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Overcapacities in banking: measurements, trends and determinants

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Abstract

This paper takes an eclectic approach to investigating the notion of overcapacities in banking along the dimensions of (i) banking sector size, (ii) bank competition and (iii) banking infrastructure/efficiency, thereby offering a nuanced and granular view of the topic. In terms of measurement, a newly developed composite indicator synthesises these different layers into a single metric of overcapacities in banking, comparing developments in major advanced economies across the globe over the period from 2006 to 2017. Offering a relative comparison across countries and time, the composite indicator suggests that most countries in the sample have managed to reduce overcapacities in banking since the onset of the global financial crisis, albeit to varying degrees, as some were better able to adapt to the changing environment than others, in particular by deleveraging, rationalising costly physical infrastructure and exploiting the benefits of technological innovation. A panel framework is then used to analyse a number of hypotheses derived from the literature, with the aim of shedding light on the determinants of overcapacities in banking, the direction of the relationship, and their relative importance. The results indicate that non-bank competition, the interest rate environment as well as bank business models are the most important driving factors of the overall degree of overcapacity in banking. With respect to the specific dimensions, non-bank competition seems to be particularly relevant for the size pillar, while demographic features and technological innovation appear to play a prominent role for explaining the competition and infrastructure/efficiency dimensions. The findings provide useful insights for policy makers concerning the possible design, calibration and effectiveness of potential policy responses that aim to address the issue of overcapacities in banking.

Keywords: overcapacity, bank size, bank competition, efficiency, composite indicator

JEL codes: C12, C23, G21, L1, O57

Executive summary

Banks across the globe have been confronted with profitability challenges in the aftermath of the global financial crisis. Alongside the large stock of legacy non-performing loans on banks' balance sheets in some jurisdictions, overcapacities are frequently mentioned as one of the more structural causes of weak bank profitability. While policymakers broadly agree that bank consolidation may help reduce overcapacities in banking, there seems to be less of a consensus within academic and policy domains on the definition and measurement thereof.

Offering a relative perspective across 26 advanced economies over the period from 2006 to 2017, this paper conceptualises the different dimensions of overcapacities in banking and designs a novel measure thereof. As suggested by a comprehensive review of the literature, the concept of overcapacities in banking must rest on three pillars: (i) the size of the banking system, (ii) the underlying competitive pressures in the sector, and (iii) the prevalent market infrastructure/efficiency. Three sub-indicators capturing these dimensions and an overall composite indicator of overcapacities are constructed. While following a relative concept, these indicators allow for analysing the degree and nature of overcapacities in banking across countries, but also for tracking specific trends over time. The results suggest that overcapacities in banking have declined in most countries since the onset of the global financial crisis, but some countries were better able to adapt to the changing environment than others, for example by exploiting the benefits of financial digitalisation.

The paper also employs the newly constructed indicators to investigate their drivers. To this end, testable hypotheses on seven potential determinants are derived from the literature. In particular technological progress, bank business model features, demographic factors, non-bank competition, the interest rate environment, bank regulation as well as financial globalisation are considered to affect the degree of overcapacities in banking. A panel regression setup is used to empirically assess the formulated hypotheses, both with respect to the overall degree of overcapacities and for the three pillars: size, competition and infrastructure/efficiency. The findings reveal that non-bank competition, the interest rate environment and bank business model features rank among the most important explanatory factors of the overall degree of overcapacity in banking. While non-bank competition seems to be particularly relevant for the size pillar, demographic factors and technological advances appear to play a prominent role in explaining the competition as well as infrastructure/efficiency pillars.

The findings from this paper may provide useful insights for policy makers regarding the design, calibration and effectiveness of policy choices. Importantly, any discussion on the related policy options on how to deal with overcapacities in banking should take into account the various different dimensions, thereby allowing for a more targeted, and if necessary multi-layered, policy response. Understanding the relative importance of the underlying determinants of overcapacities provides policy makers with additional ammunition regarding the possible design of an adequate policy response which may require support from policy areas beyond the scope of banking.

1 Introduction

Banks around the world have been confronted with profitability challenges in the aftermath of the global financial crisis. The underlying reasons are not only of a cyclical nature (i.e. related to weaker macroeconomic conditions and reduced maturity transformation opportunities due to the low interest rate environment), but are often also a consequence of more structural features. In the context of the latter, alongside the more stringent global bank regulatory landscape and the large stock of legacy non-performing loans on banks' balance sheets in some jurisdictions, overcapacities are frequently mentioned as one of the root causes of weak bank profitability (e.g. ECB (2017), IMF (2017)). While policymakers broadly agree on the need for bank consolidation as one means of reducing overcapacities and restoring sustainable bank profitability, there seems to be less of a consensus within academic and policy domains on the definition and measurement of overcapacities in banking itself.

Against this background, this paper first aims to investigate the different concepts and metrics of overcapacities in banking, whereby the notion of overcapacities is being considered relative to the sample mean across countries and time. More specifically, overcapacities in banking are defined as a state in which the economy is over-financed, the banking sector is over-banked or the customer is over-serviced (or any combination thereof). In fact, a review of the literature suggests that the concept of overcapacities in banking needs to rest on three pillars, comprising (i) the size of the banking system, (ii) the underlying competitive pressures in the sector, as well as (iii) the prevalent market infrastructure/efficiency. Three sub-indicators capturing these particular dimensions and an overall composite indicator of overcapacities in banking are constructed for a sample of 26 global advanced economies covering the period from Q1 2006 to Q4 2017. These indicators are then used for analysing the degree and nature of overcapacities in banking across countries and for identifying specific trends observed over time. In a second step, the purpose of the paper is to test the newly constructed composite indicator of overcapacities in banking in an empirical setting, in particular by investigating the determinants of banking sector overcapacities. To this end, supported by the literature, testable hypotheses are formulated on seven potential determinants of overcapacities in banking. In particular, technological progress, bank business model features, demographic factors, non-bank competition, the interest rate environment, bank regulation as well as financial globalisation are considered to affect the degree of overcapacities in banking. A panel regression setup is used to empirically assess the formulated hypotheses. The relationship between the degree of overcapacities and its candidate determinants is analysed both for the overall degree of overcapacities and for the three pillars: size, competition and infrastructure/efficiency. The robustness of the findings is examined.

The paper contributes to the literature in two ways: first, by conceptualising and formalising the different dimensions of overcapacities in banking and by constructing a novel measure thereof. Second, by being – to the best of our knowledge – the first to empirically test the main determinants of overcapacities in banking and to assess their relative importance. The existing empirical literature investigates rather narrowly

defined research questions attached to specific strands of the relevant literature which are often only indirectly linked to the concept of overcapacities in banking. This paper, however, takes a broader approach and links the notion of overcapacities to a set of high-level driving factors capturing a variety of major trends which are frequently referred to in the policy domain as factors shaping the future of the banking industry.

The findings suggest that overcapacities in banking have declined in most sample countries since the onset of the global financial crisis. Some countries were better able to adapt to the changing environment than others, in particular by downsizing or exploiting the benefits of financial digitalisation. By contrast, other countries, in particular those with a traditionally strong role of savings and cooperative banks, continue to exhibit higher levels of overcapacities as reflected, inter alia, by a relatively large number of banks, lower degree of concentration and an extensive physical infrastructure. With respect to the empirical analysis of the determinants of overcapacities, the findings confirm the relationship as formulated in the hypotheses for five of the seven driving factors of the overall degree of banking sector overcapacities. Specifically, the share of retail banking, the prevailing level of interest rates and the degree of financial integration are positively associated with overcapacities in banking, while non-bank competition and regulatory strength exhibit a negative relationship. For the remaining two determinants, i.e. technological progress and demographic characteristics, the relationship with the overall degree of overcapacity appears to be more complex. The results from including an interaction term in the model suggest that the potential for technological progress to reduce banking sector overcapacities increases with the share of retail banking in the business model. In the case of demographic characteristics, it appears that part of its effect is captured by unobserved heterogeneity in the time dimension. The findings from a panel model without the time fixed effect reveal that the share of rural population is positively associated with overcapacities in banking. In terms of the relative importance of the different determinants, non-bank competition, the interest rate environment and bank business model features rank among the most important explanatory factors of the overall degree of overcapacity in banking. The bottom-up approach of constructing the composite indicator of overcapacities based on three pillars facilitates more detailed analysis on how a specific determinant affects the size, competition and infrastructure/efficiency dimension of overcapacities. The main results highlight that non-bank competition seems to be particularly relevant for the size pillar, while demographic factors and technological advances appear to play a prominent role in explaining the competition as well as infrastructure/efficiency pillars.

The remainder of the paper is organised as follows. Based on a literature review, Section 2 outlines the various dimensions of overcapacity in banking and provides an encompassing definition of the underlying term. Section 3 discusses the related measurement issues, including the identification of a relevant set of indicators for measuring the degree of overcapacity in banking and the development of a composite indicator. Section 4 describes the main findings in both the cross-sectional and the time dimensions across countries and regions. Section 5 empirically analyses the determinants of banking sector overcapacities using a panel regression framework. Section 6 discusses some related policy considerations, while Section 7 concludes.

2 Terminology, dimensions and definition

To the best of our knowledge, there is no commonly agreed definition of overcapacities in banking, whether in academia or in the policy domain. This is not particularly surprising as "overcapacity" is an elusive concept, and the terminology used to describe the very same phenomenon is highly heterogeneous. The terms "overbanking" (e.g. ESRB (2014)), "excess capacity" (e.g. Frydl (1993), IMF (2017)) or "overcapacity" (e.g. Gorton and Rosen (1991), ECB (2017)) are employed interchangeably. However, the term "optimal capacity" (Amable et al. (2002)) is also used, which is basically approaching the same issue from the flip side of the coin. But even when the same term is used, the underlying meaning can be very different depending on the context. For example, Andreas Dombret, former Executive Board Member of the Deutsche Bundesbank, said in a speech that "Overcapacity … still has to be gradually shrunk in a process that has been going on for years … this downsizing process is shrinking to health" (Dombret (2018)). Mario Draghi, former President of the European Central Bank, conveyed in a speech that "Overcapacity in some national banking sectors, and the ensuing intensity of competition, exacerbates this squeeze on margins" (Draghi (2016)), while the Bank of Japan's Financial System Report from October 2017 states that "The number of employees and branches may be in excess (overcapacity) relative to demand." While the term "overcapacity" is used uniformly in all of these cases, its interpretation varies markedly, ranging from issues related to 1) banking sector size (deleveraging) to 2) competitive pressures (i.e. price competition) to 3) banking infrastructure/efficiency (including staffing/branch networks).

Against this backdrop, a common understanding of the term is needed, not least to ensure that policy choices to reduce overcapacities in banking are appropriate and well-targeted, thereby delivering the desired outcome. A comprehensive definition needs to build on three different strands of the academic literature, in particular (1) the vast literature on the finance-growth nexus, (2) research capturing the traditional view on bank competition, as well as (3) academic work offering alternative models on market contestability.

First, before the global financial crisis a rather broad consensus in the academic literature suggested a positive relationship between financial development and economic growth (e.g. King and Levine (1993), Levine (1997, 2005)), with academics predominantly aiming to investigate the long-term relationship (e.g. Beck et al. (2000)) as well as the direction of causality, i.e. "demand-following" vs "supply-leading" (e.g. Calderón and Liu (2003)), between the two. However, the global financial crisis has questioned the underlying linear assumption (Beck (2014)), spurring research interest in the marked increase in size and complexity of the financial sector and its contribution to economic growth and financial (in)stability.[1] One strand of the related literature has explored whether there are limits to the benefits of financial development. In fact, the severe implications of the global financial crisis for the real economy, have triggered an intense academic debate about whether there can be "too

[1] For a systematic survey of the literature on the finance growth-nexus see Carré and L'oeillet (2018).

much" finance. For example, by testing for non-linearities in the finance-growth relationship, Arcand et al. (2012) find that finance starts having a negative effect on output growth when credit to the private sector reaches 100% of GDP. Similarly, Cecchetti and Kharroubi (2012) confirm the inverted U-shaped effect of financial development on growth, but also find that the pace of financial sector expansion matters (see also Rousseau and Wachtel (2011)). Beck et al. (2014) distinguish between intermediation and non-intermediation activities and find that in advanced economies, an expansion of the latter and the related increase in overall financial sector size increases growth, but comes at the cost of higher volatility. Turner (2010) argues that the financial sector rapidly expanded into complex activities ahead of the crisis (e.g. securitisation driven by tax and capital arbitrage) which were not necessarily welfare enhancing, while Haldane et al. (2010) emphasises that much of the financial sector growth in the run-up to the crisis simply reflected higher risk-taking by means of increased leverage and larger trading books. From a more structural perspective, Langfield and Pagano (2015) find that bank-based financial structures are associated with higher systemic risk and lower economic growth, in particular during times of large asset price corrections. That said, the findings of the post-crisis literature tend to support the notion of "too much" finance, suggesting that an over-sized (and overly complex) financial sector can have negative repercussions for welfare, growth and financial stability.

Second, a key avenue of the bank competition literature investigates the "competition-stability" nexus, which consists of two alternative schools of thought (Beck (2008)). The "competition-stability" paradigm postulates a positive correlation between bank competition and stability, with more competition seen as a harbinger of greater stability and welfare, as lower lending rates translate into lower default probability of customers (Boyd and De Nicoló (2005)) and – via the better availability of credit – boost investment and growth (Beck et al. (2004), Love and Peria (2015)). By contrast, the "competition-fragility" view claims a negative relationship between competition and stability, whereby a more competitive environment squeezes profits (i.e. lower charter/franchise values), which, in turn, foster higher risk-taking and fragility (e.g. Keeley (1990)).[2] That said, excessive risk-taking itself could be an indication of overcapacities in the banking sector to the extent that banks take on additional risks without a commensurate increase in the rate of return (Chaffai and Dietsch (1999)). An alternative avenue of the bank competition literature explores the link between bank competition and performance. The structure-conduct-performance hypothesis argues that more market power (i.e. higher concentration) gives rise to the exploitation of monopolistic rents and, thus, higher profitability (albeit according to the quiet life hypothesis by Hicks (1935) not necessarily to more efficiency).[3] At the same time, the efficient-structure hypothesis (Demsetz (1973)) states that more efficient banks are able to generate higher profits and to increase their market share by exploiting x- or scale efficiencies (Berger (1995)), translating into stronger market

[2] Contrary to the conventional notion of a linear relationship, Martinez-Miera and Repullo (2010) find a U-shaped relationship between competition and bank fragility. While in very concentrated markets the entry of new banks reduces the likelihood of failure, in very competitive markets further entry increases bank fragility.

[3] The related relative-market-power hypothesis argues that banks with a higher market share and well-differentiated products earn higher profits by exerting market power in setting prices, independent of the degree of market concentration (Shepherd (1983)).

power. Following this train of thought, the prevalent market structure may also give an indication of the degree of overcapacities in the banking sector. To the extent that overcapacity is linked to insufficient economies of scale and cost inefficiencies, capacity may become excessive and lead to profitability pressures as competition increases. Put differently, if lower market concentration is associated with higher competition, according to the efficient-structure hypothesis there should be a positive relationship between bank competition and overcapacity.

Third, it is argued in the literature that bank competition cannot be solely captured by structural indicators (e.g. number of banks, various metrics of concentration) and performance measures (e.g. margins, profitability), but the operating infrastructure and its efficiency are also important. In fact, the theory of contestable markets suggests that the competitive behaviour of banks is not necessarily related to the underlying market structure, and claims that other factors, in particular, the existence of market entry and exit barriers and their intensity matter considerably (Claessens and Laeven (2004), Northcott (2004)). Accordingly, pricing might be competitive even in the presence of strong market power if the threat of potential new entry is credible (Nathan and Neave (1989)). Alongside regulatory restrictions (for example on foreign bank entry) as well as brand recognition and reputation, branch networks are frequently mentioned in the literature as barriers to entry and expansion in the banking sector. In fact, banks may not only compete in price terms, but also by offering traditional brick-and-mortar banking services in the proximity of clients. Establishing branch networks is costly though, and is, thus, typically seen as a barrier to entry. However, competition through branching can lead to a higher-than-optimal number of bank branches (Northcott (2004)) and suboptimal levels of capacity utilisation in terms of both branches and employees. The contestability literature also highlights the use of technology as a means of competition. Accordingly, technological advances, such as internet banking or the emergence of new electronic payment technologies, have the capacity to increase the contestability of the market, inter alia by fostering economies of scale, broadening the geographical reach of services and reducing entry barriers for new competitors by lowering the cost of exit (Berger (2003), Northcott (2004), Corvoisier and Gropp (2009)). Therefore, the adoption of new technology should help to reduce scale and x-inefficiencies and – to the extent that it fosters price competition via increased transparency (e.g. internet banking) – competition through the opening of new branches.

This review of the three relevant strands of the literature suggests that overcapacities in the banking system prevail if the degree of bank intermediation exceeds real economic demand (i.e. the economy is over-financed), a large number of banks with small market shares render competition too fierce (i.e. the market is over-banked) or banks operate an overblown physical banking infrastructure at the lower end of the technology frontier (i.e. customers are over-serviced). That said, these different dimensions should not be seen in isolation, as underlying causalities make them intertwined and potentially mutually reinforcing.

3 Measurement and construction of a composite indicator

The above definition and literature review suggests that a large number of metrics can be employed to measure overcapacities in banking, depending on the particular aspect under investigation. First, the “size” dimension is often captured by putting the size of the banking sector in relation to that of the broader financial sector, the real economy or banks’ equity capital. Second, indicators of the “competition” pillar can range from various performance indicators (e.g. interest rate spreads, net interest margin, return on equity, return on assets, etc.) over measures of more structural nature (e.g. concentration ratios, Herfindahl index, number of banks relative to population, etc.) to rather sophisticated metrics of bank pricing behaviour or market power (e.g. Lerner index, H-statistics, Boone indicator, etc.) (e.g. Beck (2008)). Third, the “infrastructure/efficiency” dimension is predominantly measured by institutional and regulatory variables affecting banks’ competitive behaviour (e.g. entry requirements, barriers to entry for foreign banks, etc.), but also metrics capturing the prevalent banks’ operational infrastructure (e.g. number of bank branches and employees), or the efficiency thereof, as well as the degree of technological development of the banking sector (e.g. number of ATMs, internet/online banking usage, electronic/digital/mobile payment penetration, number of POS terminals, etc.).

While the use of any of the above indicators has its own legitimacy, when used in isolation they only provide a very partial view of overcapacities in banking. Therefore, the degree of overcapacity is best captured by a set of indicators alongside the above-mentioned three dimensions, condensing the available information into a single metric. In fact, composite indicators are being increasingly used as a tool in policy analysis, as they allow for comparing and ranking countries at a given point in time, but also for monitoring the evolution over time and identifying underlying trends. In addition, composite indicators allow for synthesising complex, multi-dimensional concepts into one measure which is easier to interpret than looking at multiple indicators (Saisana and Tarantola (2002)). That said, the use of composite indicators is not uncontroversial, as they are also considered to have various caveats. In particular, aggregation conceals underlying information (Zhou et al. (2010)), while the choice, standardisation and weighting of individual indicators can be fairly discretionary. At the same time, composite indicators may also lead to simplistic conclusions and misguided policy action if poorly designed (Saltelli et al. (2005), OECD (2008)). Accordingly, for a composite indicator to be meaningful, its construction requires (1) a careful choice of the underlying variables, not least by avoiding correlation among input variables, (2) an appropriate standardisation and weighting scheme, as well as (3) adequate robustness of the composite indicator.

3.1 Variable selection

To the best of our knowledge, there is no composite indicator in the literature that would cover these three dimensions of overcapacities in banking in a targeted way. There are a few papers in the literature which develop composite indicators/indices for the financial sector, but they tend to measure other aspects while also being broader in nature. For example, Sahay et al. (2015) have introduced an index for measuring financial development in emerging market economies that captures some elements of overcapacities in banking, but also cover other financial market segments, such as stock and/or bond markets, and a broader set of financial intermediaries, including pension and mutual funds as well as the insurance sector. At the same time, some of the indicators used may not necessarily be suitable for constructing the composite indicator of overcapacities in banking for the advanced economy sample of this paper. In particular, the increasing number of ATMs as an indicator of growing financial development might be reasonable when analysing emerging market economies. However, in some Nordic countries, such as Norway and Sweden, the exact opposite trend can be observed. The number of ATMs has been falling for almost a decade, as these countries have moved further up the financial development ladder exploiting the benefits of digitalisation and the related less widespread use of cash in everyday life. Accordingly, a linear (one-sided) interpretation of this indicator – which is a prerequisite of constructing a composite – is not possible.

Based on the literature, four indicators have been chosen for each of the dimensions of overcapacities in banking (see Table 1). First, the dimension of "too much finance" is captured by the size of the banking sector relative to the broader financial sector, the real economy and banks' equity capital. The share of banking sector assets over total financial institutions assets[4], aims to capture the structure of the financial system and with this the relative importance of the banking sector in a given country (BIS (2018)). While in the literature, the size of the banking sector (measured, for example, by total assets or bank credit) is more often benchmarked to the depth of stock and bond markets in a country. A number of studies find that heavily bank-based financial structures feature higher systemic risk and, through the destructive forces of financial crises, lower economic growth (e.g. Langfield and Pagano (2015)). Other post-crisis research measures size by the total assets of the banking sector relative to GDP (e.g. ESRB (2014), Kakes and Nijskens (2018)) or the ratio of private sector credit to GDP (e.g. Arcand et al. (2012)), but similar conclusions are drawn. Finally, some researchers also argue that the leverage of the banking system matters. Higher leverage has been identified as one of the root causes of the global financial crisis, reflecting increased risk-taking by banks in the build-up phase before the crisis (e.g. Haldane et al. (2010), Langfield and Pagano (2015)). In fact, higher leverage is seen to allow for faster balance sheet expansion. While leverage may have been a more relevant metric to capture size-related aspects up to the introduction of related bank regulation (i.e. leverage ratio), in a cross-country setting and in combination with other size-related indicators it may still offer valuable insights on the pace and degree

[4] Following an institutional/sectoral approach, data are obtained from the quarterly financial accounts. The assets of the banking sector are put in relation to the assets of financial corporations (i.e. excluding the central bank and including money market funds, financial vehicle corporations, investment funds, insurance corporations and pension funds).

of banking sector expansion in individual countries. As these four indicators capture very different aspects of size from the welfare and financial stability perspective, all of them appear to be relevant for constructing the size pillar of the composite indicator.

Table 1

Overview of the dimensions of overcapacity and underlying variables

Dimension	Indicator	Selected literature	Unite of measurement
Size	Bank assets/total financial sector assets	BIS (2018)	percentage
	Total assets/GDP	ESRB (2014), Kakes and Nijskens (2018)	percentage
	Loans to the private sector/GDP	Arcand et al. (2012)	percentage
	Total assets/capital and reserves	Haldane et al. (2010), Langfield and Pagano (2015)	ratio
Competition	Net interest margin	Demirgüç-Kunt and Huizinga (1999), Sahay et al. (2015)	percentage
	No. of banks per 100,000 inhabitants	Rockoff (1974)	absolute figure
	Concentration ratio (CR5)	Gropp and Kok (2017)	percentage
	Return on assets (ROA)	Berger (1995), Sahay et al. (2015)	percentage
Infrastructure/ efficiency	Number of inhabitants per bank branch	Cihak et al. (2012), Beck and Casu (2016)	absolute figure
	Customer deposits per bank branch	Hirtle (2007), Martín-Oliver et al. (2014), IMF (2017)	EUR millions
	Total assets per bank employee	Beck and Casu (2016)	EUR millions
	No. of card transactions per 100,000 inhabitants	Berger (2003)	absolute figure

Source: Authors' compilation.

Similarly, four indicators have been selected to capture the competition pillar of overcapacity in banking, with two of them capturing the prevalent market structure and two of them being performance-related. The number of banks per 100,000 inhabitants (e.g. Rockoff (1974)) and the concentration ratio (i.e. the share of the five largest banks in total banking sector assets) are relatively widespread and simple measures, that reflect the traditional view that a higher number of firms is associated with more price competition and less market power. Concerning the performance measures, the net interest margin which tends to be the most important income source for banks and the return on assets that is considered to be a more reliable performance indicator than return on equity (ECB (2010)) are used as proxy variables for measuring competitive pressures in the market, as higher margins and profitability might be a reflection of higher market entry barriers and, hence, less competition (e.g. Smirlock (1985), Berger (1995), Demirgüç-Kunt and Huizinga (1999), Demirgüç-Kunt et al. (2003)).

Finally, the infrastructure/efficiency pillar of overcapacity comprises again four indicators. First, the number of inhabitants per bank branch, or the inverse thereof (i.e. number of branches per 100,000 inhabitants), is frequently used in the literature as a means of capturing over-branching. That said, some caution is warranted with the interpretation of this indicator in an environment of the growing importance of branchless banking (Cihak et al. (2012)), as well as differences across countries in terms of geographical structures and population density. Also, Berger et al. (1997) find that banks may accept some additional costs of over-branching should it help generate extra revenues from offering additional customer convenience, while also

differences in the underlying product mix may justify the co-existence of multiple branches (Calem and Nakamura (1998)). Following Hirtle (2007) and Martín-Oliver et al. (2014), deposits by bank branch are used as a measure of productivity with the underlying assumption that deposits per bank branch are lower in markets with higher branch density. Similarly, as suggested by Beck and Casu (2016), total assets per bank employee is used as an additional capacity indicator, thereby providing an indication about potential over-staffing. The latter two indicators would tend to capture unutilised scale economies at the branch or staff levels. Last but not least, as mentioned above, technological progress can have a profound impact on market infrastructure and efficiency through the development of new products and increasing economies of scale. This aspect is proxied by the number of card transactions per 100,000 inhabitants (e.g. Berger (2003)).

Alongside the frequency of use of the indicators in the literature, the selection of the variables was also motivated by considerations on data availability and comparability. In fact, the 12 indicators selected above are gathered for a sample of 26 countries, including the euro area aggregate and 18 euro area countries (excl. Luxembourg),[5] as well as Denmark, Japan, Norway, Sweden, Switzerland, the United Kingdom and the United States, thereby allowing for a global comparison. The dataset is a balanced sample with full coverage for all indicators and countries from 2006 to 2017. The data frequency is quarterly, with various statistical techniques having been used for back-casting and interpolation where needed. While data are obtained from multiple sources, ranging from international organisations (e.g. ECB, IMF) to national sources (e.g. national central banks, supervisory agencies, statistical offices), the data collection and mapping was conducted as such to ensure the greatest possible degree of comparability across countries. Aggregate sector-level data have been employed wherever possible, but individual bank-level data had to be aggregated to fill any remaining data gaps for certain indicators and countries.

As suggested by Saltelli et al. (2005), when constructing a composite indicator the correlation among input variables matters considerably. Highly correlated input variables may result in a composite indicator that by construction overemphasises these particular variables, thereby distorting the signalling properties of the composite indicator. However, obtaining a fully orthogonal set of indicators seems fairly unrealistic too, not least because of the underlying bank balance sheet mechanics (e.g. loans tend to be correlated with total assets). That said, even in the case of strong correlation some flexibility in interpreting the correlation coefficients may be warranted depending on the context (Kozak (2009)). Accordingly, as some of the indicators might capture similar and self-reinforcing characteristics of overcapacity, the pairwise Pearson correlation coefficients are computed (see Table 2). In this regard, the correlations between the variables within the individual pillars are of particular interest, so that a quasi “overweighting” in the average for the sub-dimensions is avoided. Overall, the correlations among the chosen variables appear to be rather limited, with none of the coefficients above 0.7 (i.e. indicating very

[5] Luxembourg has been excluded from the sample as its financial sector differs markedly from those of the other euro area countries due to the strong presence of money market funds and foreign bank holding companies. This particular characteristic would place Luxembourg as an outlier with respect to several aspects of overcapacities in banking and might bias the results.

strong correlation). Thus, the selected variables appear to strike a reasonable balance between minimising the degree of correlation and, at the same time, capturing sufficiently different aspects of each dimension of overcapacity.

Table 2

Correlation matrix among overcapacity indicators

	Bank assets/total financial sector assets	Total assets/GDP	Loans to the private sector/GDP	Total assets/capital & reserves	Net interest margin	No of banks per 100,000 inhabitants	Concentration ratio (CR5)	Return on assets (ROA)	Inhabitants per bank branch	Customer deposits per bank branch	Total assets per bank employee	No of card payments per inhabitant
Bank assets/total financial sector assets	1.000											
Total assets/GDP	-0.426	1.000										
Loans to the private sector/GDP	-0.224	0.636	1.000									
Total assets/capital & reserves	-0.084	0.089	0.075	1.000								
Net interest margin	-0.141	0.163	0.046	0.664	1.000							
No of banks per 100,000 inhabitants	-0.288	0.370	0.234	-0.132	-0.093	1.000						
Concentration ratio (CR5)	-0.173	0.123	0.012	0.099	0.194	0.029	1.000					
Return on assets (ROA)	0.070	0.166	0.197	0.001	0.002	-0.033	0.100	1.000				
Inhabitants per bank branch	0.092	0.171	0.256	0.072	-0.033	0.108	0.457	0.199	1.000			
Customer deposits per bank branch	0.524	-0.129	-0.188	-0.323	-0.385	0.000	0.007	0.045	0.410	1.000		
Total assets per bank employee	0.439	-0.515	-0.334	-0.404	-0.626	-0.184	-0.160	-0.118	0.121	0.612	1.000	
No of card payments per inhabitant	0.337	0.093	0.024	-0.192	-0.298	0.101	0.135	0.164	0.470	0.505	0.429	1.000

Source: Authors' calculation.
Note: The table shows the pairwise Pearson correlation coefficients for the overcapacity indicators based on the sample of 26 countries. Absolute correlations exceeding +/-0.5 are highlighted in yellow.

3.2 Normalisation and weighting

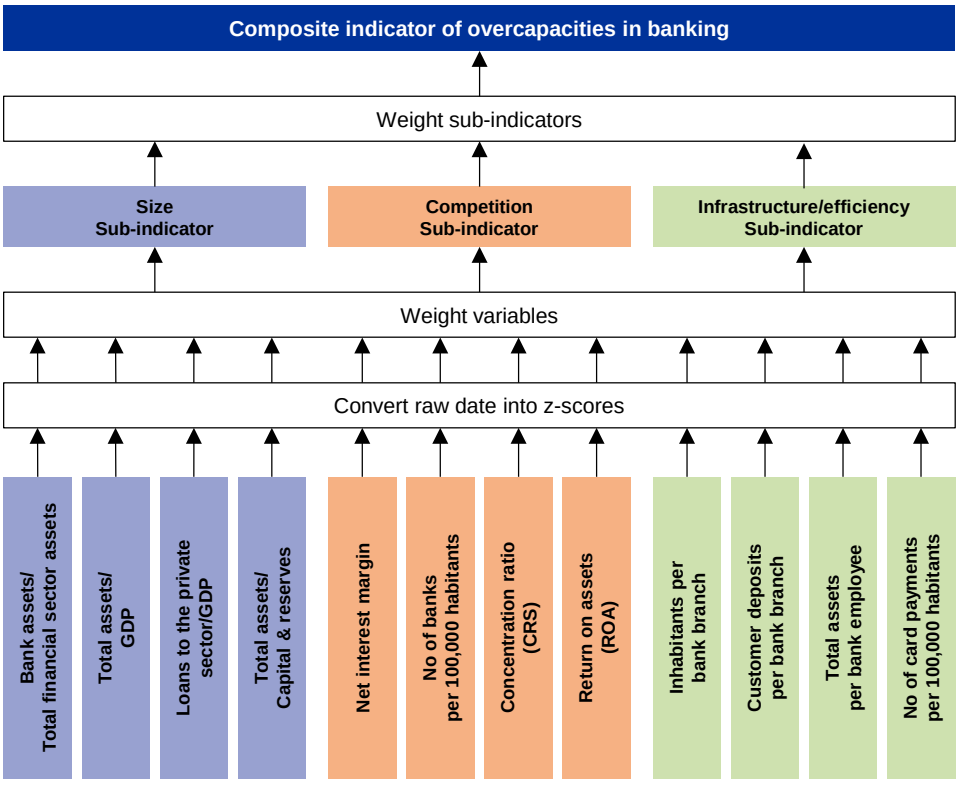
As the variables have different units of measurement (see Table 1), they are first standardised by transforming them into z-scores. A z-score indicates how many standard deviations an observation is away from the mean. It is calculated as follows: $z = (x - \mu) / \sigma$ where z is the z-score, x is the respective country value, μ is the sample mean, and σ is the standard deviation of the sample. This standardisation ensures that all indicators are converted into a common scale with a mean of zero and a standard deviation of one. Indicators for which a higher value indicates more overcapacities enter the z-score calculation with a positive value (i.e. all size-related variables and the number of banks per 100,000 inhabitants), while indicators for which a higher overcapacity is associated with a lower value enter the z-score calculation with a negative sign (i.e. all competition-related variables but the number of banks per 100,000 inhabitants and all infrastructure/efficiency-related indicators). Depending on the purpose of the analysis, i.e. comparing/ranking countries at a certain point in time

(cross-sectional dimension) or tracking developments over time (time dimension), the mean and standard deviation (and with this the z-scores) can be computed across countries or across countries and time, respectively.

To summarise the information contained in the different dimensions of overcapacities described above, first sub-indicators for each pillar are constructed which are then aggregated to a composite indicator (see Chart 1). To construct the sub-indicators and the composite indicator of overcapacities in banking, weights have to be assigned to the selected variables. While there are various options to determine the indicator weights (OECD (2008)), most composite indicators tend to follow the equal weighting principle. This weighting approach appears to be also reasonable for the analysis of overcapacities in banking, not only because the information from all underlying indicators is considered to be equally important, but also because of the limited correlation among the selected variables. More specifically, the sub-indicators are computed for each of the three dimensions by taking the simple arithmetic average of the respective underlying z-scores of the individual variables. Thereafter, the overall composite indicator of overcapacity is obtained by equally weighting the composite z-scores of the three sub-indicators, thereby effectively assigning an equal weighting to the 12 selected variables.

Chart 1

Construction of the composite indicator of overcapacities in banking



Source: Authors' compilation.

3.3 Robustness

To assess the extent to which the country ranking of overcapacities in banking is driven by the (equal) weighting scheme of the underlying variables, a so-called uncertainty analysis is carried out. According to Saisana et al. (2005), an uncertainty analysis investigates how changes in the input parameters used to construct the composite indicator (e.g. the weighting scheme) affect its values and ultimately the ranking of countries. To this end, two simulations are performed in which the weights for the indicators are chosen randomly. Based on a set of 10,000 simulations, countries are then ranked according to the relative frequency of appearances among the top (bottom) five countries with relatively higher (lower) perceived overcapacities in banking. The simulation results broadly confirm the pattern suggested by the composite indicator.

Determining the weights of the individual indicators based on statistical methods (e.g. Principal Component Analysis – PCA) could be an alternative way to address overlapping information content in the data. Based on the correlation structure, the PCA transforms the original data as such that a smaller number of derived uncorrelated factors (principal components) explain a large fraction of the variance in the dataset (Jolliffe (2002)). The principal components are linear combinations of the original variables and coefficients (factor loadings) link the observed variables to the principal components. As the coefficients reflect the variance of the respective variables, they can be used to proxy the (statistical) importance of each variable. However, the PCA weighting has a number of caveats. First, the PCA might, depending on the correlation structure, assign very low weights to some of the indicators which would be contrary to the initial intention that the composite indicator should capture all selected dimensions. This highlights that weights should not only be chosen based on statistical methods, but also on the basis of the underlying conceptual framework. Second, the PCA weighting can only account for overlapping information between correlated indicators, and, hence, if there is no correlation or only limited correlation then weights cannot be estimated. Since the aim is to include all selected dimensions in the construction of the sub-indicators and the composite indicator and as the correlation among the underlying indicators is rather limited, a PCA does not appear to be the most appropriate method to determine the indicator weights in this particular case.

4 Results and interpretation

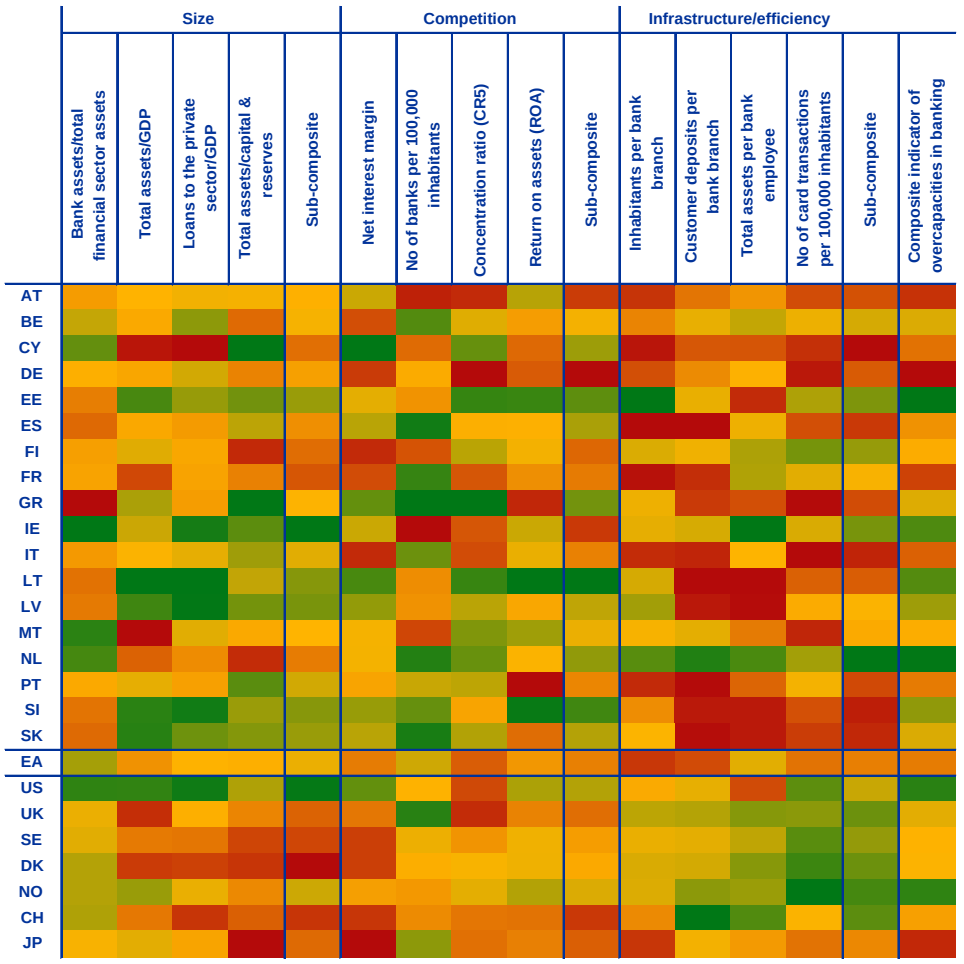
As mentioned above, the composite indicator can be calculated as such to offer either a cross-sectional or a time dimension view. In any case, when interpreting the results, it should be noted that as the indicators are converted into z-scores, respective values are always relative to the global sample mean, i.e. a positive (negative) value means that an indicator value for a specific country is higher (lower) than the global sample average for this indicator. Thus, the ranking of the countries should be interpreted in a relative way instead of an absolute one. A higher value of the composite indicator implies a higher degree of overcapacity relative to a lower composite indicator value, but a positive (negative) value of the indicator may not necessarily imply overcapacity (undercapacity) per se. Judging the optimal level of capacity utilisation would require a normative assessment, which itself would require postulating benchmark values. One way to derive a normative measure of overcapacities in banking would be to normalise the underlying set of variables relative to indicator-specific reference points (see OECD (2008)). This would require specifying a benchmark value for each underlying indicator which would be considered as a level that is consistent with a balanced level of capacity. These benchmark values could, for example, be derived from the literature. As highlighted above, the literature on the finance-growth nexus suggests that levels of credit exceeding 100% of GDP would not be beneficial for the real economy and hence this level could be chosen as a reference value. While the literature may offer thresholds also for other size-related indicators, benchmarking for most indicators in the competition and infrastructure/efficiency dimension will probably be less straight forward and would go beyond the scope of this paper.

4.1 Cross-sectional dimension

From the cross-sectional perspective, one possibility of presenting the country results would be by means of a heat map (see Chart 2) – a tool that has gained quite some popularity in the policy sphere in recent years as it helps to illustrate a complex set of information in a relatively intuitive way. A simple eyeballing of the heat map below yields two main takeaways: first, relative to the global sample, most euro area countries appear to face challenges in the infrastructure/efficiency bucket, where the red colour is flashing for a number of countries. This is not only an indication of an overblown and inefficient physical infrastructure, but often also of a less widespread use of technological advances. Second, international peers (except the US) appear to have more overcapacities in terms of size, driven in particular by above average leverage. The results for the competition pillar are rather inconclusive with no obvious geographical pattern emerging.

Chart 2

Heat map of overcapacities in banking across different dimensions in a cross-country comparison



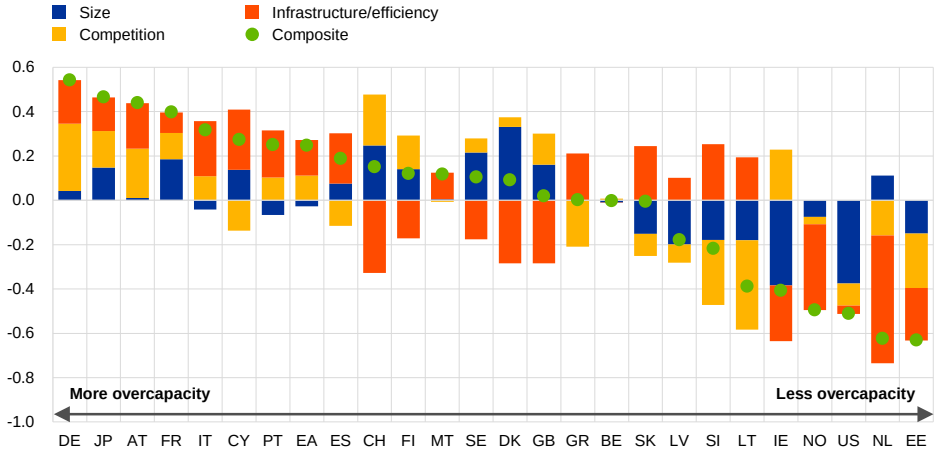
Source: Authors' calculations.
Notes: For the purpose of obtaining a snapshot of overcapacities in the banking sector at a certain point in time, the z-scores were calculated by computing the mean and standard deviation across all countries as at the final quarter of 2017. The colour coding of the heat map follows the distribution across the country sample, depending on how each indicator is expected to affect the degree of overcapacity. Accordingly, for variables for which high values indicate more overcapacities (i.e. all size-related variables as well as the number of banks per 100,000 inhabitants) the colour coding moves from dark green (low values) to dark red (high values), while for variables for which low values indicate more overcapacities (i.e. all competition-related variables but the number of banks per 100,000 inhabitants and all infrastructure/efficiency indicators) the colour coding moves from dark red (low values) to dark green (high values). For the sub-composite indicators and the overall composite indicator dark green colours are associated with less overcapacities and dark red colours with more overcapacities.

An alternative way of presenting the results is to rank the countries in the sample according to the values of the composite indicator and the respective contributions of the individual dimensions to the composite (see Chart 3). Accordingly, overcapacities in banking vary by nature and degree from country to country. Germany, Japan, Austria, France and Italy rank among the countries with the highest levels of perceived overcapacities. The banking systems of these countries are often characterised by the traditionally strong role of savings and cooperative banks, and, thus, a high number of banks, lower degree of concentration and an extensive physical infrastructure. These features are also reflected in the relatively marked positive contributions of the competition and infrastructure/efficiency dimensions to the overall composite indicator.

Chart 3

Composite indicator of overcapacities and contributing factors in a cross-country setting

(Q4 2017, z-scores)



Source: Authors' calculations.

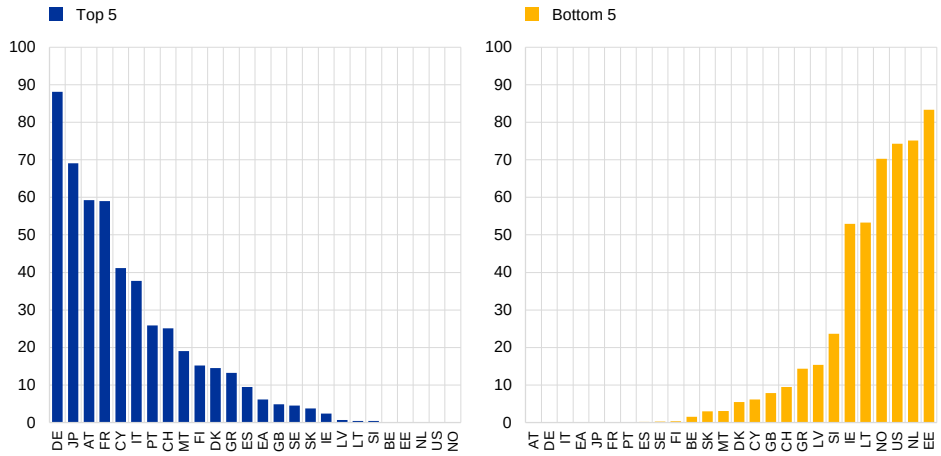
Estonia, the Netherlands, Norway and Ireland can be found on the other end of the spectrum featuring in particular a more efficient operational infrastructure and the widespread use of technological advances as indicated by the relatively large negative contribution of the infrastructure/efficiency pillar to the composite indicator. Similarly, overcapacities in the United States are relatively less pronounced, which is predominantly a corollary of the strong role of non-bank financial intermediation in that country. This is reflected by the large negative contribution of the size component to the composite for the United States. In general, the Nordic banking sectors (i.e. Denmark, Finland, Norway and Sweden) are considered to be among the most efficient ones worldwide (large negative contribution of the infrastructure/efficiency dimension), but the related benefits are offset by the large size of most Nordic banking sectors (strong positive contribution of the size component).

As outlined in Section 3.3, an uncertainty analysis is conducted to safeguard for the robustness of the composite indicator to changes in the weighting scheme. Based on a set of 10,000 random weights the countries are ranked according to how frequently a country appears among the top (bottom) five countries with the highest (lowest) levels of perceived overcapacities in banking. The country ranks derived from the simulations confirm the robustness of the composite indicator on both tails (see Chart 4). The rankings obtained from the uncertainty analysis not only serve the purpose of a robustness check, but could also be used as an additional indicator to signal overcapacities in banking.

Chart 4

Country ranking based on the uncertainty analysis (top five vs. bottom five)

(percentages)



Source: Authors' calculations.

4.2 Time dimension

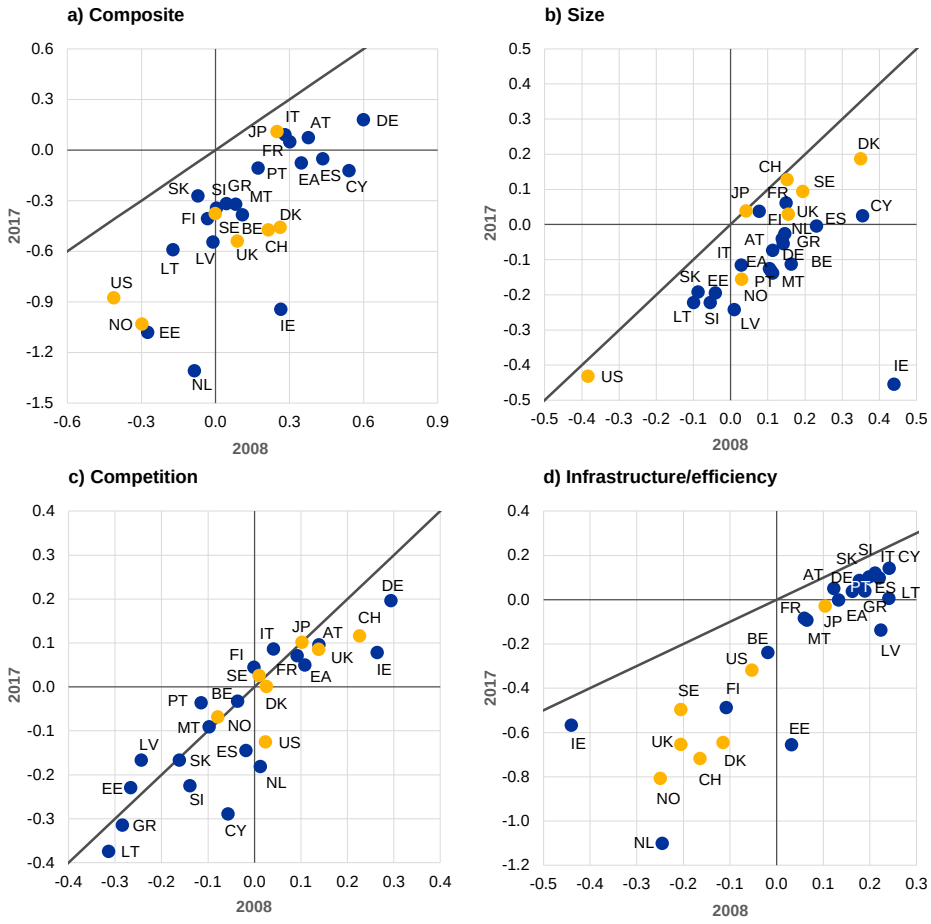
Calculating the z-score across countries and time allows for tracking developments in banking sector overcapacities over time. The development of the composite indicator suggests that overcapacities have been reduced in all countries since the onset of the global financial crisis (all countries below the 45 degree line), likely as a part of a more general trend observed since the 1990s. That said, the reduction of overcapacities has varied across countries, but the extent appears to have been more pronounced in those countries which have experienced some sort of banking sector stress during the crisis (either at the sector or individual bank levels).

In terms of the underlying dimensions, the size bucket suggests a fairly marked downsizing over the last decade in most euro area countries. This contrasts with a rather modest deleveraging observed in global peers where, as also suggested by the heat map, the banking sectors still appear to be relatively large (see Chart 5). At the same time, developments were rather heterogeneous across the sample when it comes to the competition dimension. The main reason for this is that the overcapacity-reducing effect of a decreasing number of banks and resulting higher market concentration (structural indicators) as a result of market exit or increased mergers and acquisitions (M&A) activity in almost all countries is often countered by the offsetting impact of worsening performance indicators (ROA and NIM, cyclical indicators). This is not necessarily related to changes in the competitive landscape, but is more the result of accommodative monetary policies and the ensuing low interest rate environment. The infrastructure/efficiency bucket illustrates that banks' have aimed to rationalise bank infrastructure and increase bank efficiency in the post-crisis environment, not least by adapting new technologies (i.e. digitalisation). All jurisdictions have recorded efficiency gains to a more or less considerable degree, with particularly marked improvements observed in the United Kingdom, Switzerland

and the Nordic countries, while efficiency gains appear to have been relatively less pronounced in the euro area and Japan (see Chart 5).

Chart 5

Development of the composite indicator and its sub-components over time



Source: Authors' calculations.
Notes: For the purpose of tracking developments in overcapacities over time in the banking sector, the z-scores are calculated computing the mean and standard deviation across all countries and time. Dark blue dots indicate euro area countries, while yellow dots refer to global peers.

5 Determinants of overcapacities in banking

This section aims at testing the newly constructed composite indicator of overcapacities in banking in an empirical setting, in particular by investigating the determinants of banking sector overcapacities. To this end, testable hypotheses are derived from the literature on seven potential determinants of overcapacities in banking: (i) technological progress, (ii) bank business model features, (iii) demographic factors, (iv) non-bank competition, (v) the interest rate environment, (vi) bank regulation as well as (vii) financial globalisation. A panel regression setup is then used to empirically assess the hypotheses based on a sample of 26 global advanced economies covering the period from 2006 to 2017. The relationship between the degree of overcapacities and its candidate determinants is analysed for the overall degree of overcapacities as well as for the three pillars size, competition and infrastructure/efficiency and the robustness of the findings is examined.

5.1 Hypotheses

Banks' operating landscape has changed markedly in the aftermath of the global financial crisis (BIS (2018)). In particular, the ensuing low interest rate environment and a stricter regulatory framework governing the banking industry have been important driving forces in reshaping the post-crisis operating environment for banks and reinforcing the need for adapting banks' business models. At the same time, banks are additionally challenged by some longer-term trends such as financial globalisation, technological innovation as well as heightened competition from non-bank financial intermediaries. Some of these trends appear to have become more binding in the post-crisis environment, not least given accelerating digitalisation of the financial industry and the growing importance of fintech or the migration of activities to other (at times less regulated) parts of the financial sector. All of these drivers of change together with broader demographic trends, such as ageing and urbanisation, have an important bearing on the underlying capacity needs and its degree of utilisation in banking by changing the underlying demand and supply conditions for banking services.

Against this backdrop, the empirical module investigates seven hypotheses with the aim of shedding light on the determinants of overcapacities in banking, their relative importance in explaining the downward trend observed since the financial crisis as well as the direction of the relationship.

Hypothesis 1: Technological change and innovation, i.e. the more widespread use of digital technology, leads to overall lower overcapacities in banking.

A growing body of literature highlights the implications of technological innovation (i.e. advances in internet/online/mobile banking) for banks. For example, looking at

the Italian banking sector, Ciciretti et al. (2009) find that the adoption of internet banking has a positive impact on bank performance. Similarly, based on a sample of Spanish banks, Hernando and Nieto (2006) find that internet banking entails a gradual decline in overhead expenses (in particular staff costs) and, with some time lag, higher profitability. Delgado et al. (2007) show that internet banks may generate significant scale economies as they are better able to control operational expenses than traditional banks. At the same time, related greater economies of scale may facilitate increases in bank size (Berger (2003)). Furthermore, Gropp and Kok (2017) show that internet banking contributes to heightened competition due to the increased contestability of the market, in particular for retail deposits, while the ECB (2018) finds some tentative evidence that the adoption of internet banking facilitates branch network optimisation, as technological change renders existing capacities redundant (Davis and Salo (1998)).[6]

Hypothesis 2: Banking systems which are more reliant on traditional (deposit-taking and loan-granting) retail banking activities are more prone to overcapacities.

A growing post-crisis literature investigates the implications of banks' business models, inter alia on bank performance and stability. In fact, the global financial crisis has triggered a marked shift in bank business models away from more complex capital-intensive trading activities towards less-risky traditional intermediary activities (BIS (2018)). In terms of size, Roengpitya et al. (2017) show that trading banks tended to be larger than retail-funded and wholesale-funded commercial banks before the crisis, but the former have downsized markedly, while the latter have been rather stable in size since the onset of the global financial crisis. Retail-oriented business models appear to be more profitable in the long term (Mergaerts and Vander Vennet (2016)), although diversification yields additional profitability gains for retail banks (Ayadi and De Groen (2014)), with the benefits being particularly large for savings and cooperative banks (Köhler (2015)). Concerning the physical infrastructure, traditional business models may be associated with a higher degree of overcapacities. In particular, cooperative banks tend to operate extensive branch networks which, while giving a competitive advantage in terms of market contestability, entail considerable fixed costs (Hesse und Cihak (2007), Fonteyne (2007), Hirtle (2007)). In addition, retail-oriented banks are more customer-oriented and tend to have a higher staffing bill, likely reflecting a wider geographical reach with a larger number of branches and personnel (Ayadi et al. (2011), Ayadi and De Groen (2014)).

Hypothesis 3: Overcapacities in banking are more prevalent in countries with a higher share of population living in rural areas.

Broader geographic and demographic trends may be relevant explanatory factors for overcapacities in banking as well. More specifically, the degree of overcapacities in banking is expected to be higher in countries with a higher share of rural population in total population due to a stronger need for banks' regional presence. On this note, for example, Avery et al. (1997) suggest that population shifts are strong catalysts for branch network expansion/reduction. Moreover, against the backdrop of underlying

[6] However, Hernando and Nieto (2006) show that internet as a delivery channel is more a complement to than a substitute for branch banking. Analysing US community banks, DeYoung et al. (2007) come to a similar conclusion.

urbanisation trends, rural population is likely to consist of elderly people who tend to be less technology-affine (e.g. Karjalouto et al. (2002)), and may hence demand more branch banking. In addition, there are a number of studies documenting the continued importance of spatial proximity of banks to customers, in particular small firms (e.g. Brevoort and Wolken (2009)).

Hypothesis 4: Stronger competition from the non-bank financial sector entails lower overcapacities in banking.

By competing with banks for clients and new business, alternative non-bank providers of finance may alter banks' capacity needs. In fact, non-bank financial institutions (shadow banks) and market-based finance (capital markets) have become increasingly important in financing the real economy since the crisis (BIS (2018)). The rapid expansion of the shadow banking sector in recent years is being partly attributed to regulatory arbitrage as a result of stricter bank regulation (e.g. Plantin (2015), Adrian and Jones (2018)). However, Górnicka (2016) finds that when capital requirements are high, banks and shadow banks act as competitors only in the absence of implicit guarantees, otherwise they complement each other. In addition, Boot and Thakor (2000) show that stronger competition from capital markets leads to lower total bank lending and relationship lending amid increased value added of each relationship loan for the borrower. This finding is confirmed by Fraser et al. (2012) for the Japanese experience. Banks also face rising competitive pressures from other, more novel forms of credit providers. While still in its infancy, credit intermediation via fintech has been growing rapidly in recent years (Claessens et al. (2018)). Reaping the benefits of technological innovation, fintech firms have the comparative advantage to benefit from lower levels of leverage and a more efficient operational design (Philippon (2017)), thereby having the potential to lower the cost of intermediation and, hence, challenging the traditional banking industry (Vives (2017)). This seems particularly relevant for less competitive banking systems with higher margins on bank credit (Claessens et al. (2018)).

Hypothesis 5: Lower level of interest rates is associated with lower overcapacities in banking.

In the aftermath of the global financial crisis a mushrooming literature investigated the implications of the low/negative interest rate environment for banks. Overall, most research in the area postulates a positive relationship between interest rates (or the slope of the yield curve) and bank profitability, in particular driven by strong margin compression (e.g. ESRB (2016), Claessens et al. (2017)). The implications may vary with bank size though (e.g. Genay and Podjasek (2014), Covas et al. (2015)). That said, a number of studies find that the adverse impact of low/negative interest rates on bank performance tends to be offset by the positive effect of low interest rates on bank profitability via increased lending volumes and improved credit quality (e.g. ECB (2016), Altavilla et al (2017)). Weaker bank performance is likely to be reinforced by rising competition in a low interest rate environment (Mersch (2016)). The ensuing need to restore sustainable levels of bank profitability increases the pressure on banks to reduce prevalent overcapacities, for example by improving operating (cost) efficiency via restructuring/rationalisation or by exploiting scale efficiencies through consolidation (mergers and acquisitions).

Hypothesis 6: Stricter bank regulation and supervision implies lower overcapacities in banking.

Changes in the regulatory environment are also considered to play a key role in explaining overcapacities in banking. An earlier wave of the related literature from the 1980-90s (mainly focusing on the United States) identified bank deregulation as one of the main causes of overcapacities in banking by lowering entry/exit barriers (e.g. Frydl (1993), Radecki (1993)). Conversely, bank regulation (in particular capital and liquidity requirements) and supervision have tightened since the onset of the global financial crisis. Hence, higher regulatory intensity and greater supervisory scrutiny as well as better regulatory and supervisory quality are expected to be associated with a lower degree of overcapacities in banking. For example, de-Ramon et al. (2016) show that banks tend to meet higher regulatory capital requirements after the crisis in particular by reducing balance sheet size, while Eber and Minoiu (2016) find that in response to stricter supervision banks adjust leverage more in the form of shrinking assets than by raising equity. Concerning market structure, Corbae and D'Erasmo (2019) find that higher capital requirements lead to a lower profitability and, hence, a higher exit rate of small banks, as well as a more concentrated banking industry. At the same time, higher capital levels are also seen to translate into efficiency gains (Fiordelisi et al. (2011)), or vice versa, banks with lower levels of capital tend to be more inefficient (Altunbas et al. (2007)). Similarly, Chortareas et al. (2012) show that stricter capital requirements and stronger supervisory powers contribute to improved bank efficiency, with the impact being more pronounced in countries with better institutional quality.

Hypothesis 7: Financially more integrated banking systems tend to exhibit a higher degree of overcapacity.

The decades in the run-up to the global financial crisis were marked by rapid globalisation in banking and growing financial integration in certain jurisdictions (e.g. Europe), propelling the expansion of banks across borders, not least in an attempt to diversify risks and achieve scale economies through growth. The market entry of and fiercer competition from foreign banks may, however, underpin overcapacities in the banking sector (Radecki (1993)). For example, financial globalisation allowed for a rapid growth in banks' balance sheets, in particular of globally-active banks (Lane (2013)). Increased foreign bank presence, in turn, helps boost the funding available to the local economy by facilitating capital inflows (Ghosh (2016)), while the possibility to tap international wholesale markets has increased the lending capacity of local banks too (Lane (2013)). In addition, Allen et al. (2011) note that foreign bank entry increases competitive pressures due to the larger number of banks in the domestic market, while Bremus (2015) shows that cross-border banking, be it in the form of cross-border lending or foreign bank ownership, reduces market concentration. In the aftermath of the global financial crisis the perception of deglobalisation in banking has emerged. However, McCauley et al. (2019) find that the notion of deglobalisation is a regional (mainly European) phenomenon and should not be interpreted as a long-term deglobalisation trend. In a similar vein, Claessens and van Horen (2015) find that compared to the sharp drop in cross-border lending foreign bank presence was affected less, while having become more regionalised, as banks exited more distant and entered closer markets.

5.2 Data

The sample for analysing the determinants of overcapacities in the banking sector covers 26 global advanced economies over the period from Q1 2006 to Q4 2017.[7] The dependent variables used in the different model specifications include the composite indicator and the sub-indicators of overcapacities in the banking sector. The explanatory variables capturing the potential determinants of banks' overcapacities in line with the formulated hypotheses and their respective data sources are listed in Table 3. Four of the seven indicators (i.e. fixed broadband subscriptions, rural population, trustworthiness and financial globalisation) are available only at the annual frequency and are converted into a quarterly frequency using linear interpolation. The stationarity of all variables included in the models is assessed based on a Fisher-type panel unit root test (Choi (2001)). While the results reveal that about half of the variables exhibit a strong persistency, transforming all variables into first differences appears not reasonable in this particular analysis. This is because some of the variables (e.g. technological progress or demographic developments) exhibited pronounced trends over the last years which contain important information that would be eliminated by taking first differences.

Table 3

Candidate explanatory variables of overcapacities in the banking sector

Determinants	Indicator	Data source
Technological progress (TECH)	Fixed broadband subscriptions per 100 people	World Bank, WDI
Business model (BM)	Share of household loans in total bank lending to the non-financial private sector	National central banks
Demography/geography (DEM)	Share of rural population in total population	World Bank (WDI)
Non-bank competition (NBC)	Share of non-bank credit in total credit to the non-financial private sector	BIS
Interest rate environment (INTR)	10-year government bond yields	Bloomberg
Regulatory environment (REG)	Pillar 8B "Trustworthiness and confidence" of the Global Competitiveness Index	World Economic Forum
Financial integration (FINT)	Financial Globalisation Index	Cordella and Ospino Rojas (2017)

Source: Authors' compilation.

Technological progress (TECH) in a country, specifically with a focus on the use of high speed internet by the population, is captured by the number of fixed broadband subscriptions by 100 people taken from the World Bank's World Development Indicators. A more widespread availability of fast internet can be considered as a prerequisite for bank clients to use online banking services. The use of mobile banking could be an alternative indicator, but it is not considered here, as the availability of smartphones and mobile banking apps became only more widespread in the second half of the time span covered by our sample and surveys show that clients who use mobile banking still use internet banking (Srinivas and Wadhwani (2018)).

While a bank's business model (BM) can be characterised in various ways (Ayadi et al. 2011, Cernov and Urbano (2018)), this paper focuses on the extent to which a bank is engaged in traditional retail banking. This is because the way banks carry out retail

[7] The sample covers the 18 euro area countries, the euro area aggregate, the United States, the United Kingdom, Sweden, Denmark, Norway, Switzerland and Japan.

banking activities (e.g. via branches or internet banking) differs substantially across the country sample and because the digitalisation of retail banking is considered to have a substantial cost-saving potential (Morgan Stanley (2018)). Retail banking is captured by the share of household loans in total bank lending to the non-financial private sector obtained from national central banks.

Despite a long-term global trend of rising urbanisation, the share of the population living in rural areas differs considerably across the countries included in the sample. In the rural areas of some jurisdictions, the availability of stable and fast internet is limited and its population is often ageing. Depending on the importance of this market for banks, credit institutions might have to offer services via local branches with cost implications. This important demographic/geographic (DEM) aspect is captured by the share of rural population in total population obtained from the World Bank's World Development Indicators.

Non-bank competition (NBC) has increased in recent years partly due to tighter bank regulation after the global financial crisis (BIS (2018), FSB (2019)). As a consequence of comparatively lighter regulatory parameters, non-banks might be able to provide services at lower costs which were previously offered only by banks. Based on financial accounts data obtained from the BIS, the degree of non-bank credit intermediation is quantified by the share of non-bank credit in total credit to the non-financial private sector.

The interest rate (INTR) prevailing in a country is captured by the yield of 10-year government bonds obtained from Bloomberg. Government bond yields have been chosen to ensure sufficient heterogeneity among the euro area countries despite having the same policy rate and as the overall funding costs of banks are a composite measure of policy rates and market funding rates, where the latter might be affected by the credit risk of the sovereign.

The sub-indicator "trustworthiness and confidence" of the global competitiveness index obtained from the World Economic Forum is used to capture the regulatory environment (REG) in which banks operate. This sub-indicator is an aggregation of three underlying variables capturing the (i) soundness of banks, (ii) the regulation of securities exchanges and (iii) the legal rights index. While the first two are gathered from a survey among global business leaders, the third combines questionnaire information from financial lawyers with an analysis of laws and regulations. The soundness of banks captures the quantity dimension of regulation with higher values indicating a better capitalised banking sector. The regulation of securities exchanges has been included as banks are themselves important financial market participants, while the legal rights index aims at measuring the quality dimension of the broader regulatory environment with higher values reflecting a stronger legal protection of borrowers' and lenders' rights.

Financial integration (FINT) is captured by the financial globalisation index proposed by Cordella and Ospino Rojas (2017). The final measure for a country in a given year is the R-squared obtained from regressing a country's daily stock market returns on the first principal component from the returns of the 20 largest global stock markets. In line with the reasoning in Pukthuanthong and Roll (2009), the measure not corrected

for the changes in the volatility of the global factor is used as in the absence of a sampling error in volatility a country can be considered to be financially well integrated when a global factor explains the bulk of its stock market return.

5.3 Empirical evidence

To assess the hypotheses formulated in Section 5.1, a panel regression framework is used. In the baseline specification of the panel regression model

$$Overcapacities_{i,t} = \alpha + \beta_1 * TECH_{i,t} + \beta_2 * BM_{i,t} + \beta_3 * DEM_{i,t} + \beta_4 * NBC_{i,t} + \beta_5 * INTR_{i,t} + \beta_6 * REG_{i,t} + \beta_7 * FINT_{i,t} + \gamma_i + \delta_t + \varepsilon_{i,t} \quad (1)$$

the degree of overcapacity in the banking sector of country *i* at time *t* is regressed on the potential driving factors capturing the seven factors listed in Table 3, the country-fixed effects γ_i and the year-fixed effects δ_t. The fixed effects are included to eliminate a potential omitted-variables bias. Specifically, the country-fixed effects aim at controlling for unobserved country-specific factors that are time-invariant (e.g. the attitude towards the usage of internet banking) while the year-fixed effects control for unobserved factors that change over time but not across countries (e.g. the global trend of urbanisation).

The results reported in the first column of Table 4 reveal that for five of the seven potential determinants of banking sector overcapacities, the estimated coefficients are statistically significant and have the expected sign. To better understand the relative importance of the different explanatory variables, the estimated coefficients can be standardised. This way each coefficient captures the effect of a one standard deviation change of the respective explanatory variable on banking sector overcapacities. Ranking the standardised coefficients reveals that non-bank competition, the interest rate environment and bank business models are the factors which have the largest effect on the degree of banking sector overcapacities.

Table 4

Determinants of overcapacities in banking – Composite indicator

Variables	(1) Composite indicator	(2) Composite indicator	(3) Composite indicator
Technological progress (TECH)	-0.003 (0.002)	0.018*** (0.004)	-0.013*** (0.002)
Business model (BM)	0.629*** (0.142)	1.436*** (0.159)	0.128 (0.149)
Technological progress (TECH) * Business model (BM)		-0.040*** (0.006)	
Demography (DEM)	-0.035 (0.744)	-0.251 (0.738)	2.612*** (0.806)
Non-bank competition (NBC)	-1.259*** (0.107)	-1.235*** (0.102)	-1.307*** (0.120)
Interest rate environment (INTR)	0.024*** (0.002)	0.024*** (0.002)	0.034*** (0.004)
Regulatory environment (REG)	-0.065*** (0.018)	-0.068*** (0.018)	-0.069*** (0.019)
Financial integration (FINT)	0.098** (0.045)	0.146*** (0.045)	0.333*** (0.044)
Constant	0.403* (0.243)	0.021 (0.241)	0.163 (0.252)
Observations	1,248	1,248	1,248
Adjusted R-squared	0.901	0.904	0.876
Country-FE	YES	YES	YES
Year-FE	YES	YES	NO

Notes: Robust standard errors are reported in parentheses. Coefficients marked with ***, **, * are significant at the 1%, 5% and 10% level, respectively.

For the remaining two potential determinants, i.e. for technological progress and for demography, the results differ from the formulated hypotheses. To investigate this further, the baseline model specification is modified to take additional considerations into account. One aspect is that the extent to which technological progress impacts overcapacities might depend on a bank's business model. To this end, an interaction term is added which intends to capture this more complex relationship

$$Overcapacities_{i,t} = \alpha + \beta_1 * TECH_{i,t} + \beta_2 * BM_{i,t} + \beta_3 * DEM_{i,t} + \beta_4 * NBC_{i,t} + \beta_5 * INTR_{i,t} + \beta_6 * REG_{i,t} + \beta_7 * FINT_{i,t} + \beta_8 * TECH_{i,t} * BM_{i,t} + \gamma_i + \delta_t + \varepsilon_{i,t} \quad (2)$$

The results reported in the second column of Table 4 suggest that technological progress (as captured by fixed broadband subscriptions) can reduce banking sector overcapacities when the share of retail banking in the business model is sufficiently high. While for banks with no retail banking (as proxied by the share of household loans in total loans) more technological progress appears to be associated with an increase in overcapacities, the relationship is negative for banks that are substantially active in retail banking. This appears reasonable as the cost-saving potential of digitalisation is likely to be more pronounced in retail banking (Gropp and Kok (2017), Morgan Stanley (2018)). This effect is also economically significant. Given 40

broadband subscriptions per 100 people, a share of household loans to total loans of 80% instead of 50% is associated with a reduction in the level of overcapacities by 0.28, which corresponds, for example, to the difference in the overcapacity level between Cyprus and Belgium.

The second aspect is that at least some of the impact of demographic changes on banking sector overcapacities might be captured by unobserved heterogeneity in the time dimension. As a consequence, in a model with both country and year-fixed effects, the latter term might absorb at least part of the effect that is considered to be capturing demographic changes. To investigate this aspect, a modified baseline model is estimated without the year-fixed effect. The coefficient of demography reported in the third column of Table 4 is significantly positive (compared to a non-significant coefficient in the baseline model) which suggests that demographic changes affecting all countries in the sample similarly were positively associated with changes in the degree of overcapacities. This appears to be consistent with the ongoing global trend of urbanisation which is reflected in an increase in the ratio of urban to total population from 39% in 1980 to 52% in 2011 (Chen et al. (2014)).

The construction of the composite indicator of overcapacities based on the three sub-composite indicators allows investigating in more detail how the potential driving factors are related to the size, competition and structure dimension of overcapacities. To this end, three models are estimated in which the baseline model is modified such that the sub-composite indicators are used as dependent variables.

$$Size_{i,t} = \alpha + \beta_1 * TECH_{i,t} + \beta_2 * BM_{i,t} + \beta_3 * DEM_{i,t} + \beta_4 * NBC_{i,t} + \beta_5 * INTR_{i,t} + \beta_6 * REG_{i,t} + \beta_7 * FINT_{i,t} + \gamma_i + \delta_t + \varepsilon_{i,t}$$

$$Competition_{i,t} = \alpha + \beta_1 * TECH_{i,t} + \beta_2 * BM_{i,t} + \beta_3 * DEM_{i,t} + \beta_4 * NBC_{i,t} + \beta_5 * INTR_{i,t} + \beta_6 * REG_{i,t} + \beta_7 * FINT_{i,t} + \gamma_i + \delta_t + \varepsilon_{i,t} \quad (3)$$

$$Structure_{i,t} = \alpha + \beta_1 * TECH_{i,t} + \beta_2 * BM_{i,t} + \beta_3 * DEM_{i,t} + \beta_4 * NBC_{i,t} + \beta_5 * INTR_{i,t} + \beta_6 * REG_{i,t} + \beta_7 * FINT_{i,t} + \gamma_i + \delta_t + \varepsilon_{i,t}$$

Table 5 reports the results of which a few are worth highlighting.

With respect to demography, the estimated coefficient is negative for the size and competition dimensions but positive for the structure dimension. These findings can be interpreted in such a way that a higher share of rural population tends to be associated with a smaller banking sector size and a lower degree of bank competition but with higher operational inefficiencies. This appears to be consistent with the notion that banks operating in rural areas tend to have a more extensive branch network which on the one hand can act as an entry barrier for competitors but on the other hand also leads to cost inefficiencies that banks might try to compensate/balance with smaller business units. It also illustrates that as the signs across the sub-composite indicators differ the coefficient of the composite indicator might become insignificant which emphasises the importance of a granular analysis. This result might be relevant for policy recommendations of reducing overcapacities in countries which are

characterised by a still strong presence of bank branches in rural areas, especially when the market contestability is limited by a tiered banking system which does not foresee mergers across banks operating in different pillars (e.g. Germany).

Table 5

Determinants of overcapacities in banking – Sub-indicators

Variables	(1) Composite indicator	(2) Sub-indicator Size	(3) Sub-indicator Competition	(4) Sub-indicator Infrastructure/efficiency
Technological progress (TECH)	-0.003 (0.002)	-0.001 (0.001)	-0.009*** (0.002)	0.008*** (0.001)
Business model (BM)	0.629*** (0.142)	-0.213*** (0.061)	0.058 (0.109)	0.784*** (0.059)
Demography (DEM)	-0.035 (0.744)	-1.182*** (0.204)	-1.317*** (0.442)	2.464*** (0.462)
Non-bank competition (NBC)	-1.259*** (0.107)	-1.153*** (0.047)	0.030 (0.080)	-0.136*** (0.038)
Interest rate environment (INTR)	0.024*** (0.002)	0.003*** (0.001)	0.018*** (0.002)	0.003*** (0.001)
Regulatory environment (REG)	-0.065*** (0.018)	0.021*** (0.007)	-0.032** (0.013)	-0.054*** (0.007)
Financial integration (FINT)	0.098** (0.045)	0.023 (0.021)	0.012 (0.032)	0.062** (0.031)
Constant	0.403* (0.243)	0.808*** (0.079)	0.621*** (0.137)	-1.026*** (0.135)
Observations	1,248	1,248	1,248	1,248
Adjusted R-squared	0.901	0.914	0.762	0.943
Country-FE	YES	YES	YES	YES
Year-FE	YES	YES	YES	YES

Notes: Robust standard errors are reported in parentheses. Coefficients marked with ***, **, * are significant at the 1%, 5% and 10% level, respectively.

Another interesting finding is related to non-bank competition. It is negatively related to the composite indicator of overcapacities which is due to the size and structure dimension of overcapacities. This result is consistent with a smaller banking sector size and a leaner infrastructure coupled with a higher operational efficiency for those banking sectors facing a higher degree of non-bank competition.

Finally, as regulatory conditions for banks have tightened since the global financial crisis, it is interesting to see what can be inferred from this with respect to the different dimensions of banking sector overcapacities. The estimated coefficient is positive for the size dimension and negative for the competition and structure dimension. This suggests that banking sectors with a stricter regulatory environment tend to be characterised with a larger banking sector size, a smaller number of banks and a smaller degree of operating inefficiencies. A possible interpretation of this finding could be that banks operating in a tighter regulatory regime are more likely to exploit economies of scale to find the right balance between being profitable and being able to effectively respond to regulatory demands.

Similar to the composite indicator, an examination of the standardised regression coefficients provides valuable insights on the relative importance of the different explanatory variables on each of the sub-indicators of overcapacities in banking.

Specifically, non-bank competition, demography and bank business models are the factors that have the largest effect on the size dimension of overcapacities. Demography, technological progress and the interest rate environment appear to affect, most strongly, the competition dimension of overcapacities, while demography, bank business models and technological progress are the most important driving factors of the infrastructure/efficiency dimension of overcapacities.

5.4 Robustness

The previous section reached the conclusion that for five out of seven potential determinants the estimated relationship with banking sector overcapacities is in line with the formulated hypotheses while for the remaining two more complex relationships were revealed. Subsequently, the robustness of these main findings to (1) using lagged explanatory variables, and (2) using different econometric models is examined. Table 6 reports the findings with the first column repeating the results of the baseline specification for ease of comparison.

Table 6

Determinants of overcapacities in banking – Robustness

Variables	(1) Baseline standard	(2) Baseline lagged regressors	(3) Baseline only country-FE	(4) Baseline only year-FE	(5) Baseline pooled OLS
Technological progress (TECH)	-0.003 (0.002)	-0.002 (0.002)	-0.013*** (0.002)	-0.011*** (0.002)	-0.013*** (0.002)
Business model (BM)	0.629*** (0.142)	0.628*** (0.148)	0.128 (0.149)	-0.647*** (0.075)	-0.791*** (0.071)
Demography (DEM)	-0.035 (0.744)	-0.111 (0.757)	2.612*** (0.806)	-0.275*** (0.078)	-0.300*** (0.079)
Non-bank competition (NBC)	-1.259*** (0.107)	-1.300*** (0.113)	-1.307*** (0.120)	-1.143*** (0.057)	-1.145*** (0.058)
Interest rate environment (INTR)	0.024*** (0.002)	0.023*** (0.004)	0.034*** (0.004)	0.003 (0.003)	0.013*** (0.003)
Regulatory environment (REG)	-0.065*** (0.018)	-0.050*** (0.018)	-0.069*** (0.019)	-0.041*** (0.015)	-0.003 (0.011)
Financial integration (FINT)	0.098** (0.045)	0.119*** (0.045)	0.333*** (0.044)	0.433*** (0.031)	0.502*** (0.029)
Constant	0.403* (0.243)	0.323 (0.256)	0.163 (0.252)	1.111*** (0.093)	1.001*** (0.090)
Observations	1,248	1,222	1,248	1,248	1,248
Adjusted R-squared	0.901	0.902	0.876	0.527	0.508
Country-FE	YES	YES	YES	NO	NO
Year-FE	YES	YES	NO	YES	NO

Notes: Robust standard errors are reported in parentheses. Coefficients marked with ***, **, * are significant at the 1%, 5% and 10% level, respectively.

While reversed causality appears not to be an issue for most of the explanatory variables, it is possible that banking sector overcapacities induced credit institutions to change their business model. To mitigate a potential endogeneity, all explanatory variables are lagged by one period. The results reported in the second column are qualitatively unchanged.

The choice of the regression model might also have an impact on the estimation results. To investigate this aspect, columns three to five report the results of a model which only contains country-fixed effects, a model which contains only year-fixed effects and a pooled OLS model. While our main findings from the baseline model are qualitatively confirmed, a few aspects are worth highlighting.[8] Comparing the R-squared of the pooled OLS model with that of the two panel models which include only country or year-fixed effects, respectively, reveals that a substantial share of the variance in the degree of banking sector overcapacities is explained by (unobserved) country-specific factors. In comparison to that the share of variance explained by (unobserved) time-varying factors is relatively small. This emphasises the importance of including country-fixed effects in the model. That aspect becomes also apparent from the insignificant coefficient on the interest rate environment in the panel model which includes only year-fixed effects. It can be interpreted in the sense that in some banking sectors structural features seem to dominate which might interact with some of the driving factors of banking sector overcapacities.

[8] For technological progress and demography more complex relationships were revealed. To account for those, the baseline specification was modified. Hence, the focus in this robustness section is only on those determinants whose estimated coefficients from the baseline model were consistent with the hypotheses.

6 Policy considerations

The above findings suggest that any discussion of the options on how to deal with overcapacities in banking may need to take into account the different dimensions of overcapacities, thereby allowing for a more targeted response and a multi-layered approach should multiple dimensions be at play.

In general, any adjustment process needs to be driven by market forces (Nouy (2017)). However, even if the main responsibility of transitioning to leaner structures lies with the banks, depending on the nature of the underlying problem, rebalancing towards a new state of equilibrium may benefit from supportive action from relevant stakeholders, such as central banks, supervisors, regulators or various governmental bodies. The findings of the paper may provide useful insights for policy makers regarding the potential design and calibration as well as prospective effectiveness of policy choices, and any need for coordination thereof between relevant authorities at the national and international/supranational levels. In addition, understanding the relative importance of the underlying determinants of overcapacities in banking provides authorities with additional information on the possible design of an adequate policy response which may require support from policy areas beyond the scope of banking.

Remedial action, be it on the part of banks or policymakers, requires a clear strategy that is strongly contingent on the specific dimension of overcapacities (i.e. size, competition and infrastructure/efficiency) in question. In terms of the strategy, there is obviously no one-size-fits all solution given national specificities and differences in initial conditions, but there are some common elements which can be applied in most jurisdictions:

Market exit is the most straightforward way of reducing overcapacities in banking while being relevant for all the three dimensions under review. However, market exit is more difficult in banking than in other sectors as a result of the underlying specificities of the banking industry, notably the potential negative externalities of bank failures for financial stability and the overall economy (Borio (2016)), especially when it concerns systemically important institutions. In addition, exit from the banking sector involves high sunk costs that cannot be recovered when leaving the industry and which are viewed to be particularly binding in retail banking (Davis and Salo (1998)). Against this backdrop, market exit requires the existence of appropriate mechanisms for orderly resolution of banks. In fact, developing frameworks which allow for a swift and orderly resolution of banks has been a key priority on the post-crisis regulatory agenda, as indicated, for example, by the guidelines prepared by the Financial Stability Board on the orderly resolution of institutions and TLAC or the setting-up of the Single Resolution Board in the euro area.

Furthermore, consolidation will be key in restoring the sustainability and efficiency of bank operations, with the reduction of overcapacities likely encompassing some form of: (1) downsizing, (2) mergers and acquisitions, and/or (3) rationalisation.

First, rebalancing in terms of size would mainly need to build on efforts by individual banks for balance sheet repair, in particular, downsizing. That said, any deleveraging strategy, ranging inter alia from the sell-off of non-core, non-domestic business lines over the disposal of liquid assets to debt-to-equity conversions, would need to reflect the source of underlying bank balance sheet pressure (see ECB (2012)). In some cases, policy support may be warranted to ensure an orderly deleveraging of the banking sector. The "Vienna Initiative" serves as a good example of possible private-public cooperation in this regard. Similarly, measures may target the structure of bank balance sheets, inter alia by balance sheet de-risking and policies limiting the conduct of high-risk activities that have contributed to the rapid expansion of the banking sector in many advanced economies in the run-up to the global financial crisis (e.g. Volcker and Vickers rules, see Chow and Surti (2011)).

Second, bank consolidation via M&A is also frequently mentioned as a means of reducing overcapacities in banking. First and foremost, M&As impact the competitive landscape in the banking industry by reducing the number of institutions and, in the case of in-market mergers, also leading to higher market concentration (Borio and Tsatsaronis (1999), Dombret (2018)). Depending on the underlying objective, the literature distinguishes between two main M&A types (Davis and Salo (1998), Radecki (1999)): diversification and consolidation mergers. While the former often aim at increasing the geographic reach in order to diversify risk across borders, the latter focus on enhancing efficiency via restructuring and rationalisation, and tend to be the dominant form of domestic mergers.[9] In the case of consolidation mergers, clear synergies can be achieved, for example, by eliminating competing branch networks. That said, while M&As may help to reach a banking sector size that is critical for ensuring economies of scale and density as well as enhance cost efficiency, M&As are not a panacea, as they may give rise to the too-big-to-fail problem that may require enhanced supervision and carefully defined resolution frameworks to mitigate systemic risks (Yellen, (2011), Dombret (2018)). Policymakers may facilitate mergers and acquisitions, for example, by better disclosure practices and enhanced transparency obtained, for example, through asset quality reviews or stress tests as carried out by major central banks (Nouy (2017)).

Third, rationalisation is carried out with a view to improve banks' cost efficiency. Cost savings tend to be generated mostly from cutting the number of branches and staff. Technological innovations play a key role in this regard as banks increasingly offering their services via non-traditional distribution channels (i.e. internet and/or mobile banking) can reduce the expenses required to maintain costly branch networks. That said, cost cutting and the adoption of new technology may require substantial upfront investments and costs (e.g. new IT systems, severance pay for layoffs) (Constâncio (2017)), so that the benefits of cost cutting strategies are likely to materialise only in the medium to long term. In addition, the ease with which banks can take advantage of the benefits of technological advances depends on a number of factors such as the technological infrastructure in a jurisdiction and the technological affinity of the population. Authorities can play an active role in improving the general conditions, for

9 For further details see Duijm and Schoenmaker (2018).

example, by promoting the digitalisation of the economy or enhancing the "technological literacy" of the population.

The pace of adjustment is likely to vary across countries and banks, depending on the severity of the underlying pressure to act (e.g. shareholders, macroeconomic conditions, degree of competition faced from alternative providers of finance), the sunk costs involved (e.g. reputational concerns of withdrawing from certain activities, market entry/exit conditions) as well as the regulatory and institutional perimeters shaping any adjustment process (e.g. prevalent employment protection laws).[10]

[10] See, for example, Davis and Salo (1998).

7 Conclusion

This paper investigated the notion of overcapacities in banking via the dimensions of banking sector size, bank competition as well as infrastructure/efficiency, thereby providing a more nuanced view on whether a banking sector is over-financed, over-banked and/or over-serviced. A newly constructed composite indicator of overcapacities in banking crystallises these different layers into a single metric and suggests that overcapacities have declined in most countries in the sample since the onset of the global financial crisis, albeit to varying degrees. That said, some countries were better able to adapt to the changing environment than others, in particular by deleveraging, reducing costly branch networks and exploiting the benefits of financial digitalisation.

In addition, this paper empirically investigated how a set of high-level factors, which are derived from the theoretical and empirical literature and are being considered as dimensions shaping the future of the banking industry, are related to overcapacities in banking. Based on a panel regression approach and a sample of 26 global advanced economies covering the period from 2006 to 2017, seven hypotheses were tested with respect to the overall degree of overcapacities and regarding the size, competition and infrastructure/efficiency pillars. The paper is the first that empirically analysed the main determinants of overcapacities in banking. At a time when the banking sector faces challenges partly as a consequence of the global financial crisis, it sheds light on how major trends which are shaping the future of the banking industry are related to overcapacities in banking. The main results are as follows. Non-bank competition, the interest rate environment as well as the importance of retail banking in a bank's business model are the most important explanatory factors of the overall degree of overcapacity in banking. The ranking of the driving factors differs for the three underlying pillars of overcapacity. While non-bank competition appears to be particularly relevant for the size pillar, demographic factors and technological advances appear to play a prominent role for explaining the competition as well as infrastructure/efficiency pillars.

The findings provide useful insights for policy makers regarding the design, calibration and effectiveness of policy choices with the aim of reducing banking sector overcapacities. Accordingly, any discussion on the related policy options for how to deal with overcapacities in banking should take into account the different dimensions of overcapacities in banking, thereby allowing for a more targeted policy response and, should multiple dimensions be at play, a multi-layered approach. Understanding the relative importance of the underlying determinants of overcapacities provides policy makers with additional ammunition regarding the possible design of an adequate policy response which may require support from policy areas beyond the scope of banking, such as promoting digitalisation of the economy or enhancing the "technological literacy" of the population.

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