Banking System in Time of Covid-19: A Reverse Analysis on Loss Absorption Capacity, Lending to the Economy and Market Valuation (*)

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Abstract

All over the world, governments, institutions and central banks have enacted massive actions in order to mitigate the effects of the Covid-19 pandemic on real economies and banking systems. This paper shows the extent of losses the banking systems of Germany, France, Italy, Spain, UK and US could bear thanks to their existing capital position and the relief measures recently taken by the ECB, the BoE and the FED. At the same time, we will show the amount of new lending that banks might grant to support the real economies based on capital constraints. Finally, we will investigate the relationship between financial stability, protection of public funds and profitability in the banking system. A key finding is that the banking systems are currently much better capitalized than at the beginning of the Global Financial Crisis in 2008-2009 and that they appear to be able to support the economy. Nevertheless, it seems unlikely that banks will be profitable in a high-regulated context in which the implicit public guarantee on their liabilities is partially lacking.

Keywords: Bank Fragility, Loss Absorption Capacity, Covid-19, Financial Regulation, Reverse Analysis, Bank Profitability, Bank Valuation.

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1. Introduction

The recent and sudden outbreak of a new pandemic is putting pressure on even the world's most advanced economies. The severity of the crisis in terms of reduction of GDP[1], increase in unemployment, decrease in investment and increase in company defaults will depend on the duration of the pandemic and the various measures adopted by governments, institutions and central banks to support the economy.

In this vein, in the Eurozone, in UK and the US, the European Central Bank (ECB), the Bank of England (BoE) and the Federal Reserve System (FED) have granted, *inter alia*, temporary capital and operational relief[2] to their respective banking systems. The measures taken by the three central banks will allow the banking system to better support the real economy and to better absorb losses that might come up due to the current worldwide economic recession.

The purpose of this paper is to estimate for the banking systems: i) the maximum capacity to absorb losses before breaching minimum capital requirements set by the Supervisors (see par. 2 to 4); ii) the capacity to support the real economy (see par. 5 and 6); and iii) the minimum level of profitability in order to have a return for investors equal to or greater than the cost of capital (see par. 7). For points i) and ii), we will take into account some of the relief measures recently enacted by supervisors. Our goal is not to evaluate the entire degree of resilience of each banking system, but only one of its components, i.e. the maximum amount of losses that could be borne. Other components of resilience (i.e. macro risk, market risk, quality of management, etc.) will not be analyzed.

The countries on which the analysis will focus are Germany, France, Italy, Spain, the United Kingdom (UK) and the United States of America (US). The simulated data for these countries are obtained by aggregating the estimates made for each individual bank included in the respective country sample. We will also provide a comparison with the initial position of these banking systems at the beginning of the global financial crisis in 2008-2009 in order to show how much the overall capital position has been improved thanks to the more stringent regulations adopted by the various legislations[3].

Bank loss absorption capacity is mathematically determined by a few technical variables: current level of regulatory capital and prudential capital requirements imposed by supervisors, and, to some extent, expectations regarding growth rate and riskiness of banking activities. We will see that there is a trade-off between allocating actual capital either to absorb losses or to support the economy through lending. In fact, given a determined amount of free capital (i.e. capital exceeding regulatory requirements), banks could decide either to retain it (in order to be better prepared should losses materialize) or to use it (in order to expand the lending). Of course, banks could implement a combination of the two actions (holding a part of capital and using part of it to provide lending).

In order to better compare the different banking systems, we will determine the maximum loss rate on Total Assets (TAs), Risk Weighted Assets (RWAs) and Equity Book Value (EBVs) that a bank could suffer without breaching minimum regulatory capital requirements. Given the maximum loss rate on TAs, we will also estimate the maximum lending capacity against different capital thresholds.

For point iii), we will investigate the relationship between financial stability, bank regulation and bank market value from current and historical perspectives. We will highlight the evolution of banks' profitability, market appetite to invest (through a simple valuation model), and leverage in the banking sector over the period 2001-19. Finally, we will discuss how regulation may have influenced some decisions for investors.

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[1] See IMF - World Economic Outlook Update, June 2020.

[2] In this Report - EU/EA measures to mitigate the economic, financial and social effects of coronavirus by the European Parliament from the 1st July 2020, there is a good overview of the measures proposed and enacted at the EU or Euro Area Level to mitigate the economic and social effects of Covid-19.

[3] See Basel III post-crisis regulatory reform, Dodd-Frank Act (DFA) in US and Banking Package in EU.

2. Break-Even ROA: A Measure of Loss Absorption Capacity

We use a simplified model to represent bank accounting and risk dynamics through four fundamental factors[4].

1) **Risk**: measured in terms of risk-weighted assets (RWA).
2) **Profitability**: we calculate three profitability indexes: the first in terms of total assets (RoA), the second in terms of RWAs (RoRWA), and the third in terms of equity book value (RoE). In order to fully consider all the losses that could be generated, we calculate the profitability indexes using the "Total Comprehensive Income" (TCI), i.e. income that also takes into account gains/losses not accounted directly in the income statement but in Other Comprehensive Income (OCI)[5]. Therefore, RoA = TCI/Total Assets, RoRWA = TCI/RWA and RoE = TCI/Equity Book Value.
3) **Regulatory Capital Requirements**: the main capital requirements are the Minimum Common Equity Tier 1 Ratio (SREP[6] CET1 Ratio in the EU) and the Leverage Ratio (LR). Our hypothesis is that (in most cases), at least in the Banking Union (BU) and the UK, the former ratio is more binding than the latter. For this reason, we will focus on the risk-based capital requirements in terms of Pillar 1 and Pillar 2 (see Bevilacqua et al. 2019). We will take into consideration the fact that banks can fully use capital buffers (including Pillar 2 Guidance), and that, for the purposes of own funds requirements, the Total SREP Capital Requirement (TSCR) includes: (a) the minimum own funds requirement of 8%; and b) a Pillar 2 additional own funds requirement to be made up in the form of 56.25% of CET1 capital and 75% of Tier 1 capital, as a minimum[7]. Differently than in Europe, the FED does not explicitly set Pillar 2 capital requirements under the CCAR (Comprehensive Capital Analysis and Review) and the capital rule (see FED 2018a, FED 2018b). In any case, the FED considers "well capitalized banks" to be those with at least 2% of capital ratio in addition to that stipulated by the regulation (see Walter 2019). For this reason, we assume that (implicitly) the "P2R" requirement for all US banks would be equal to 2%. As it has been widely reported that for many US banks, leverage requirement was more binding that their risk-based capital requirement (Duffie 2017, Choi et al. 2018, JPMorgan 2014), we will also conduct an analysis considering the "enhanced" Supplementary Leverage Ratio (SLR) rule finalized in 2014. This rule requires advanced approach firms designated as global systemically important banks (G-SIBs) to hold a minimum of 5%. The UK, implementing the CRD-IV/EBA Guidelines, has some features in common with the BU, but with important differences. Specifically, there are two main requirements the Prudential Regulation Authority (PRA) sets when assessing a firm's capital adequacy under a SREP: Pillar 2A (P2A) and Pillar 2B/PRA buffer (P2B) (See BoE and PRA, 2018). In particular, the P2A is the amount of capital that a bank should hold at all times in addition to Pillar 1 and it is to be met with at least 56% CET1, no more than 44% AT1 capital and no more than 25% Tier 2 (See BoE and PRA, 2020). In response to the economic shock from Covid-19, the PRA allowed banks, on a voluntary basis and subject to supervisory agreement, to set all P2A requirements as a nominal amount (using RWAs as of end-December 2019), instead of a percentage of the total RWAs. This change would apply for 2020 and 2021 SREP assessment (see Statement by the PRA on 7 May 2020). We will see that this measure could have an important effect on the capacity of UK banks to provide new lending to the economy, but not on the actual capacity to absorb losses.
4) **Growth Rate** of the Total Assets.

Based on the four variables described above, we can obtain a solution in a closed formula that allows us to detect the critical level of profitability/loss that triggers the breaching of the regulatory capital constraints. The

[4] Actually, bank accounting and risk dynamics depends on the dividend policy as well. In line with what is recommended by the major supervisor authorities, we assume that no dividends will be distributed in the near future. In any case, the MDA trigger still applies.

[5] In banks' balance sheets, there are many financial instruments valued at Fair Value, the value variations of which are accounted in the OCI Equity Reserve and not in the income statement.

[6] Supervisory review and evaluation process.

[7] See the 12 March 2020 press release from ECB here.

following formula defines the break-even RoA ($BERoA$), i.e. the level of ROA that causes a CET1 ratio below the pre-set regulatory threshold[8]:

$$BERoA_t = \overline{CET1}_t \cdot RW_t - \frac{CET1_{t-1} \cdot RW_{t-1}}{1 + g_t} \quad (1)$$

where: $\overline{CET1}$ is the minimum level of Common Equity Tier 1 Ratio that the bank should comply with; RW is the average risk density (RWA/Total Assets), g is the growth rate of the total assets. Time "*t-1*" refers to the last period for which data are available. For our analysis, data refers to Q4 2019.

As we should expect that $\overline{CET1}_t < CET1_{t-1}$, the *BERoA* represents the maximum loss rate on Total Assets that a bank can stand without breaching the regulatory capital requirements. Therefore, the higher/lower the loss rate (*BERoA*), the higher/lower would be the capacity of the bank to absorb losses. The derivation of the *BERoRWA* and *BERoE* is similar.

Refer to the appendix for the sample used in the analyzes and the data sources used.

3. The Loss-Absorbing Capacity of Banks in the Pre-Covid 19 Scenario

Table 1 assesses the capacity of the different banking systems to absorb losses against two distinct thresholds in 2019: the first is the Minimum SREP CET1 Ratio, which represents the binding total capital demand in terms of CET1 capital (see Fig. 1 for a summary of the different definitions of the capital thresholds used in our analysis). It is calculated as 4.5% + Pillar 2 (P2R) + Deficit (AT1) + Deficit (T2) The second is the MDA Trigger (CET1 Ratio Requirement), which represents the CET1 ratio threshold that, if breached, would lead to automatic restrictions on capital distributions and certain discretionary incentive compensation payments. It is calculated as 4.5% + Pillar 2 (P2R) + Deficit (AT1) + Deficit (T2) + CBR. The estimates on the capacity to absorb losses have been obtained setting $g=0$ and $RW_t = RW_{t-1}$ in formula (1). The loss value, in both nominal and relative terms (*BERoA*, *BERoRWA* and *BERoE*) are represented in absolute value for a better reading.

Fig 1. - CET1 Requirement for Banks: Threshold Used in the Analysis

	Minimum CET1 Ratio	MDA Trigger
BU	= 4.5% + 56.25%×P2R + Deficit (AT1) + Deficit (T2)	= 4.5% + Pillar 2 (P2R) + Deficit (AT1) + Deficit (T2) + CBR *where*: CBR= CCB(2.5%) + Systemic Risk Buffer
UK	= 4.5% + 56% × P2R + Deficit (AT1) + Deficit (T2)	= 4.5% + 56% × P2R + Deficit (AT1) + Deficit (T2) + CBR *where*: CBR= CCB(2.5%) + Systemic Risk Buffer
USA	= 4.5% + 2% + Deficit (AT1) + Deficit (T2)	4.5% + 2% + Deficit (AT1) + Deficit (T2) + CBR *where*: CBR= CCB(2.5%) + Systemic Risk Buffer

Note: CBR = Capital Conservation Buffer; CBR = Combine Buffer Requirement. Following the decision of the most of Macro-prudential Authorities the CBR now includes the CCyB (Countercyclical Capital Buffer) set at zero. (see ESRB - Countercyclical capital buffer)

The Loss Rate on TAs (*BERoA*) is equal to 2.58% on average whereas the one on RWA (*BERoRWA*) is equal to 7.15%.

[8] The break-even RoA (*BERoA*) has been obtained according to the following equilibrium condition and with the hypothesis that the regulatory capital adjustments are constants:

$$BERoA_t \cdot TA_{t-1} \cdot (1 + g_t) = \overline{CET1}_t \cdot RW_t \cdot TA_{t-1} \cdot (1 + g_t) - CET1_{t-1} \cdot RW_{t-1} \cdot TA_{t-1}$$

where TA it is the Total Assets.

As we can see, Italy has the best capacity to absorb losses in terms of TAs compared to other countries (3.07%), while the UK has the worst (2.24%). However, considering the capacity to absorb losses in terms of RWA, we can see that except for Spain and the USA, countries are more or less on the same level[9]. This would suggest that the capital levels and the actions of supervisors are more or less coherent with the degree of risk of the assets in the various banking systems[10], as well as the level of resilience.

For the banking systems belonging to both the SSM and the UK, the loss absorption capacity may be underestimated, as we do not consider all the "Anti-Covid19" relief measures taken by the Authorities[11].

On the contrary, for the US banking system the loss absorption capacity could be overestimated. The G-SIB banks are subject to a minimum Leverage Ratio equal to 5% (the so-called Supplementary Leverage Ratio - SLR), which is a more binding requirement than that based on RWA. In this case, the *BERoA* would decrease from 2.79% to 1.76%[12].

If we consider the minimum level of capital the one correspondent to the MDA trigger, we can see that the loss absorption capacity would decrease by around 50% for the European banking systems, and by around 75% for the US. The reason for this is that US Banks have higher G-SIB buffers and RWA densities but lower CET1 Ratio than European ones. It is important to keep in mind that if regulatory capital falls below the MDA trigger, banks can make distributions only within the limits of the maximum distributable amount (MDA), and they should submit a capital conservation plan to the supervisory authorities in order to restore the buffers.

Tab. 1 – Loss Absorption Capacity in 2019
(Data in millions)

Country	Total Assets[1] Q4 2019	CET1 Ratio Q4 2019	RWA Density Q4 2019	P2R[2] Q4 2019	Surplus (Deficit) AT1	Surplus (Deficit) T2	Minimum CET1 Ratio[3]	Max Capacity to Absorb Losses	BERoA	BERoRWA	BERoE	MDA Trigger[4] (CET1 Ratio Requirement)	Max Capacity to Absorb Losses	BERoA	BERoRWA	BERoE
GERMANY	3,638,672 EUR	14.63%	29.60%	2.10%	-0.58%	0.09%	6.78%	84,595 EUR	2.32%	7.85%	53.59%	10.53%	44,236 EUR	1.22%	4.11%	28.02%
FRANCE	8,523,044 EUR	15.08%	29.54%	1.55%	-0.78%	0.30%	6.19%	217,418 EUR	2.55%	8.63%	46.67%	9.61%	129,544 EUR	1.52%	5.14%	27.81%
ITALY	2,573,232 EUR	13.96%	41.89%	1.87%	-0.82%	-0.05%	6.64%	79,002 EUR	3.07%	7.33%	45.41%	9.66%	46,432 EUR	1.80%	4.31%	26.69%
SPAIN	3,451,009 EUR	12.21%	42.17%	1.60%	-0.44%	-0.42%	6.26%	86,687 EUR	2.51%	5.96%	37.61%	9.41%	40,748 EUR	1.18%	2.80%	17.68%
UK	5,287,488 GBP	14.45%	28.61%	3.80%	0.79%	1.34%	6.63%	118,358 GBP	2.24%	7.82%	40.83%	10.84%	54,647 GBP	1.03%	3.61%	18.85%
USA	14,755,292 USD	11.84%	52.50%	2.00%	0.15%	0.58%	6.53%	411,028 USD	2.79%	5.31%	34.66%	10.54%	100,107 USD	0.68%	1.29%	8.44%

(1) The total assets of the US banks are adjusted to take into account the derivatives netting allowed in US-GAAP. This adjustment ensures a fair comparison with the European banks that adopt IFRS accounting standards.
(2) P2R (Q4 2019): Represent the Pillar 2 (P2R) capital add-on to be held in excess of Pillar 1 (P1R). For US banks, P2R is set equal to 2% which represents the implied CET1 capital ratios add-on required for classification as "well capitalized".
(3) Minimum CET1 Ratio: represents the binding total capital demand in terms of CET1 capital. It is calculated as 4.5% + Pillar 2 (P2R) + Deficit (AT1) + Deficit (T2).
(4) MDA Trigger (CET1 Ratio Requirement): represents the CET1 ratio threshold which, if breached, would lead to automatic restrictions on capital distributions and certain discretionary incentive compensation payments. It is calculated as 4.5% + Pillar 2 (P2R) + Deficit (AT1) + Deficit (T2) + CBR. Following the decision of most Macro-prudential Authorities, the CBR now includes the CCyB set at zero (see ESRB - Countercyclical capital buffer).

[9] Unlike the loss rate on TAs (which, like the Leverage Ratio, is a "neutral measure"), the loss rate on RWA implicitly takes into account the underlying risk of the assets themselves. So, for example, as Germany has a risk density substantially lower than Italy (29.60% vs 41.89%), the loss absorption capacity in terms of TAs is lower than the one in Italy, but similar in terms of RWAs.

[10] The underlying hypothesis is that the RWA framework is able to capture all the risks associated with banking activities, although the calculation of the RWAs depends on the method used (AIRB or Standard). Usually, AIRB models tend to lower RWAs.

[11] For example, we have not taken into account the temporary relief measures related to capital requirements for market risk (see the 16 April 2020 press release from ECB here); the extension by two years of transitional arrangements related to the implementation of the international accounting standard IFRS 9, and the earlier introduction of some capital relief measures for banks under CRR 2 (see the 24 June press release from European Council here). For the UK, we have not taken into account the capital relief granted by the BoE to banks in order to boost lending to UK businesses and households (see statement from BoE on 20 March 2020 here).

[12] On 1st April 2020, the FED announced a temporary change to its supplementary leverage ratio rule to ease strains in the Treasury market resulting from the coronavirus and increase banking organizations' ability to provide credit to households and businesses. The change would temporarily decrease Tier 1 capital requirements of holding companies by approximately 2 percent in aggregate (see the FED's press release available here).

4. A Flashback: 2007 vs 2019[13]

Table 2 reports the same data analyzed in the previous paragraph but for 2007, at the beginning of the last financial crisis. The sample of the banks considered in each country is different than the 2019 one (except that for the UK) as some data are not fully available; some 2019 banks did not even exist then, and some US banks did not follow Basel rules in 2007 (e.g. investment banks like Goldman Sachs, Morgan Stanley, etc.). However, we think that the sample is still a good proxy of the respective banking systems.

The minimum capital requirement in terms of CET1 is considered equal to 2%, because in 2007 the general applicable legal framework was Basel I (see Hull 2018, ECB 2010, Ferreira et al. 2019) plus deficit in terms of AT1 and T2. The deficits have been calculated considering that, as a maximum, the Tier 1 Ratio could be covered by instruments different from capital for 2% and T2 Ratio for 4% (8% of Overall Capital Ratio).

Comparing 2007 and 2019 data, we can see that the *BERoA* and *BERoRWA* values are consistently higher now, especially in Germany (3.22x and 2.41x), France (6.54x and 6.44x) and Italy (3.00x and 4.49x)[14].

The conclusion is that today, banking systems are in a better position to face a pandemic crisis-like scenario, i.e. large magnitude in a very short time.

Tab. 2 - Loss Absorption Capacity in 2007

(Data in millions)

Country	Total Assets[(1)] Q4 2007	CET1 Ratio Q4 2007	RWA Density Q4 2007	Surplus (Deficit) AT1	Surplus (Deficit) T2	Minimum CET1 Ratio[(2)]	Max Capacity to Absorb Losses	BERoA	BERoRWA	BERoE
GERMANY	2,677,025 EUR	7.29%	21.98%	-1.40%	-0.62%	4.02%	19,201 EUR	0.72%	3.26%	35.85%
FRANCE	4,180,439 EUR	6.11%	28.99%	-0.75%	-1.77%	4.77%	16,268 EUR	0.39%	1.34%	14.49%
ITALY	2,139,279 EUR	6.14%	62.78%	-1.41%	-1.09%	4.50%	21,904 EUR	1.02%	1.63%	14.35%
SPAIN	1,541,066 EUR	6.07%	56.78%	-0.56%	1.03%	2.61%	30,249 EUR	1.96%	3.46%	34.14%
UK	5,322,019 GBP	6.08%	33.57%	0.01%	-0.01%	2.91%	56,640 GBP	1.06%	3.17%	35.27%
USA	8,391,703 USD	5.46%	53.56%	0.09%	0.16%	2.38%	138,111 USD	1.65%	3.07%	27.90%

(1) The total assets of the US banks have been adjusted to take into account the derivatives netting allowed in US-GAAP. This adjustment allows ensuring a fair comparison with the European banks that adopt IFRS accounting standards.

(2) Minimum CET1 Ratio: represents the binding total capital demand in terms of CET1 capital. It has been calculated as 2% + Deficit (AT1) + Deficit (T2).

5. CET1 Relief P2R Rule in Banking Union and Maximum Capacity to Expand Loans/Assets

Authorities have declared that one of the purposes of the capital relief measures was to allow banks to support the real economy in such a difficult moment. There is a trade-off between allocating capital to absorb losses or to support the economy. Moreover, the relationship is not linear as, *ceteris paribus*, expanding activities can cause larger deficits in terms of AT1 and T2 that should be covered with more capital.

In particular, the possibility that for the purposes of own funds requirements, the Pillar 2 additional own funds requirement could be made up in the form of 56.25% of CET1 capital and 75% of Tier 1 capital as a minimum has freed up about EUR 19.3bn of additional capital for Germany, France, Italy and Spain. This is because some banks in each country have surpluses in terms of AT1/T2 instruments. This additional capital could be used to provide new lending and support the economy[15]. In Table 3, we reported two different

[13] There are some caveats to be considered in weighing the results of this paragraph, as most of the paragraph relies on analysis of historical data. The shortcoming of using cross-country historical data is that they are not perfectly consistent across jurisdictions. It is not possible, for example, to isolate the impact of the different capital regulations in the computations, or differences in the definition (and thus the quality) of capital. This means that the data reflect regulatory restrictions, a range of banking sector and macroeconomic environments, and bank behavior that will almost certainly differ from those prevailing in the present.

[14] It is worth noting that, for example, that Citigroup accumulated about USD 40bn in losses between 2008 and 2009; Unicredit Group registered EUR 14bn in losses in 2013 and RBS experienced about GBP 46bn in losses between 2008 and 2013. See also BIS 2010 for an empirical analysis on the amount of losses experienced in several banking systems in the world.

[15] We have not considered in this calculation freed-up capital related to the use of the capital buffers. In fact, according to the Basel regulatory framework, the purpose of a buffer is to provide capital sufficient for a banking company to withstand downturn events

scenarios under the assumption that all the new free capital would be entirely used to support the economy and that the average riskiness of the counterparties would increase due to the significant deterioration of the economy[16]. In the first scenario, new total lending would be equal to about EUR 313bn under the conservative assumption that it would be weighted marginally at 100%. In the second, new lending would be equal to about EUR 634bn under a slightly less conservative assumption that the new marginal RWA density would increase by 50% above the 2019 level (see Tab.1)[17]. This second hypothesis is less conservative than the first because the starting RWA densities are lower than 66.67% in all the Countries. In relative terms (Total Assets Growth Rate), Italy would be the country with the highest benefit.

It is important to note that if banks were able to issue AT1 and T2 instruments in order to compensate for deficits, further EUR 40bn could be freed up. On this point, it is important to note that there is a high dispersion of capital relief related to AT1/T2 deficits. For banks with deficits, the measure is not effective.

Table 3 – SSM Measures in Reaction to the Covid-19: CET1 Relief & Potential Loans/Assets Capacity Released

(Data in millions)

Country	CET1 Capital Relief New P2R Rule	CET1 Ratio Relief New P2R Rule	Marginal RWA Density = 100%		Marginal RWA Density = $RWADensity_{2019} \times (1+50\%)$	
			New Assets	New Assets Increase (%)	New Assets	New Assets Increase (%)
GERMANY	3,834 EUR	0.36%	59,596 EUR	1.64%	130,424 EUR	3.58%
FRANCE	8,723 EUR	0.35%	138,817 EUR	1.63%	327,751 EUR	3.85%
ITALY	4,397 EUR	0.41%	73,429 EUR	2.85%	116,234 EUR	4.52%
SPAIN	2,416 EUR	0.17%	41,694 EUR	1.21%	59,413 EUR	1.72%
TOTAL	**19,370 EUR**	**0.32%**	**313,536 EUR**	**1.72%**	**633,822 EUR**	**3.49%**

6. Maximum Potential Capacity to Expand Loans/Assets

In the previous paragraph, we calculated potential lending capacity solely in relation to the CET1 relief P2R rule for SSM banking systems. In this paragraph, we show the potential maximum lending capacity associated with the two minimum CET1 Ratios as defined above, even though we are perfectly well aware that banks will not be likely to exploit all the room they have. In fact, using all available capital to support the economy would lead banks to a too-risky position, with operational limits potentially imposed by supervisors as a result. Nevertheless, due to this unprecedented situation, banks might be called to make unprecedented efforts to support the economy. Table 4 reports the results of the simulations using the same hypotheses as in the previous paragraph in relation to the riskiness of the new potential lending. As we can see, the level of potential lending capacity depends, *inter alia*, on the starting level of the CET1 Ratio and RWA density. This is particularly evident for countries like Germany, France and the UK where, due to the low RWA density, the riskiness of new lending is crucial in order to determine maximum lending capacity. Considering all the scenarios, France and Italy seem to be the countries with the highest maximum lending capacity in relative terms. Finally, we report the Landing CET1 Ratio, i.e. the CET1 Ratio *after* the growth of the total assets (on average about 7.79% and 10.64%, considering the two thresholds of the CET1 Ratio). It is worth noting that the average minimum Landing CET1 Ratio (7.79%) is 160 bps higher than the average CET1 Ratio in 2007 (6.19%). This is a further demonstration of how much more capital banks have now.

(particularly systemic stressful events) and still remain above its regulatory minimum capital requirement. Moreover, buffers should be rebuilt within a certain time frame.

[16] Both of the assumptions are coherent with that made by ECB which considers the 75th percentile of the distribution of risk weights applied by significant institutions to households and corporations, reflecting the current composition of bank balance sheets (see FAQs on ECB supervisory measures in reaction to the coronavirus).

[17] The calculation of "*g*" is built starting from the formula (1), considering a loss rate *ante* Covid-19 relief measures and the two new RWA Densities. The results have been obtained through an iterative mathematical process.

It is important to highlight that the capital relief measure on P2A introduced by the BoE/PRA in the UK (discussed above) could have a dual effect. On one hand, it can increase loss absorption capacity in cases of increased riskiness (and consequently the associated RWAs) of the existing assets. On the other hand, it could significantly increase the capability of UK banks to expand lending. In Tab. 4, we have reported both the effect on "new" lending continuing to calculate the P2A as a percentage of RWAs, and calculating the P2A in a nominal amount using RWAs as of the end of 2019. The table shows that maximum lending capacity increases when "new" lending has higher RWAs. Of course, due to the temporary nature of the measure, it seems reasonable to assume that UK banks would in any case take into account P2A calculated as a percentage of RWAs for their business plans.

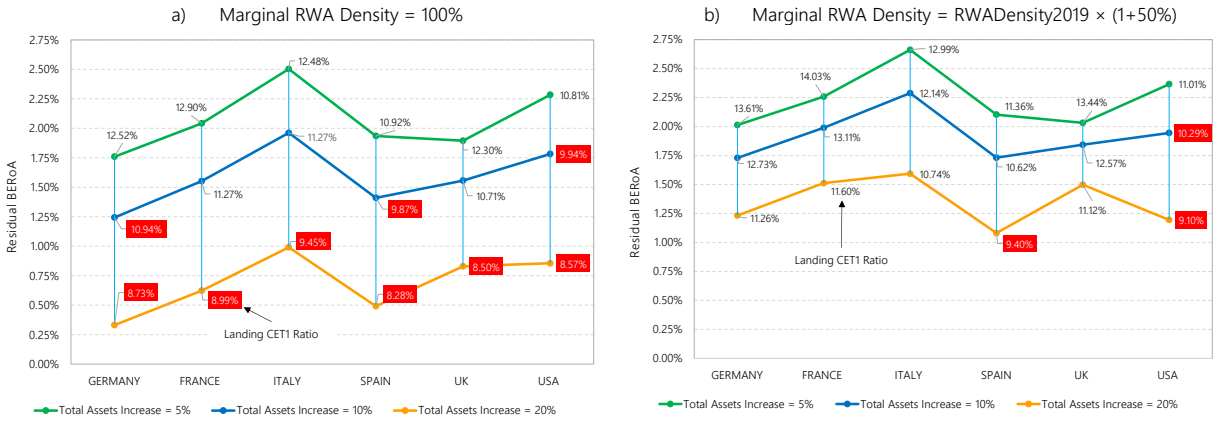
Tab. 4 – Maximum Potential Capacity to Expand Loans/Assets
(Data in millions)

Country	Minimum CET1 Ratio[1]					MDA Trigger (CET1 Ratio Requirement)[2]				
	Landing CET1 Ratio[3]	Marginal RWA Density = 100%		Marginal RWA Density = $RWADensity_{2019} \times (1+50\%)$		Landing CET1 Ratio[3]	Marginal RWA Density = 100%		Marginal RWA Density = $RWADensity_{2019} \times (1+50\%)$	
		New Assets	New Assets Increase (%)	New Assets	New Assets Increase (%)		New Assets	New Assets Increase (%)	New Assets	New Assets Increase (%)
GERMANY	7.99%	894,845 EUR	24.59%	2,052,382 EUR	56.40%	11.03%	351,553 EUR	9.66%	811,368 EUR	22.30%
FRANCE	7.77%	2,370,309 EUR	27.81%	5,214,861 EUR	61.19%	10.56%	1,079,193 EUR	12.66%	2,324,574 EUR	27.27%
ITALY	7.89%	829,888 EUR	32.25%	1,326,539 EUR	51.55%	10.34%	378,522 EUR	14.71%	605,498 EUR	23.53%
SPAIN	7.53%	903,990 EUR	26.19%	1,420,584 EUR	41.16%	10.01%	321,295 EUR	9.31%	503,147 EUR	14.58%
UK (P2A: Nominal Amount)[4]	6.74%	1,732,019 GBP	18.35%	4,017,282 GBP	75.98%	10.57%	555,628 GBP	5.61%	1,271,013 GBP	24.04%
UK (P2A: RWA Percentage)[5]	8.10%	1,186,717 GBP	12.96%	2,735,708 GBP	51.74%	11.21%	436,749 GBP	4.50%	996,930 GBP	18.85%
USA	7.45%	4,566,379 USD	30.95%	6,101,544 USD	41.35%	10.65%	864,535 USD	5.86%	1,281,362 USD	8.68%

[1] Minimum CET1 Ratio: represents the binding total capital demand in terms of CET1 capital. It is calculated as: 4.5% + Pillar 2 (P2R) + Deficit (AT1) + Deficit (T2).
[2] MDA Trigger (CET1 Ratio Requirement): represents the CET1 ratio threshold which, if breached, would lead to automatic restrictions on capital distributions and certain discretionary incentive compensation payments. It is calculated as 4.5% + Pillar 2 (P2R) + Deficit (AT1) + Deficit (T2) + CBR. Following the decision of most Macro-prudential Authorities the CBR now includes the CCyB set at zero (see ESRB - Countercyclical capital buffer).
[3] Landing CET1 Ratio: represents the CET1 Ratio after new lending increase.
[4] P2A (Pillar 2A) requirements as a nominal amount. This change would apply on voluntary basis and subject to supervisory agreement for 2020 and 2021 SREP assessment (see Statement by the PRA on 7 May 2020).
[5] P2A (Pillar 2A) requirements as a percentage of total Risk Weighted Assets (RWAs). This is the pre-pandemic regulatory framework.

In Fig. 2, we try to clarify how maximum lending capacity could be in each country under the two different hypotheses regarding the riskiness of "new" lending. For UK banks, we have reported only values assuming P2A in nominal terms. In the graphs, we report the Landing CET1 Ratio (i.e. the CET1 Ratio that results after "new" lending has been provided) linked to three different levels of total assets expansion (5%, 10% and 20%). In red, we highlight when the Landing CET1 Ratio breaches the MDA trigger. As we can see in Fig. 2a, under the hypothesis that the new lending would receive a marginally risk-weighted factor equal to 100%, three countries (France, Italy and the UK) would be able to expand assets by 10%. No country would be able to expand assets by 20% without breaching the MDA trigger (and with a very tiny space left to absorb losses). On the contrary, under the hypothesis that "new" lending would receive a marginal risk-weighted factor lower than 100% (but still higher than the one as of end-2019), all of the countries considered (except for the US) would be able to expand assets by 10%, and four (Germany, France, Italy and the UK) by 20% (see Fig. 2b) keeping their CET1 Ratio above the MDA trigger (and with further room to absorb potential losses). From this point of view, it appears clear why many countries have decided to provide public guarantees on "new" lending provided by banks.

Fig. 2 – Capacity to Increase to Expand Assets.



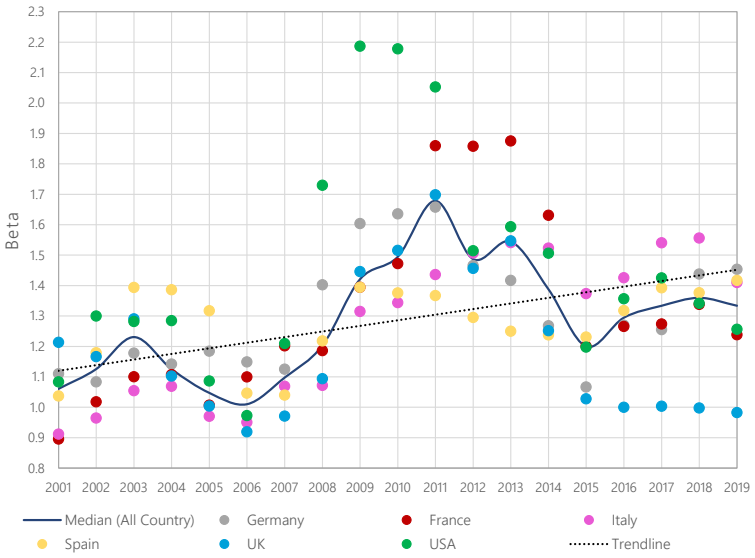
7. The Difficult Balance Between Financial Stability, Bank Regulation and Bank Market Value

As we have seen in the previous paragraphs, banking systems are now less fragile than before 2008-2009. This has probably been the most important result achieved by regulation and supervisors, along with reforms regarding bank crisis management (see Basel III post-crisis regulatory reform, Dodd-Frank Act in the US and Banking Package in the EU) that have reduced the probability of bank bailouts with public funds. In this section, we will see that the other side of the coin is that bank profitability is still low, and in fact is too low to make banks attractive to investors.

The banking sector seems to be facing a sort of trilemma (at least for the moment), i.e. the impossibility of simultaneously having: 1) a high level of capitalization and consequently stronger financial stability; 2) protection of public funds; and 3) profitability capable of satisfying the cost of capital that allows banks to stay competitive. In fact, even if banks are able to reach pre-2008 ROA levels, they will not be able to have a ROE above the cost of equity (see Fig. 4). In past years, various authors[18] have suggested that a higher level of capitalization would have led to a lower level of profitability, but that a lower of risk would counterbalance it. Actually, bank profitability has declined while the investor risk perception seems to have increased, despite the fact that banks today are significantly more capitalized and less fragile than they were before. Even an analysis using market beta data, despite all its limitations, seems to confirm this perception. Fig. 3 shows that, in recent years (excluding the period of the financial crisis), betas tend to be higher than before 2008-09 (about 30%); now, we see pre-crisis levels only for UK banks.

[18] We refer in particular to the proposal by leading economists to set up a minimum leverage ratio equal to 15%. The proposal was published in the Financial Times in 2010 (see Admati *et al.* 2010). Afterwards, the same economists proposed setting the leverage ratio at 30% (see Admati and Hellwig 2013; Admati *et al.* 2014, 2018).

Fig. 3 – Market Beta for Banking Stocks: Historical Evolution by Country(*).



(*) The analysis includes a total of 40 banks (for a list by country, see Appendix). The betas for each Country are obtained as a weighted average (as a function of market capitalization) of the betas of the individual banks in the country. The market index used for the estimate is the country's reference stock index. Data Source: Bloomberg

Of course, the more stringent regulation necessary following the great financial crisis may not be the only cause of lower profitability and higher cost of capital. For example, the low level of interest rates, high level of NPLs and (in some cases) cost inefficiencies could contribute to explain low levels of ROE. Moreover, many empirical studies confirmed that the augmented level of regulation (and the uncertainty on the future level of capital requirements, see Cottarelli, 2020) has partially stopped the supply of credit to the real economy (see Aiyar *et al*., 2016; Gropp *et al*., 2019, Fraisse and Thesmar 2020, De Jonghe *et al*., 2020). It is needless to say that the credit to the real economy provided by the bank is crucial to make investments. For the moment, we do not see other players that in the medium term could substitute the banks in this important role (the total assets of the banking systems in our sample is over 40 trillion dollars, of which at least the half are credits).

In the next two paragraphs, we will investigate what the determinants of banks' value could be and we will show that the regulation could substantially influence banks' value. At the same time, we will see that well before the Covid-19 crisis banks were not attractive for investors.

7.1. The Math of Value Creation in Banks: A Short Summary

In this paragraph, we introduce a short summary of the fundamental relationships that determine the value of a bank. In a steady state condition[19], in order to keep the target level of capitalization unchanged, a bank should retain a share of its own net income equal to the ratio between the growth rate of the activities (g) and the return on equity (ROE). This implies that the bank must have a *ROE* equal to g[20]. If a bank has a *ROE*

[19] A steady state condition can be defined as one in which a bank has reached the target level of capitalization while it continues to grow, keeping the riskiness of activities unchanged (so RWA density is constant).

[20] The fact that in a steady state condition *ROE* should be equal to g in order to keep a target level of capitalization unchanged can be demonstrated by the following equilibrium condition:

$$ROE_t \cdot TA_{t-1} \cdot CET1_{t-1} \cdot RW_{t-1} \cdot TA_{t-1} \cdot (1+\alpha_{t-1})$$
$$= \overline{CET1}_t \cdot RW_t \cdot TA_{t-1} \cdot (1+g_t) \cdot (1+\alpha_t) - CET1_{t-1} \cdot RW_{t-1} \cdot TA_{t-1} \cdot (1+\alpha_{t-1})$$

From the above equilibrium condition, we can derive the break-even *ROE* that allows the maintenance of a pre-determined target level of capitalization. Finally, if we set: $\overline{CET1}_t = CET1_{t-1}; \alpha_t = \alpha_{t-1}; RW_t = RW_{t-1}$, as required by the steady state condition, the break-even condition is $ROE_t = g_t$.

lower than g, there will be no adequate remuneration for shareholders (on the contrary, they would subscribe a new capital increase to keep the target level of capitalization). Under the assumptions that a bank is in a steady state condition and growth at a constant level g, the implied equity value of the bank (P) can be calculated using either a DCF model or a Residual Income model[21]:

$$P = \underbrace{EBV_0 \cdot \sum_{t=1}^{\infty} \frac{(ROE - g) \cdot (1+g)^{t-1}}{(1+k)^t}}_{\text{DCF MODEL}} = \underbrace{EBV_0 \cdot \left(1 + \sum_{t=1}^{\infty} \frac{(ROE - k) \cdot (1+g)^{t-1}}{(1+k)^t}\right)}_{\text{RESIDUAL INCOME MODEL}} \tag{2}$$

where: EBV_0 represents the equity book value in the last accounting period; ROE is the return on equity; g is the growth rate of the assets; and k is the cost of equity. If we define the implied equity value in terms of a multiple of the EBV ($m = P/EBV$), we can determine the multiple as:

$$m = \frac{ROE - g}{k - g} \tag{3}$$

We decided to base our analysis on the *P/EBV* because it is a key measure in the valuation of banks. This is linked to the fact that an important part of the value of a bank depends on the quality of its assets and the maintenance of certain levels of capitalization are essential to support the bank's investment activity and create the conditions for shareholder remuneration.

From formula (3) we can derive that m would be equal to 1 only if $ROE = k$. We can also derive the ROE as a function of m, k, e g as:

$$ROE = m \cdot k + (1 - m) \cdot g \tag{4}$$

and from formula (4), given g and k, we can set up the level of ROE needed to have a pre-determined value of m. The condition in (4) could also be expressed in terms of ROA as:

$$ROA = \frac{m \cdot k + (1 - m) \cdot g}{\ell} \tag{5}$$

where $\ell = TA/EBV$ is the leverage. From (5) we derive that the higher the capital requirements, the higher the ROA required to maintain a certain level of g.

7.2. A Value Map for Banks: Market vs. Fundamental

In order to show that the simplified model introduced in the previous paragraph is able to capture the implied equity value of a bank, we estimated the *price-to-equity book ratio* (*P/EBV)* for all the listed banks in our sample (there are 40) and then conducted an empirical analysis that supports the existence of a strong positive relationship between implied *P/EBV*, estimated using the formula (3), and market *P/EBV* (see Fig. 4). We carried out the analysis for two periods[22]: December 2019 (pre Covid-19 pandemic) and August 2020 (post Covid-19 Pandemic). To determine implied *P/EBV*, we used the median of the 2-year consensus *ROE* (at each estimate date), while the cost of equity (*k*) was determined based on the Capital Asset Pricing Model (CAPM). For this purpose, we used the risk-free rates and market risk premiums for each country provided by Fernandez *et al*. (2020), while the betas were estimated using the last-3-years weekly data (for both the bank price shares and the corresponding stock market country index)[23]. Finally, we set the growth rate of the assets (*g*) at either

[21] Of course, the result of the two models must be the same (if the underlying assumptions are coherent), since the value of a firm cannot be dependent on the model used to determine it.

[22] See the appendix for the sample used in the analysis.

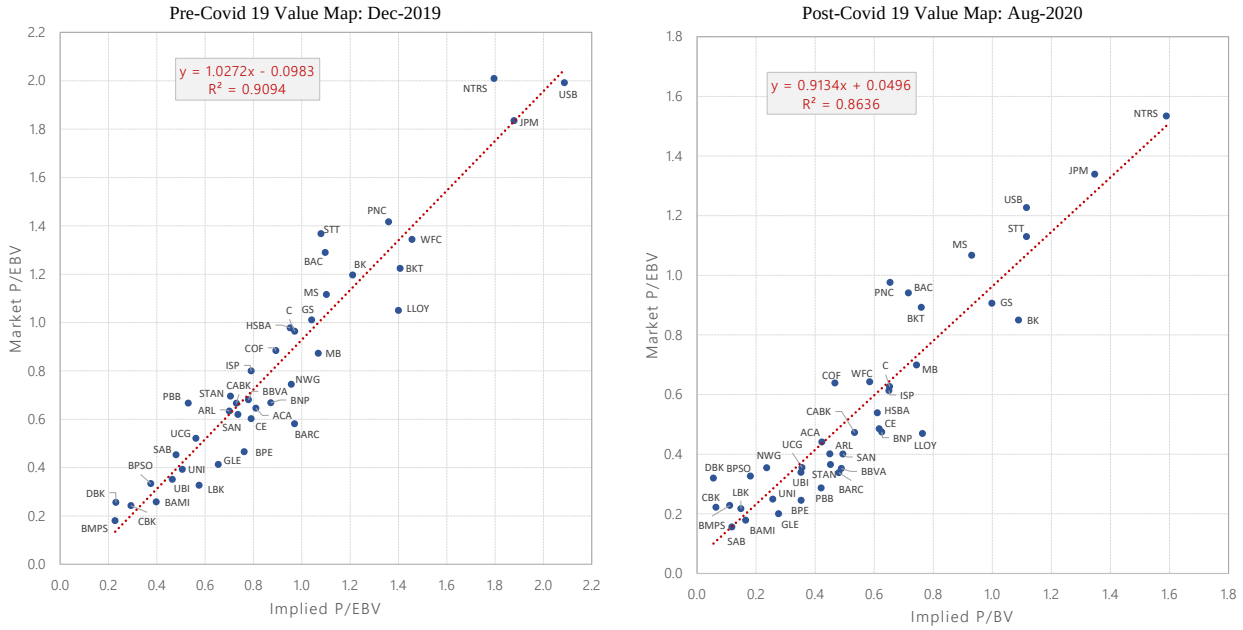
[23] For the cost of equity, we set a floor of 8%, also in line with the subsequent analysis. The floor is used only for six banks in Dec-2019 and four in Aug-2020.

3% (when *ROE* is greater than *k*) or zero (when *ROE* is lower than *k*). In this latter case, positive growth would lead to value destruction. The 2-year consensus median *ROE* substantially declined from 7.8% in Dec. 2019 to 5% in Aug. 2020. The average cost of equity for the entire sample it is about 9.5% in both periods.

It is worth noting that the implied *P/EBV* multiple estimated on the basis of the expected *ROE* fits the actual market multiple: it is likely that investors make decisions on the basis of few variables (well summarized by a multiple) as bank business is more difficult to evaluate with more complex valuation models.

As we can see in Fig. 4, the post Covid-19 value map shows a substantial decrease in both implied equity value and actual market value compared to the pre-Covid-19 value map.

Fig. 4 – A Value Map of Baking System: Fundamental P/BV vs. Market P/BV



7.3. Market Value, Profitability and Leverage: A Historical Perspective

In paragraph 7.1, we saw that there are specific conditions in terms of profitability that banks should meet in order to be attractive to investors. Since the beginning of the global financial crisis, banks *P/EBV* has persistently declined across banks and countries (see Ciocchetta, 2020). The *P/EBV* is a measure of the expected value that a company can create (or destroy) in addition to the accounting value reported in the financial statements. Differences between market and accounting values, i.e. values of the *P/EBV* other than one, can derive from investors' assessment of bank risk and expectation of future profits. This perspective is of the utmost importance, as the new banking regulation requires banks to gather private resources in the case of financial difficulties.

In this paragraph, we investigate the relationship between the market value (defined in terms of *P/EBV*), the implied *ROA* necessary to have a *P/EBV* either equal to 1 or 1.5, and leverage. We conducted the analysis on a sample of forty listed banks in each country over the period 2001-19[24]. We considered a cost of equity (*COE*) range between 8% and 11% (see Global Financial Stability Report, Oct 2017, IMF) and a growth rate *g* equal to 3%. Finally, we calculated implied *ROA* using the actual leverage in each period.

[24] As in analyses described in the previous paragraphs, we aggregated banks' data in each country in order to have a single country estimate, and we adjusted total assets in order to take into account netting on derivatives for US banks. See the appendix for the sample used in the analysis.

In fig. 5, we report the evolution of leverage (grey area, scale on the right); the range of implied *ROA* necessary to have a *P/EBV* equal to 1 (green line, scale on the left); the range of implied *ROA* necessary to have a *P/E*BV equal to 1.5 (red line, scale on the left); and the evolution of historical *ROA* (blu line, scale on the left). In a separate graph, we show the evolution of market *P/EBV*. As we can see, implied *ROA* increased over the years, while leverage decreased in every country[25]. Moreover, despite improvements in profitability in recent years, actual *ROA* is a long way from the implied *ROA* needed to have a *P/EBV* equal to 1. The only exception is US banks. In any case, in 2019, even US banks needed implied *ROA* about double than in 2007 in order to have a *P/EBV* equal to 1.5. For German banks the value is more than doubled.

We saw in paragraph 7.2 that with the outbreak of Covid-19, market expectations of bank returns have been further lowered due to an increase in loan losses as a consequence of the pandemic, and uncertain trading revenues hampered by increasing volatility, despite massive central bank interventions (which are likely to be considered temporary by the markets). In such a scenario, it seems very difficult for banks to be sufficiently profitable to attract investors or generate enough capital by themselves to expand their business (see Mascher and Strauch, 2020).

In paragraph 7, we discussed the suggestion put forward by some economists to increase banks' leverage ratio to 15% or 30% in order to ensure a safer banking system. This proposal does not seem sustainable in any of the countries analyzed. If we assume a cost of capital equal to 8%, a *g* equal to 3% and a leverage ratio equal to 15%, banks would need to have an implied *ROA* in a range between 1.2% and 1.6% in order to have a *P/EBV* in a range between 1 and 1.5. With leverage equal to 30%, the implied *ROA* would be in a range between 2.4% and 3.15%. These levels of ROA were not sustainable even in the years before the financial crisis in 2008-09 (unless we assume a very low level of the cost of equity)[26].

Affirming this does not mean that these authors' proposals are not coherent and do not have their own logic, i.e. the one underlying Modigliani and Miller's theory. For example, it is hard to disagree with the claim of Admati *et al.* (2014) that while a reduction in leverage can lower ROE in good times, it will raise ROE in bad times, reducing shareholder risk. The clearest demonstration of this can in fact be found looking back to the financial crisis of 2007-2009, when those financial institutions that operated with particularly high levels of leverage (ex: Lehman, Merrill Lynch, Bear Stearns, Northern Rock) and had managed to multiply profits in the years preceding the crisis, saw losses multiply just as readily when market conditions changed.

The point is that in order for certain market price formation mechanisms to work, there must be a few fundamental conditions, which are not easily brought about in the banking sector. The banking business is much more complex than other sectors, and the level of informational asymmetry is much higher (perhaps even higher than it was in the past), which increases uncertainty, and uncertainty, as we well know, is poison for the financial market. In this sort of context, it is hard to imagine, for example, that a bank that is quoted on the stock market with a *P/EBV*=1, a *ROA* of 1%, a capital cost of 10%, and a leverage of 10, will be able to maintain its market value if it is forced to cut its leverage in half, from 10 to 5. To maintain the same value (*P/EBV*=1), presuming that *ROA* remains unchanged, the cost of capital must drop from 10% to 5%. And presuming that there is an increase in *ROA* tied to a reduction in funding costs, it is hard to imagine that, under current conditions, there would not be a significant effect on market value.

The need to envision a context of reference in which the business of lending (and everything that goes along with it) will tend to provide sufficient returns to be attractive to investors is a problem that regulators should perhaps address, with the awareness that many of their decisions can have serious repercussions on the market value of banks. This need arises not only due to the fact that banks can effectively "compete in the market" and thus reduce public intervention to a minimum, but also because the market will find other channels (shadow banking) if it must, and in such cases control over the risks of the financial intermediation will be reduced rather than increased.

[25] Leverage decreased thanks in part to the adoption of the Basel III regulation.

[26] Toveronachi (2013) also highlights that a significant increase in capital requirements for banks could have negative effects on banks' ability to finance economic growth in many countries.

Fig. 5 – Market Value and Economic Fundamentals for Banks

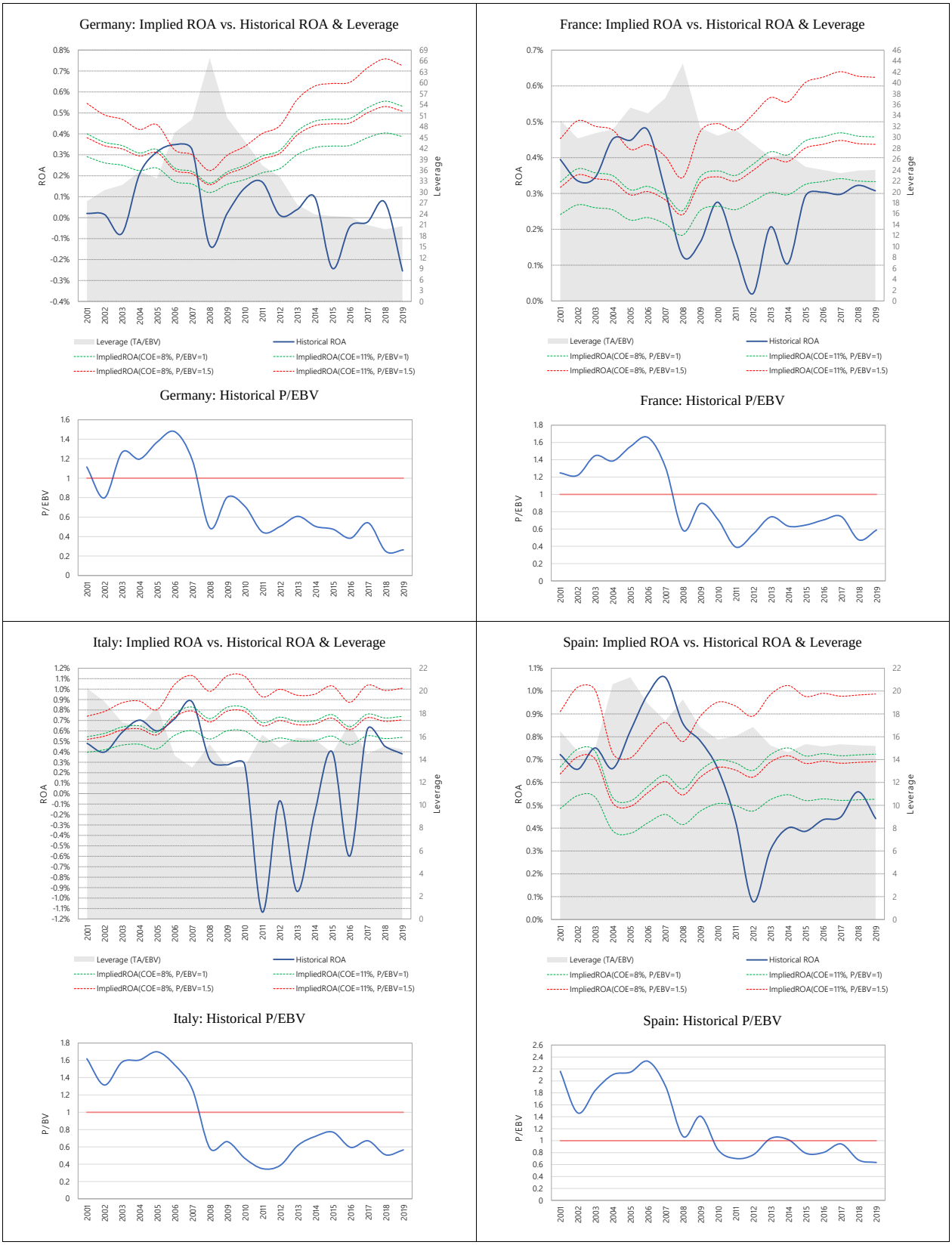
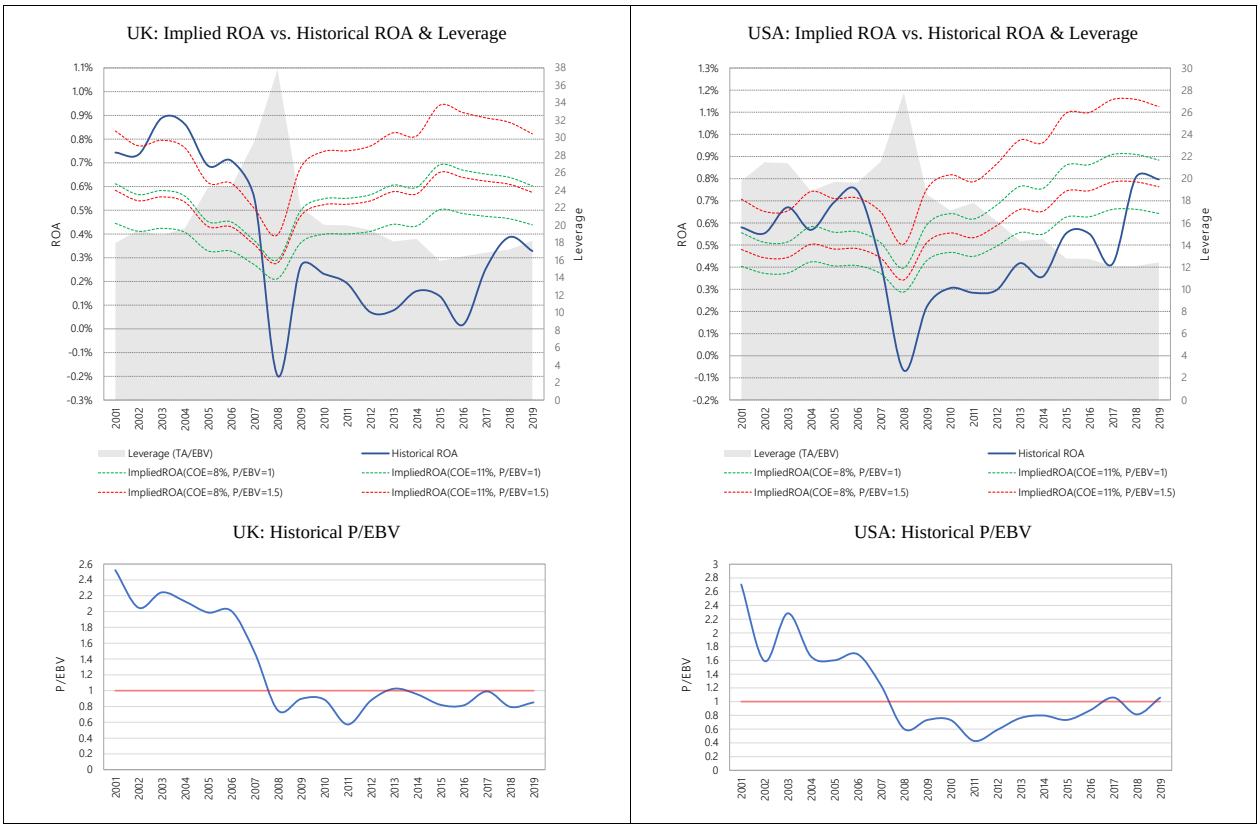


Fig. 5 *(follows)* – Market Value and Economic Fundamentals for Banks



8. Conclusions

Thanks to the reforms adopted by governments, institutions and central banks in the aftermath of the global financial crisis of 2008-2009, the banking system has become much stronger in the last decade. Banks entered the Covid-19 crisis in better shape than they had in the previous crises. Compared with the global financial crisis of 2008-2009, banks now hold larger capital buffers. The average CET1 Ratio rose from 6.19% at the end of 2007 to 13.70% at the end of 2019, well above regulatory requirements. Finally, the capacity to absorb losses (or support the economy) has more than doubled. In particular, Germany and Italy currently have a loss absorption capacity three times that of 2007, and France five times greater. Nevertheless, the economic effects of this unprecedented crisis are still unknown. The resilience of each banking system will also depend on the severity/duration of the crisis in each country and the measures adopted in order to mitigate the immediate effects on the economy and accelerate recovery. Finally, it seems that with the support of public guarantees on "new" lending, banking systems could apply between 10% and 20% of their total assets to boosting the economy while still having room to absorb potential losses.

On the other hand, bank profitability (in both Europe and the US) is still too low to attract private investors or generate enough capital by itself to expand bank business. This condition is now exacerbated by the pandemic crisis. Despite improvements in profitability in recent years, the actual *ROA* is far from the implied *ROA* needed to have a *P/EBV* equal to 1. In fact, since the beginning of the global financial crisis, bank *P/EBV* has persistently declined across banks and countries, while implied *ROA* has increased over the years. The banking sector seems to be facing a sort of trilemma (at least for the moment), i.e. the impossibility of simultaneously having: 1) high levels of capitalization and consequently stronger financial stability; 2) protection of public funds; and 3) profitability capable of satisfying the cost of capital and attracting private

investors. In the aftermath of the global financial crisis, the approach to bank rescue has drastically changed. Banks had to acquire substantial amounts of additional capital and liquidity as well as step up their risk governance, while regulation and supervision became more intrusive in almost all business aspects. Investors must contribute to bank resolution and restructuring. All of these aspects contribute to making the banking system much safer, but at the same time less attractive for private investors.

Appendix

List of Banks Used in the Analyses

Following are the bank samples for each country used in our analyses.

The first list includes the banks used in the analyses reported in paragraphs 3, 5, 6 and 7. The sample of banks used in paragraph 7 is limited to those listed and highlighted with an asterisk ("*"). For 2019, our sample includes the following significant banks in each country:

- **Germany**: Aareal Bank AG*; ByernLB; Commerzbank AG*; Deka Group; ApoBank; Deutsche Bank AG*; Deutsche Pfandbriefbank AG*; DZ Bank AG; Hamburg Commercial Bank; LLBW; Helaba; Münchener Hypothekenbank eG; NordLB; State Street Europe Holdings Germany; UBS Europe SE; Volkswagen Bank. The consolidated total assets of our sample represent about half of the consolidated total assets of the entire German banking system. Unlike the other countries considered in our analysis, Germany has a large number of less-significant banks.
- **France**: BNP Paribas Group*; BPCE Group; Crédit Mutuel Group; Crédit Agricole Group*; HSBC France; La Banque Postale; RCI Banque SA; SFIL SA; Bpifrance S.A. (Banque Publique d'Investissement); SoGen Group*. The consolidated total assets of our sample represent almost the entire consolidated total assets of the French Banking system as a whole.
- **Italy**: MPS Group*; BPS Group*; Banco BPM Group*; BPER Group*; CCB Group; Credem Group*; Iccrea Group; ISP Group*; MB Group*; UCG Group*; UBI Banca Group*. The consolidated total assets of our sample represent almost the entire consolidated total assets of the Italian Banking system as a whole.
- **Spain**: Abanca Holding Financiero SA; BBVA*; BCC; Banco de Sabadell SA*; Santander Group*; Bankinter SA*; BFA Tenedora de Acciones SA; CaixaBank SA*; Ibercaja Banco SA; Kutxabank; Liberbank*; Unicaja Banco SA*. The consolidated total assets of our sample represent almost the entire consolidated total assets of the Spanish Banking system as a whole.
- **UK**: HSBC Group*; Lloyds Banking Group PLC*; Barclays PLC*; Natwest Group plc (former RBS Group)*; Standard Chartered PLC*. The consolidated total assets of our sample represent about 60% of the entire consolidated total assets of the Britannic Banking system as a whole.
- **USA**: Bank of America Corp*; Bank of NY Mellon Corp*; Capital One Financial Corp*; Citigroup INC*; Goldman Sachs Group INC*; JPMorgan Chase & Co*; Morgan Stanley*; Northern Trust Corp*; PNC Financial Services Group; State Street Corp*; U.S. Bancorp*; Wells Fargo & Co*. The consolidated total assets of our sample represent almost the entire consolidated total assets of the US Banking system as a whole.

The sample of banks used in paragraph 7 includes the following banks in each country:

- **Germany**: Aareal Bank AG; Commerzbank AG; Deutsche Bank AG. The consolidated total assets of our sample represent about 27% of the entire consolidated total assets of the German Banking system as a whole;
- **France**: BNP Paribas Group; Crédit Agricole Group; SoGen Group. The consolidated total assets of our sample represent about 67% of the entire consolidated total assets of the French Banking system as a whole;
- **Italy**: MPS Group; Banco Popolare; BPER Group; Credem Group; ISP Group; MB Group; UCG Group; UBI Banca Group. The consolidated total assets of our sample represent about 80% of the entire consolidated total assets of the Italian Banking system as a whole;
- **Spain**: BBVA; Banco de Sabadell SA; Santander Group; Bankinter SA. The consolidated total assets of our sample represent about 42% of the entire consolidated total assets of the Spanish Banking system as a whole;
- **UK**: HSBC Group; Lloyds Banking Group PLC; Barclays PLC; Natwest Group plc (former RBS Group); Standard Chartered PLC. The consolidated total assets of our sample represent about 59%of the entire consolidated total assets of the Britannic Banking system as a whole;
- **USA**: Bank of America Corp; Bank of NY Mellon Corp; Citigroup INC; JPMorgan Chase & Co; Northern Trust Corp; PNC Financial Services Group; U.S. Bancorp; Wells Fargo & Co. The consolidated total assets of our sample represent about 77% of the entire consolidated total assets of the Britannic Banking system as a whole.

Data Source

In order to run our calculations, we used the following data sets: banks' official 2019 consolidated annual reports; banks' official press releases; Bloomberg L.P. (in particular for 2007 data); banks' official capital Pillar 3 report; banks' official capital requirements (including P2R requirements). For both 2019 and 2007, the total amount of assets for the entire banking system in each country can be found through this query on the ECB web site (for German, British and Spanish banking systems only, 2008 data were used, as 2007 ones were not available in the ECB database). For the US, the 2019 data is drawn from BIS Statistics, and 2007 data from the Federal Reserve Bank of St. Louis. It is worth noting that the consolidated accounting data provided in the banks' official financial statements and the consolidated data provided by ECB, BIS or other authorities cannot be perfectly matched, as the source may be different (e.g. official regulatory reporting).

Market data and consensus estimates used in the analysis reported in paragraph 7 were taken from Bloomberg.

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