PhD she visited OeNB, ECB and IMF and conducted part of her research there.

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