Can better capitalised banks be more profitable? An analysis of large French banking groups before and after the financial crisis

Olivier de Bandt*, Boubacar Camara*, Pierre Pessarossi* and Martin Rose**

Abstract – The article studies the effect of French banks' capitalisation on their profitability. It contributes to the debate which has emerged, following the financial crisis, on the impact of the tightening of the regulation of capital (Basel III). Our econometric results show that over the period of 1993-2012, beyond the general trend of profitability which is weaker after the crisis, banks which increase their capital ratio more than the average improve their profitability, without it being possible to distinguish between voluntary increases and those imposed by regulation. All else being equal, a 100 basis point increase of the different capitalisation measures leads to a 3 to 10% increase in the average return on equity (ROE), depending on the measures considered, and to a 7 to 30% increase in the average return on assets (ROA). The positive impact of an increase of capitalisation on ROA is less significant when it is done by issuing shares.

JEL Classification: G21, G28
Keywords: ROE, ROA, solvency ratios, capital, banking regulation, Basel III

** French Prudential Supervision and Resolution Authority (olivier.debandt@acpr.banque-france.fr; boubacar.camara@acpr.banque-france.fr; pierre.pessarossi@acpr.banque-france.fr).*
*** European Central Bank (martin.rose@ecb.europa.eu).*

The opinions presented here are those of the authors and not those of the French Prudential Supervision and Resolution Authority or the European Central Bank. The authors would like to thank the anonymous reviewers for their remarks and suggestions.

Received on 16 February 2016; accepted after revisions on 10 April 2017 https://doi.org/10.24187/ecostat.2017.494t.1922
Translated from: « Des banques mieux capitalisées peuvent-elles être plus profitables ? Analyse des grands groupes bancaires français avant et après la crise financière »

The financial crisis has highlighted the need to tighten the regulation and supervision of the banking sector in order to strengthen its ability to absorb negative shocks. The Basel III reform, whose outline was announced in 2010, has brought particular attention to the role of banks' capital, since numerous highly leveraged financial institutions have failed or have had to be bailed out by public authorities. The social cost of bank failures justifies the capital requirements for financial institutions (Berger et al., 1995; Admati et al., 2011, Calomiris, 2013). According to the Governor of the Bank of England, Mark Carney, *"only well-capitalised banks can serve the needs of the real economy and promote strong, sustainable growth. [...]. Where capital has been rebuilt and balance sheets have been repaired, banking systems and economies have prospered."* (Carney, 2013 a and b).

The Basel III Accords propose a strengthened framework in terms of capital requirements for banks. This reform imposes an improvement of the quality of capital by requiring higher levels of common equity. It also provides for a minimum leverage ratio[1] (see box 1). These capital requirements risk, however, to have differentiated effects across the economy. Banks often contend that the increase of these requirements risks reducing their profitability: for example, their overall funding costs could increase greatly due to the higher level of capital. This increase of costs could thus have a negative knock-on effect on the distribution of credit and reduce banks' profitability. However, economic theory does not allow for conclusions to be drawn since no consensus is emerging with regards to the effect of capital on banks' performance. Drawing on the perfect market hypothesis, Modigliani and Miller (1958) conclude that decisions linked to the capital structure do not have an impact on companies' market value, especially banking companies (Miller, 1995). However, another strand of literature highlights that debt, by limiting managers' freedom to act with regards to shareholders, can have positive effects on the value of firms (cf., for example, Hart & Moore, 1995; Diamond & Rajan, 2001). Capital

1. The leverage ratio relates an indicator of capital to a measure of total assets and off-balance sheet exposures. It aims to guarantee the holding of a minimum level of capital to cover the bank's unexpected losses.

Box 1 – **Regulation of bank capital**

The banking regulation of international banks is defined by the Basel Committee, an international authority now composed of 28 jurisdictions. In 1988, the so-called "Basel I" Accords, focusing mainly on credit risk, introduced a minimal solvency ratio called the "Cooke ratio" which relates capital to a measure of assets. In 2004, the "Basel II" Accords reformed the international prudential rules by proposing a more exhaustive approach of banking risks and a finer calculation of credit risk which until then was determined on the basis of a uniform weighting for each large asset class. This calculation can now be made using internal models developed by banks under the control of the supervisor or a standard approach which employs the counterparties' ratings made by rating agencies. The internal banking models have been validated in most countries and notably in France as from 2008, the regulator authorising a limited reduction of capital requirements for banks which implement better internal risk management.

Nevertheless, the subprime crisis and its consequences reveal the need to revise Basel II in order to better take into account the risks associated with the banking system. The banking activity has in fact evolved and new risks such as those borne from securitisation have emerged. Regarding Basel II, the United States adopted a different approach, by distinguishing the large systemic banks from the smaller ones, without, however, formally implementing the whole framework. The Basel Committee revised its legislation in 2009 and 2010, to better account for securitisation and market risk, with a set of recommendations sometimes referred to as "Basel 2.5". These rules entered totally into force in France on 31 December 2011. The Basel Committee published the main orientation of the "Basel III" agreements in 2010, and the details on the reform were subsequently discussed. The Committee retained a stricter definition of the instruments eligible to regulatory capital for the calculation of the regulatory capital ratios (Common Equity Tier 1, Tier 1 and total regulatory capital ratios) A non risk-weighted ratio called the "leverage ratio" has been defined and major advances relating the management of liquidity risk have been made.

In Europe, the transposition of the Basel III Accords (by the CRD IV directive and CRR regulation) entered into force on 1 January 2014 and applies to all credit institutions of the Union, both on a solo and consolidated basis. Nevertheless, phase-in arrangements will run into 2019. Impact studies led by the Basel Committee have revealed that French banks have gradually anticipated from 2010 onwards the introduction of Basel III requirements.

increases, by reducing constraints on managers, could thus turn out to be detrimental to performance. Finally, a third theoretical trend contends that capital should on the contrary have a positive effect on performance (for example, Holmstrom & Tirole, 1997). Actually, capital increases limit the moral hazard which exists between shareholders and creditors, which in turn facilitates the improvement of banks' performance.

Our empirical strategy consists of assessing the role of banks' capitalisation measures on their profitability (see online complement C2, for an analysis of the main channels likely to lead to a change in profitability). We proceed in several stages. Firstly, we demonstrate the significant positive relationship between capitalisation and profitability. Secondly, we test the delayed impact of capitalisation. Thirdly, we evaluate whether the effect depends on the way the bank increases its capitalisation (for example, by issuing new shares). When there is an asymmetry of information, the decision to issue new shares could be perceived by investors as a bad signal for the firm's prospects (Myers & Majluf, 1984) and negatively affect its value. Then, we evaluate whether this relationship is different for banks with a smaller capital buffer. The level of this buffer depends on both total capital requirements including additional requirements from the "pillar 2"[2] and the bank's choice to hold capital at a level close or above such regulatory requirements. Banks with smaller buffers could be considered to face a higher risk of breaching the regulatory capital requirements. Finally, we examine the channel through which banks' capitalisation influences profitability.

This study contributes to the literature in several ways. First of all, we use a new confidential database on French banking groups, including their subsidiaries in foreign countries, compiled by the French Prudential Supervision and Resolution Authority. In comparison with other available public data, this database contains more harmonised indicators, since all banking groups submit their financial information in the same regulatory format for a given year. We consider different capitalisation measures, which correspond to different forms of capital, and commonly referred to in the economic literature and by the supervisory authorities. These measures take into account, depending on the case, risk-weighted and non-risk-weighted assets, as well as banks' on- and off-balance sheet exposures. They therefore reflect the logic of the new Basel III standards which combines all of these characteristics. By using confidential supervisory data relating to the additional capital requirements from the "pillar 2" for each bank, we can calculate a more accurate indicator of capital requirements. Then, our sample of large French banks, which represent more than 90% of the total assets of French banks in 2012, allows us to study one of Europe's largest banking systems and to focus on significant institutions for which the prudential regulation is the most relevant. The relatively long 1993-2012 analysis period allows us to cover several economic cycles, which in turn enhances the robustness of our results.

We test the impact of capital on profitability using fixed effect regressions, in which the capital ratios are lagged in order to reduce possible biases linked to the endogeneity caused by simultaneous capital measures and profitability. In addition, we run Granger causality tests which lead us to reject the endogeneity hypothesis. Our econometric strategy relies on these Granger causality tests; still, even if it shelters us from biases linked to certain types of reverse causality (for example, the impact of profitability on capital at a given date), it does not allow us to avoid others (banks which anticipate a better future return now raise more capital) or those linked to omitted variables such as the quality of management (better managed banks now raise more capital and are more profitable after a few years). However, additional tests show that these potential biases do not hamper the robustness of our results.

Our results show that beyond the general trend of profitability, banks which increase their capital ratio more than the average improve their profitability, without it being possible however to distinguish between voluntary increases and those imposed by regulation.[3] In fact, it is important to note that voluntary increases allow for a larger capital buffer and facilitate the seizing of investment opportunities. However, the data available over the whole period do not accurately distinguish between these two types of capital increases. All else being equal, a 100 basis points increase of the

2. In the "Basel II" and "Basel III" regulatory frameworks (see box 1), "pillar 2" refers to the additional bank-specific capital requirements, which come on top of the requirements imposed on all institutions ("pillar 1").
3. The online complement C2 provides a few empirical elements which show that the positive relationship between capitalisation and profitability might be explained by improved banking efficiency.

different capitalisation measures leads to a 0.31 to 1.12 percentage point increase of the ROE, depending on the type of capital ratio considered (that is, a 3 to 10% increase of the average ROE). This impact ranges between 0.04 and 0.18 percentage points for the ROA (that is, a 7 to 30% increase of the average ROA). In relative terms, the effect on ROA therefore appears to be economically more significant than on ROE.

This effect of a capital increase on profitability is stronger when the lag is longer, generally when it reaches two years, which shows that time is needed for this to affect performance. As a result, we reject the hypothesis of a negative effect of capital on profitability. The increase of capital requirements can certainly have deterrent effects beyond a certain threshold (Calomiris, 2013), and when institutions do not have reasonable time to meet them, but our results do not highlight this.

Additionally, in general, the increase of share capital, by means of issuing shares, tends to reduce the positive impact of capitalisation on ROA. The existence of issuing costs and information asymmetries actually makes issuing shares more costly.

Finally, the positive impact of capital increases on profitability is stronger for those banks which have *ex ante* smaller capital buffers. In this case, capital increases seem to be highly targeted, and aim more to seize investment opportunities than to build a simple safety buffer.

The article is structured as follows: firstly, the existing literature is reviewed, followed by the formulation of the hypotheses; then the data and methodology are detailed; then come the results; finally the complementary investigations on the results[4] are presented, followed by the conclusion.

Examination of the existing literature and hypotheses

There is a considerable theoretical literature on the effect of capital on the value of firms, in particular banks. Three distinct theories come to different conclusions. In Modigliani and Miller's framework (1958), sources of financing do not have an effect on cash flows generated by the assets. Changes in the relative shares of equity and debt therefore have no effect on the value of the company. The cost of equity is a function of asset risk and debt and, in order to keep the weighted average cost of capital constant, it decreases when the share of equity increases. This effect explains why the funding structure is neutral for a company's value. Miller (1995) contends that nothing prevents the application of this framework to the banking sector.

The two other theories diverge from Modigliani and Miller's propositions (1958) and predict that the relative levels of capital have an effect on the value of companies, and banks in particular. The second theoretical trend relating to corporate finance addresses the disciplinary role of debt as a way to reduce managers' freedom to act with regards to shareholders (see for example Hart & Moore, 1995), which reduces the risk that they invest in businesses which do not increase profitability. Managers can seek to attenuate market discipline by building up a capital buffer, which would reduce their incentive to increase effort and would therefore be detrimental to profitability. Debt can also present advantages with regards to capital due to the existence of asymmetries of information. Managers might have confidential information relating to the company's profitability prospects or to investment opportunities. By issuing debt, the company would reveal to external investors its ability to reimburse the principal and debt interest and highlight its soundness (Ross, 1977; Leland & Pyle, 1977). Banks could also decrease liquidity creation when capital is too high (Diamond & Rajan, 2001).

The third strand of the literature claims, on the contrary, that a capital increase will have a positive effect on the value of banks, which is explained by two main channels based on the moral hazard between shareholders and creditors. The first channel is based on the risk premium demanded by creditors. Shareholders' potential losses are capped due to the limited liability of the shares. However, gains increase with risk-taking, encouraging excessive risk-taking to the detriment of other stakeholders. Creditors anticipate this behaviour and demand an extra premium to finance banks. As a consequence, market discipline coming from debtors forces banks to hold positive amounts of capital (Calomiris & Kahn, 1991). The second channel rests on the monitoring effort exerted by the bank. This (costly) effort depends on the bank's capital: When it is higher, it internalises

4. The online complement C3 presents a certain number of robustness checks.

potential losses attributable to a lack of monitoring. In this channel, the funding structure has an effect on asset cash flows, with monitoring affecting the return from loan portfolios (Chemmanur & Fulghieri, 1994; Holmstrom & Tirole, 1997; Boot & Thakor, 2000; Mehran & Thakor, 2011; Allen et al., 2011). As "delegated monitors" (Diamond, 1984), banks need incentives to act in the interest of their creditors. In fact, higher levels of capital and the concentration of shareholders increases banks' incentives to make a bigger effort to monitor their borrowers since shareholders would have more to lose in the event of failure. They can then have higher expected returns on assets.

Empirical studies have already seeked to assess the impact of an increase of capital on banks. Berger (1995) highlights a positive effect of capital ratios on ROE for the US banking sector. Mehran and Thakor (2011) examine how capital ratio influences the price of the target in the case of bank acquisitions in the US over the period 1989-2007. They show that buyers pay a higher price for targets with a higher capital ratio considering the fair value of assets and goodwill. Berger and Bouwman (2013) test the way in which capital ratio has influenced banks' performance during the financial crises from 1984 to 2010 in the US over extensive quarterly bank data from 1984 to 2010 which distinguishes between banks according to their size. Small banks with higher capital ratios have shown a higher probability of survival and have presented relatively larger market shares and higher profitability levels (ROE) both in "normal" periods and during financial crises. These results are valid for large banks, but only during times of crisis. With regards to Berger and Bouwman (2013), our contribution lies in the analysis of the effect of heterogeneity between banks, looking at the capital buffer held by each bank. This buffer corresponds to the excess capital beyond the minimum required by regulation. It is a relevant question at a time when regulation for large banks is getting tougher. Cohen and Scatigna (2016) show that banks with higher capital ratios or strong profitability were more likely, after the crisis, to support credit activity.

Another trend in the literature studies more specifically the effects of an increase of capital requirements on credit activity. Francis and Osborne (2012), by taking into account the capital requirements specific to UK banks, study their impact on capital, loan activity and banks' balance sheet management. They demonstrate in particular that banks which hold a surplus of capital, being above the target level, show higher loan activity and balance sheet growth. Aiyar et al. (2016) study the impact of capital requirements, monetary policy, and their potential interactions on banks' credit supply in the UK over the period 1998-2007, drawing on quarterly bank data from more than 80 regulated banks (48 British banks and 40 subsidiaries of foreign banks), achieving broad coverage of the domestic credit activity. The authors show that the increase of capital requirements reduces credit supply. With capital constraints already being hard-hitting and the issuing of shares costly, banks reduce their weighted assets subject to credit risk in order to meet the additional requirements. Fraisse et al. (2015) measure over the period 2008-2011 the impact of capital requirements on banks' credit activity. They take advantage of the heterogeneous methods used by banks in calculating these requirements, since under Basel II banks may use their own internal models to measure the credit risk stemming from exposures to non-financial corporations. The authors highlight a negative effect of higher capital requirements on credit activity. Over a longer period, 1993-2012, our work studies the link between banks' capitalisation and future profitability.

Data and econometric strategy

Data

Our sample covers the period running from 1993 to 2012 for 17 French banking groups on a consolidated basis. We use a new database held by the French Prudential Supervision and Resolution Authority, which contains confidential accounting and supervisory data relating to the French banking groups. These data give access to balance sheet and off-balance sheet items, as well as prudential information over the course of this long period. The selection criteria include banks which are significant in the sense of the definition retained by the European Single Supervisory Mechanism. The banking groups with total assets above or close to 30 billion euros are included. Our sample is an unbalanced panel of 135 yearly observations (see Box 2).

The banking groups' profitability is measured here by two ratios: return on equity (ROE) and return on assets (ROA) which are

bank net income over capital and over total assets respectively.

We consider different capitalisation measures. We first calculate three non-weighted ratios: the "Capital ratio", the "Tier 1 / Tangible Assets" ratio and the "Tier 1 / Tangible and Off-balance Sheet Assets" ratio. Capital ratio refers simply to capital over total assets. The Tier 1 / Tangible Assets ratio is based on the leverage ratio implemented by the US bank regulator within the framework of the Federal Deposit Insurance Corporation Improvement Act of 1991. It is calculated as follows: (Tier 1 capital - intangible fixed assets) / (total assets - intangible fixed assets). The Tier 1/Tangible and Off-balance Sheet Assets ratio is close to the Basel III definition of leverage ratio. It corresponds to Tier 1 capital over total assets to which are added off-balance sheet exposures weighted by a conversion factor in terms of credit. These exposures' weightings follow the Basel III framework: a weighting of 10% is applied to all the exposures that a bank can withdraw at any moment with no conditions. All other exposures are weighted at 100%. For what is off-balance sheet, we include only the items which relate to credit risk, since regulatory changes prevent us from consistently measuring the exposure to market risk over the whole period. We also use two solvency capital ratios defined within the Basel I framework. The Tier 1 regulatory ratio is calculated as regulatory Tier 1 capital over risk-weighted assets (Basel I). Total regulatory ratio is calculated as follows: Tier 1 capital + Tier 2 capital + Tier 3 over risk-weighted assets (Basel I). We prefer to use the Basel I framework over the whole period in order to remain consistent knowing that Basel II has introduced significant changes in the calculation of the risk weighted assets. Even after 2007, banks report minimal capital requirements according to the Basel I definition, which allows us to calculate risk-weighted assets in accordance with the Basel I definition for the period from 2008 to 2012.

In the estimations, we introduce different variables deemed to have an influence on profitability indicators. They take into account the bank's business model, as well as the assets' risk levels, considering the usual risk-return trade-off. "Asset diversification" is defined as the Herfindahl-Hirschmann (HH) index which is calculated on the basis of four asset classes: cash, interbank loans, loans to non-financial corporations and other interest-bearing assets. The higher values of the index indicate a strong concentration of asset classes and therefore lower diversification. Diversification is often calculated using the HH index (cf. for example Thomas, 2002; Stiroh & Rumble, 2006).

"Loan share" represents the amount of loans over all interest-bearing assets. In the same way, Berger and Bouwman (2013) use the share of assets available for sale. Loan share measures the significance of traditional credit activities: it differentiates between banks according to the business model, which meets respectively different profitability requirements. For example, investment banks displayed on average higher ROEs than traditional banks before the financial crisis. This scenario has however reversed over the course of the financial crisis (European Central Bank, 2010).

The "Safety net" is calculated as the amount of deposits over total assets. Deposits have been insured in France since 1980; banks which have a higher proportion of deposits therefore could benefit from more government guarantee. In the same vein, Berger and Bouwman (2013) take into account the core deposit-to-assets ratio. The safety net is supposed to influence risk-taking (Merton, 1977; Keeley, 1990). Moreover, deposits can turn out to be a less costly source of financing.

In a portfolio approach, average return must be explained by risk. We therefore add the variable "Portfolio risk". According to Berger (1995) and Berger and Bouwman (2013),

Box 2 – **Processing of bank mergers in the database**

The unbalanced structure of the database is explained by mergers and acquisitions over the sample period and data availability constraints. For example, after the 2008 merger of the Banques Populaires and Caisses d'Épargne, these two banking groups disappeared from the database and were replaced by the BPCE Group. The other main mergers and acquisitions processed over the sample period are: the acquisition by Banque Nationale de Paris of Compagnie financière de Paribas in 2000 (the two banks were distinct before the merger and the new group BNP Paribas then appeared in the database with a new identification number); and Crédit Lyonnais's exit from the database in 2003 after it was taken over by the Crédit Agricole Group.

portfolio risk is calculated as risk-weighted assets (according to Basel I) over total assets. It reflects the allocation of assets into four classes of weighting (0, 20, 50 and 100%) defined in the Basel framework. The use of this measure allows us to monitor the effects of the portfolios shifts on their profitability. Again, we prefer to use the Basel I definition of risk-weighted assets, in order to remain consistent over the whole period.

Finally, we also include a "Liquidity ratio". It corresponds to the French regulatory liquidity ratio calculated as available liquid assets over liquid liability requirements. Berger and Bouwman (2013) also take into account liquidity, albeit in a more basic manner, by including in their model cash and other liquid assets divided by total assets. Banks which have more liquidity have a smaller chance of being in dire straits. However, liquid assets are generally less risky and therefore have a lower expected return.

Table 1 presents descriptive statistics on our sample's variables. With an average ROE of 10.71%, French banks have displayed strong profitability of capital over the course of the period. ROA has in turn been at 0.61% on average. Our different capital ratios reveal relatively contrasting situations between banks and over time. The first decile of the Capital ratio is at 2.68%, while the last decile is at 10.10%. Figures I-A and I-B below demonstrate furthermore the evolution of the median value of ROE and ROA, Tier 1 / Tangible and Off-balance Sheet Assets and the Tier 1 regulatory ratio. Tier 1 / Tangible and Off-balance Sheet Assets covers all banking activity by taking into account off-balance sheet items and the Tier 1 regulatory ratio only takes into account Tier 1 regulatory capital which has a better ability to absorb losses. We observe a rising trend of banks' median profitability up to 2000 (Figure I-A). It drops considerably over the periods corresponding to the take-off of the internet bubble and to the subprime crisis with regards to the period before. The indicators of capitalisation increase over the whole period, in particular after the triggering of the financial crisis (Figure I-B). Banks have started to strengthen their solvency and to anticipate the increase of capital requirements imposed by the new Basel III regulatory framework. In fact, even if the Basel III regulatory framework was not yet mandatory, the main outline of the new framework was known (following the publication of the consultative Basel III document in 2010) and both the financial markets and supervisors were monitoring banks' levels of preparation to transfer to Basel III. All in all, we began to observe a more significant increase in retained earnings. Banks also have different business models: the first decile of asset diversification is at 0.39 (high level of diversification) and the last decile at 0.79 (very high level of concentration). The same observation can be made for loan share (from the first decile at 28.5% to the last decile at 88.37%) and for portfolio risk (from the first decile at 21.01% to the last at 90.29%), which reveals that the banks in our sample choose different business models.

Econometric strategy

To assess the effect of bank capitalisation on profitability, we conduct fixed-effect regressions. Standard errors are adjusted in terms of heteroscedasticity and autocorrelation by using the Newey-West standard errors. We include lagged values of the capitalisation measure. Our reference model is as follows:

Equation 1

$$Y_{i,t} = \alpha_i + \theta_t + \beta_1 \, Capitalisation_{i,t-j} + X_{c,i,t}\,\beta_c + \varepsilon_{i,t}$$

where i is an index for the ith bank, t for the tth period and $j \in \{1,2\}$ for estimations taking into account only one lag and $j \in \{1,2,3\}$ for estimations including two lags. α_i and θ_t are, respectively, the fixed effects by bank and by period. $Y_{i,t}$ represents, respectively, ROE or ROA. The variable called $Capitalisation_{i,t-j}$ is one of the five bank capital ratios described above. $X_{c,i,t}$ is a vector of the following independent variables: asset diversification, loan share, safety net, portfolio risk and liquidity ratio. β_1, and β_c are parameters to be estimated. $\varepsilon_{i,t}$ is the error term.

We use lagged values for all our capitalisation measures because contemporaneous capital ratios are endogenous to banks' profits (undistributed profits automatically increase banks' capital). We test the endogeneity of these lagged values. To do so, we run a Granger causality test which includes fixed effects by bank and by period and we test the null hypothesis according to which the past values of the profitability measures do not explain the capitalisation measures. The Wald test does not reject the null hypothesis that each of the coefficients associated with the lagged values of ROE and ROA are equal to zero. Finally, we do not reject the null hypothesis that the sum

of these coefficients is equal to zero. Including a lag of one and two years respectively, the lagged values of ROE and ROA do not bear information, in the sense of Granger causality,[5] on the explanation of our bank capitalisation measures beyond what is provided by the past values of the capitalisation measures themselves.[6] This test does not take into account the fact that the banks which anticipate better future returns raise more capital. We conduct complementary tests in order to test the existence of a relationship between future values of the indicators of profitability and the present values of the capitalisation measures. The results do not highlight any significant relationships. Furthermore, an alternative method to the lag of explanatory variables to avoid endogeneity bias would be to turn to instrumental variables methods. However, the relatively small size of the sample due in part to the concentration of the banking system does not allow for a correct implementation of the generalised method of moments. Berger and Bouwman (2013) identify endogeneity issues which require the use of instrumental variables for small banks only. We therefore introduce the capital ratios with a lag of one and two years respectively in the specifications which explain the ROE and ROA. The results remain consistent when we explain the ROA by one year lagged values of capital ratio. In an augmented model, we consider two lags of capitalisation measures to test the hypothesis of a gradual effect of capitalisation on profitability.

5. The Granger test is based on the hypothesis that the future does not "cause" the past. In certain cases, predictions can play an important role in the determination of present values.
6. The results are presented in the on line complement C1.

Figure I-A
Profitability of French banking groups (median)

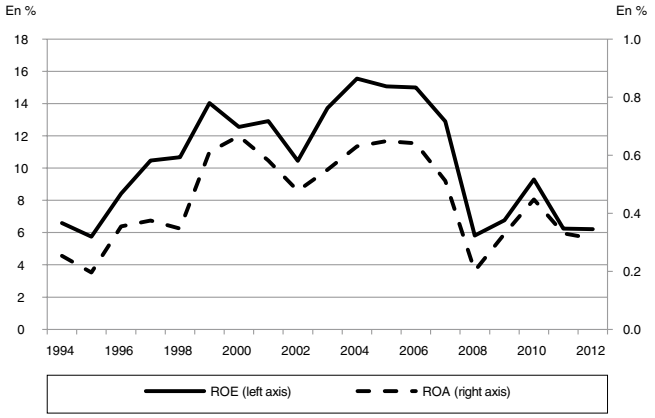
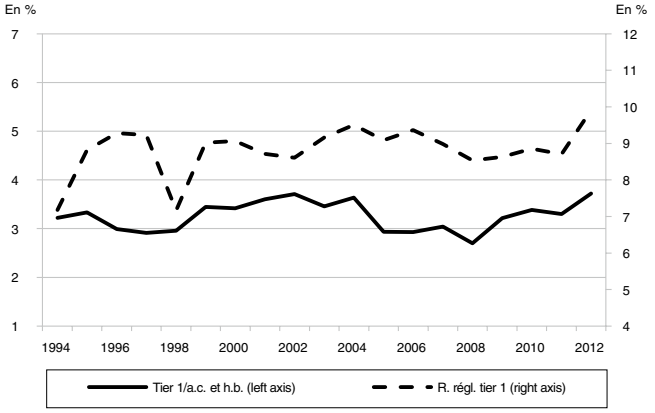


Figure I-B
Capitalisation of French banking groups (median)



Note: ROE: Net income/capital; ROA: Net income/Total Assets; Tier 1/TA and OBS: Tier1/Tangible assets and off-balance sheet assets; Tier 1 reg. r.: Tier 1/Basel I risk-weighted assets.
Source: Data drawn from the accounting and prudential database of the French Prudential Supervision and Resolution Authority; unbalanced panel of 17 French banking groups over the period 1993-2012; calculations by the authors.

Table 1
Descriptive statistics on the different variables of profitability, capitalisation measures and other indicators relating to large French banking groups over the period 1993-2012

Variables	Definition	Number	Average	Standard deviation	1st decile	Median	9th decile
ROE (%)	Net income over total equity	135	10.71	5.84	4.23	10.82	17.77
ROA (%)	Net income over total assets	135	0.61	0.47	0.14	0.46	1.33
RORAC (%)	Net income over 8% of risk-weighted assets (according to the Basel I methodology).	135	14.45	8.34	3.82	13.83	24.95
Efficiency	Net operating income over administrative expenses	132	1.95	0.74	1.4	1.63	3.3
Capital ratio t 1 (%)	One year lagged value of balance sheet equity over total assets.	135	5.56	2.93	2.68	4.58	10.10
Tier 1/tangible assets t-1 (%)	One year lagged value of tier 1 regulatory capital minus intangible fixed assets over total assets minus intangible fixed assets	135	5.00	2.60	2.40	4.01	8.96
Tier 1/tangible and off-balance sheet assets t-1 (%)	One year lagged value of tier 1 regulatory capital over the sum of total assets and off-balance sheet weighted credit risk exposures	135	4.28	2.57	1.88	3.17	8.81
Tier 1 regulatory ratio t-1 (%)	One year lagged value of tier 1 regulatory capital over risk-weighted assets (according to the Basel I methodology)	135	9.20	2.28	6.86	8.87	11.96
Total regulatory ratio t-1 (%)	One year lagged value of total regulatory capital over risk-weighted assets (according to the Basel I methodology)	135	11.39	2.16	9.15	11.18	14.22
Asset diversification	Herfindahl-Hirschmann index of 4 different asset classes: cash, interbank assets, loans and other earning assets.	135	0.53	0.15	0.39	0.47	0.79
Loan share (%)	Loans to non-financial entities over total earning assets	135	54.06	22.31	28.50	49.65	88.37
Safety net (%)	Deposits over total assets	135	22.48	16.16	1.39	25.02	39.98
Portfolio risk (%)	Risk-weighted assets (according to the Basel I methodology) over total assets	135	51.47	23.91	21.01	46.63	90.29
Liquidity ratio	Available liquid assets over liquid liability requirements	135	1.95	1.75	1.18	1.41	2.99

Sources: Annual data drawn from the accounting and prudential database of the French Prudential Supervision and Resolution Authority; unbalanced panel of 17 French banking groups over the period 1993-2012; authors' calculations.

Main results

Bank capital and profitability

Table 2 takes into account the results of fixed effect regressions of ROE and ROA on our capitalisation measures. Capitalisation ratios are lagged by one and two years respectively to explain ROE and ROA (variant A of Equation 1). For all specifications, the coefficient of the capitalisation variable is positive. For estimations which explain the ROE, the coefficients are statistically significant for the Tier 1 / Tangible and Off-balance Sheet Assets ratios, the Tier 1 regulatory ratio and the total regulatory capital ratio (columns 3, 4 and 5). For ROA, all the coefficients associated with the capital ratios are highly significant. Profitability tends to increase on average after an increase of capitalisation. Our analysis therefore supports the "positive vision": the increase of capital intensifies the bank's monitoring effort, hence leading to a greater return on assets. Among the regulatory ratios, the magnitude of the coefficient is weakest for the total regulatory ratio. This result is consistent with the fact that this ratio comprises other forms of capital such as long-term subordinated debt and certain hybrid instruments. These forms of capital should influence less the monitoring effort conducted by the bank since only core capital allows to fully benefit from the improvement in monitoring. These results are consistent with those of Berger and Bouwman (2013) who show in particular that capital generally improves bank profitability. For small banks, this result is valid both at normal times and in times of crisis while this positive effect is observed in times of crisis for large banks.

We also demonstrate a significant impact of asset diversification and loan share on ROE. For ROA, this effect is mainly highlighted only for specifications which integrate the regulatory capital ratios (columns 9 and 10). The positive coefficient on asset diversification indicates that banks whose activities are more concentrated tend on average to have higher profitability. This can reflect the higher risk profile of banks which choose to concentrate their activities in one sector, which generates more profits on average. This result can also be explained by the know-how and expertise developed in several market segments. The negative sign of the loan share coefficient might be explained more by a mechanical effect of the variation of market activities in earning assets. The reduction in market activities has been accompanied by a drop in profitability during the crisis period.

Consideration of lags of two periods in the capital measures

The different specifications relating to variant A of Equation 1 presented in table 2 consider that capital ratio affects profitability with only one lag. If the positive effect rests on an improvement of the effectiveness of investment choices made by the management under the control of the shareholders, more time is undoubtedly needed for the bank to fully profit from an increase of capitalisation. In order to test this, we estimate the effect of capitalisation by including two lags. Table 3 displays results when one and two-year lagged capital measures are included in the model which explains the ROE, and two- and three-year lagged measures in the model which explains the ROA (variant B of Equation 1). We conduct a test of joint significance on the sum of the coefficients of the lagged variables. According to our results, the capitalisation measures mainly involve a two-year lag. Their coefficients are significant in models 1 to 3 which explain the ROE and models 6 to 8 for the ROA. The one-year lag capitalisation variables are never significant in the ROE estimation models. Those lagged by three years are never significant in the ROA estimation models. The null hypothesis that the coefficients of the lagged capitalisation variables sum to zero is rejected, with the exception of the specifications which explain the ROE by regulatory capital ratios (Table 2, columns 4 and 5).

Overall, capitalisation has a positive effect on a bank's profitability. The effect is particularly significant two years after the initial capital increase. The empirical data therefore broadly confirm the "positive vision" of the effect of capital on banks' performance.

The economic effect of increases of capital

The results show that capitalisation has a statistically positive effect on profitability. The magnitude of the effect is also significant from an economic point of a view. In Table 2, which considers only one lag for the capitalisation measures, all else being equal, an increase by 100 basis points of capitalisation triggers an increase of the ROE ranging from 0.31% to 1.12% according to the capital ratio

considered. This represents thus at maximum around 10% of the average ROE observed over the period. This effect ranges between 0.04% and 0.18% for the ROA, which represents at maximum nearly 30% of the average observed over the period. The magnitude of the effect is more significant on the ROA. This might be explained by the mechanical impact on the ROE (an increase of the denominator of the ROE ratio) when capital increases. If we include two lags in the same specification (cf. Table 3), the average effect on the ROE (that being the sum of the lagged coefficients) ranges between 0.46 and 1.94% and between 0.04 and 0.16% for the ROA.

Complementary investigations

Does the way in which banks increase their capital hold any significance?

Our results show that higher capitalisation generates greater accounting profit. However, some authors claim that capital represents a costlier source of financing, which leads to a decrease of banks' profits following an increase of capital requirements. Myers and Majluf (1984) go from the observation that managers have more information than investors on the value of the firm. Managers who act in the interest of the firm's existing shareholders can choose to not issue shares even if this would allow the financing of projects with a net positive present value. Actually, the issuing of shares creates dilution costs for the existing shareholders and imposes issuing costs. The new shares could then be sold at a low price if the issuing is interpreted as a bad signal for the bank's prospects. Miller (1995), who examines the application of Modigliani and Miller's propositions (1958) to banks, underlines the fundamental distinction between the cost of "raising new capital" and the cost of "holding capital". Therefore, the raising of new capital can turn out to be costly while the effects of holding capital might be beneficial.[7]

In order to test whether the cost of raising capital has a negative effect on profitability, we calculate a lagged dummy variable,[8] namely "share capital growth" equal to 1 when share capital growth is strictly positive, and equal to 0 otherwise. In fact, the variation of share capital reports only increases of capital made by an issuing of shares. We are interested in the interactions between share capital growth and our capital ratios. More precisely, we aim at assessing to what extent the effect of capitalisation on profitability is different when capital is raised. If the costs of raising capital reduce banks' profits, we should estimate a negative sign coefficient for the interaction term between share capital growth and each of our capitalisation measures. The estimated model is as follows:

Equation 2

$$
\begin{aligned}
Y_{i,t} = {} & \alpha_i + \theta_t + \beta_1 Capitalisation_{i,t-j} \\
& + \beta_2 Capitalisation_{i,t-j} \\
& \times Growth\ of\ social\ capital_{i,t-j} \\
& + \beta_3 Growth\ of\ social\ capital_{i,t-j} \\
& + X_{c,i,t}\beta_c + \varepsilon_{i,t}
\end{aligned}
$$

Table 4 reports the results of fixed effect regressions with the different capital ratios interacting with share capital growth. The dichotomous variable is introduced in the model with the same lag as the capital ratios. For the ROE, none of the interaction terms are significant. For the models that explain the ROA, the interaction terms are significantly negative with the exception of those associated with the regulatory capital ratios. We have also tested the same fixed effect models by including only the capital ratios, share capital growth and interaction terms. The results remain consistent. The issuing of shares therefore appears to be more costly and contributes to the reduction of the positive effect of capitalisation on the ROA.

Is this result valid for banks which have a smaller capital buffer in accordance with the minimum requirements of "pillar 2"?

We then assess to what extent the capital buffer built up by banks beyond the total requirements set by regulation can affect the relationship between capital and performance. We use confidential prudential data which focus on the extra

7. It should be noted that capital requirements are not imposed from one day to the next but are gradually implemented (box 1). This allows banks to pursue different strategies, like distributing less profit or reallocating assets, in order to reach the required capitalisation levels. In addition, the costs of raising capital can also be spread over the whole implementation period and over the period during which banks anticipate the entering into force of the new framework presented in the consultative documents published by the Basel Committee. Consequently, this gradual implementation eased bankers' worries with regards to the costs of raising capital, especially after taking into account the beneficial effects that holding more capital entails.

8. Since the cost of raising capital can have a short-term effect, we have also conducted tests using non-lagged variables of share capital growth. The results remain the same.

Table 2
Bank capital and profitability (estimations of variant A of Equation 1)

	Return on equity (ROE)					Return on assets (ROA)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Capital ratio $_{t-1}$	0.307									
	(0.498)									
Capital ratio $_{t-2}$						0.107***				
						(0.028)				
Tier 1 / tangible assets $_{t-1}$		0.611								
		(0.490)								
Tier 1 / tangible assets $_{t-2}$							0.116***			
							(0.039)			
Tier 1 / tangible and off-balance sheet assets $_{t-1}$			1.118*							
			(0.615)							
Tier 1 / tangible and off-balance sheet assets $_{t-2}$								0.179***		
								(0.040)		
Tier 1 regulatory ratio $_{t-1}$				0.553*						
				(0.320)						
Tier 1 regulatory ratio $_{t-2}$									0.071***	
									(0.019)	
Total regulatory capital ratio $_{t-1}$					0.413*					
					(0.231)					
Total regulatory capital ratio $_{t-2}$										0.039***
										(0.013)
Asset diversification	0.278*	0.265*	0.259*	0.278**	0.271**	0.003	0.004	0.002	0.009*	0.010*
	(0.148)	(0.141)	(0.138)	(0.135)	(0.136)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Loan share	- 0.248*	- 0.253*	- 0.266**	- 0.288**	- 0.264**	- 0.005	- 0.009	- 0.011*	- 0.015**	- 0.012*
	(0.139)	(0.132)	(0.128)	(0.128)	(0.130)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
Safety net	0.174	0.195	0.191	0.178	0.174	- 0.001	0.001	- 0.002	- 0.001	0.001
	(0.149)	(0.139)	(0.140)	(0.139)	(0.140)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)
Portfolio risk	- 0.018	- 0.042	- 0.047	0.041	0.013	0.001	0.003	0.004	0.016**	0.011
	(0.119)	(0.128)	(0.125)	(0.133)	(0.133)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
Liquidity ratio	0.003	0.003	0.003	0.003	0.003	- 0.000	- 0.000	- 0.000	- 0.000	- 0.000
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	- 0.012	- 0.012	- 0.009	- 0.051	- 0.051	- 0.001	- 0.003	- 0.001	- 0.008**	- 0.008**
	(0.057)	(0.055)	(0.055)	(0.059)	(0.060)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Fixed year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	135	135	135	135	135	135	135	135	135	135
Number of banks	17	17	17	17	17	17	17	17	17	17
Adj. R^2 (%)	44.5	45	45.7	45.6	45.5	77.8	77.4	78.8	77.5	76
Adj. R^2 within (%)	31.6	32.1	33	32.9	32.8	27.7	26.6	31.1	26.8	22

Note: This table presents the estimations' results (variant A of equation 1) with fixed effects of return on equity (ROE) and assets (ROA) on a series of independent variables. Capital ratios are lagged respectively by one and two years for ROE and ROA estimations. The definitions of the variables figure in table 1. The estimations have been made with the Stata software using the Newey-West method which provides robust standard errors in the presence of heteroscedasticity and autocorrelation of the error term for the coefficients estimated by the ordinary least squares method. The standard errors are indicated in brackets. The ***, ** and * represent the levels of statistical significance of 1%, 5% and 10% respectively.
Reading note: In the (1) specification, an increase of 1 percentage point of the capital ratio at the *t*-1 date leads to an increase of 0.307 percentage points of the ROE at the *t* date, all else being equal.
Sources: Annual data drawn from the accounting and prudential database of the French Prudential Supervision and Resolution Authority; unbalanced panel of 17 French banking groups over the period 1993-2012.

Table 3
Bank capital with two year lag and profitability (estimations of variant B of Equation 1)

	Return on equity (ROE)					Return on assets (ROA)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Capital ratio $_{t-1}$	- 0.893									
	(0.891)									
Capital ratio $_{t-2}$	1.769*					0.081*				
	(0.932)					(0.041)				
Capital ratio $_{t-3}$						0.027				
						(0.057)				
Tier 1 / tangible assets $_{t-1}$		- 0.704								
		(0.867)								
Tier 1 / tangible assets $_{t-2}$		1.848**					0.061			
		(0.926)					(0.058)			
Tier 1 / tangible assets $_{t-3}$							0.053			
							(0.061)			
Tier 1 / tangible and off-balance sheet assets $_{t-1}$			- 0.578							
			(0.933)							
Tier 1 / tangible and off-balance sheet assets $_{t-2}$			2.522**					0.119*		
			(1.015)					(0.063)		
Tier 1 / tangible and off-balance sheet assets $_{t-3}$								0.043		
								(0.068)		
Tier 1 regulatory ratio $_{t-1}$				- 0.021						
				(0.486)						
Tier 1 regulatory ratio $_{t-2}$				0.790					0.034	
				(0.550)					(0.027)	
Tier 1 regulatory ratio $_{t-3}$									0.031	
									(0.025)	
Total regulatory ratio $_{t-1}$					0.223					
					(0.384)					
Total regulatory ratio $_{t-2}$					0.232					0.009
					(0.423)					(0.019)
Total regulatory ratio $_{t-3}$										0.026
										(0.019)
Sum of lag coefficients	0.877	1.144	1.944	0.769	0.456	0.108	0.113	0.162	0.065	0.035
	0.495*	0.547**	0.674***	0.378**	0.26*	0.04***	0.048**	0.049***	0.021***	0.014**
Test for all lags=0	2.51*	2.99*	5.05***	2.18	1.58	5.52***	2.88*	5.98***	4.63**	3.43**
p-value	0.087	0.0552	0.008	0.118	0.212	0.006	0.062	0.004	0.012	0.037
Asset diversification	0.195	0.192	0.163	0.262*	0.267*	0.003	0.003	0.002	0.008	0.009*
	(0.132)	(0.127)	(0.129)	(0.135)	(0.140)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Loan share	- 0.207	- 0.245*	- 0.265**	- 0.312**	- 0.272**	0.000	- 0.003	- 0.005	- 0.009	- 0.007
	(0.131)	(0.128)	(0.125)	(0.135)	(0.131)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)
Safety net	0.126	0.118	0.097	0.133	0.162	- 0.001	0.001	- 0.000	0.000	0.001
	(0.142)	(0.131)	(0.135)	(0.142)	(0.153)	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)
Portfolio risk	- 0.065	- 0.038	- 0.045	0.072	0.019	0.001	0.004	0.004	0.015**	0.011
	(0.121)	(0.124)	(0.121)	(0.137)	(0.139)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
Liquidity ratio	0.002	0.002	0.000	0.002	0.002	- 0.000	- 0.000	- 0.000	- 0.000	0.000
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.031	0.021	0.039	- 0.045	- 0.048	- 0.002	- 0.004	- 0.003	- 0.008**	- 0.007**
	(0.056)	(0.055)	(0.057)	(0.062)	(0.062)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Fixed year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	135	135	135	135	135	118	118	118	118	118
Number of banks	17	17	17	17	17	17	17	17	17	17
Adj. R^2 (%)	46.2	46.4	47.8	46.2	45.1	85.4	84.7	85.4	84.2	83.5
Adj. R^2 within (%)	33.8	33.9	35.7	33.7	32.4	39.4	36.3	39.1	34.2	31.3

Note: This table presents the estimations' results (variant B of equation 1) with fixed effects of return on equity (ROE) and assets (ROA) on a series of independent variables. The capital ratios are lagged by one and two years in the specifications which explain the ROE, and two and three years in the specifications which explain the ROA. The definitions of the variables figure in table 1. The estimations have been made with the Stata software using the Newey-West method which provides robust standard errors in the presence of heteroscedasticity and autocorrelation of the error term for the coefficients estimated by the ordinary least squares method. The standard errors are indicated in brackets. The ***, ** and * represent the levels of statistical significance of 1%, 5% and 10% respectively.
Reading note: In the (1) specification, an increase of 1 percentage point of the capital ratio at the *t*-1 and *t*-2 dates leads to an increase of 0.877% percentage points of the ROE at the *t* date, all else being equal.
Sources: Annual data drawn from the accounting and prudential database of the French Prudential Supervision and Resolution Authority; unbalanced panel of 17 French banking groups over the period 1993-2012.

capital requirements from "pillar 2": the supervisor can in fact demand that a bank holds more capital than the regulatory minimum imposed on all banks.[9]

We calculate banks' capital buffer for each year as the difference between their effective level of regulatory capital and the level of capital required from pillars 1 and 2 (minimum requirements plus additional individual requirements). Banks always have to meet the minimum capital imposed by the pillar 1 or pillar 2 regulation. But the level of the buffer is explained by the bank's choice to hold a level of capital more or less close to the requirements imposed by regulation. We build a dummy variable equal to 1 when the bank's buffer level at a given date is less than the median value of the sample and equal to 0 in the other cases.[10] We interact it with the different variables of banks' capitalisation measures. This variable isolates the behaviour of banks which have a small capital buffer. The following model is estimated:

Equation 3

$$Y_{i,t} = \alpha_i + \theta_t + \beta_1 Capitalisation_{i,t-j} + \beta_2 Capitalisation_{i,t-j} \times Small\ capital\ buffer_{i,t-j} + \beta_3 Small\ capital\ buffer_{i,t-j} + X_{c,i,t}\beta_c + \varepsilon_{i,t}$$

Table 5 presents the results of the interaction between capitalisation and the dichotomous variable which discriminates between banks according to the level of their capital buffer. This dichotomous variable is introduced in the model with the same lag as the capitalisation measures. The coefficients of the capitalisation measures are positive and significant with the exception of models 1, 9 and 10. For the ROE, the coefficients of the interactions are not significant. For the ROA, we observe overall a stronger positive effect of the increase of capital on profitability for banks which have *ex ante* a smaller capital buffer. Capital increases seem to be managed as closely as possible and correspond more to the seizing of investment opportunities that are profitable than to the building of a simple safety buffer.

Robustness of the results

We amend all our models by replacing the variable of the ROE (resp. of ROA) by a variable of "return on risk-adjusted capital" (RORAC). RORAC focuses on the link between banks' profits and capital requirements associated with risk-taking instead of capital or assets. We highlight again the positive influence of the capitalisation measures on the RORAC variable (for more details see the online complement C3). Finally, we run various complementary tests: non-linearity of certain effects; impact of the differences of market power between banks on profitability. The existence of non-linear effects between two capital ratios and the ROA is highlighted and the size of market share does not contribute to the improvement of profitability.

* *
*

The article contributes to the debate on the relationship between capitalisation, capital requirements and banks' performance, for which, so far, no consensus has emerged in the literature. It brings new elements to this question by analysing the French banking system. We demonstrate that an increase of capital has a positive effect on banks' profitability, beyond the lower level observed with regards to the pre-crisis period. Our econometric estimations highlight a positive and significant effect of the increase of capital on profitability. However, capital increases through the issuing of new, more costly shares, entail a lower positive effect on profitability.

By drawing on confidential data relating to all the regulatory requirements (especially the pillar 2 requirements that are specific to each bank), we highlight that the positive impact of capital on the profitability of assets is stronger for banks which have a smaller capital buffer. For these banks, capital increases seem to be more dedicated to seizing investment opportunities than to building a simple safety buffer. The positive relationship between capital and performance might be explained in particular by a management monitoring the investment choices better, leading to improved efficiency. Finally, gradual capital increases through

9. As indicated above, since Basel II these requirements are called "Pillar 2" capital requirements. These requirements are not revealed to the market.
10. We also separate the sample according to the 25th percentile. Our results remain the same.

Table 4
Strengthening of bank capital, share capital growth and profitability (estimations of Equation 2)

	Return on equity (ROE)					Return on assets (ROA)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Capital ratio$_{t-1/t-2}$	0.271					0.107***				
	(0.499)					(0.030)				
Capital ratio$_{t-1/t-2}$ × share capital growth$_{t-1/t-2}$	- 0.367					- 0.048***				
	(0.325)					(0.018)				
Tier 1 / tangible assets$_{t-1/t-2}$		0.553					0.117***			
		(0.480)					(0.035)			
Tier 1 / tangible assets$_{t-1/t-2}$ × share capital growth$_{t-1/t-2}$		- 0.184					- 0.051***			
		(0.312)					(0.018)			
Tier 1 / tangible and off-balance sheet assets$_{t-1/t-2}$			0.989					0.151***		
			(0.624)					(0.040)		
Tier 1 / tangible and off-balance sheet assets$_{t-1/t-2}$ × share capital growth$_{t-1/t-2}$			- 0.097					- 0.040**		
			(0.316)					(0.017)		
Tier 1 regulatory ratio$_{t-1/t-2}$				0.325					0.061***	
				(0.309)					(0.022)	
Tier 1 regulatory ratio$_{t-1/t-2}$ × share capital growth$_{t-1/t-2}$				0.296					- 0.011	
				(0.259)					(0.016)	
Total regulatory ratio$_{t-1/t-2}$					0.333					0.036
					(0.334)					(0.024)
Total regulatory ratio$_{t-1/t-2}$ × share capital growth$_{t-1/t-2}$					0.049					- 0.007
					(0.383)					(0.024)
Dummy variable of share capital growth$_{t-1/t-2}$	0.034	0.023	0.018	- 0.012	0.009	0.002**	0.002**	0.002**	0.001	0.001
	(0.023)	(0.021)	(0.019)	(0.024)	(0.048)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)
Asset diversification	0.271*	0.258*	0.254*	0.270**	0.264**	0.002	0.002	0.002	0.009*	0.009*
	(0.142)	(0.136)	(0.134)	(0.130)	(0.130)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Loan share	- 0.251*	- 0.255*	- 0.267**	- 0.305**	- 0.269*	0.000	- 0.002	- 0.004	- 0.007	- 0.005
	(0.138)	(0.132)	(0.128)	(0.138)	(0.137)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)
Safety net	0.174	0.190	0.190	0.185	0.179	0.002	0.004	0.002	0.002	0.002
	(0.148)	(0.136)	(0.137)	(0.141)	(0.138)	(0.007)	(0.007)	(0.007)	(0.008)	(0.009)
Portfolio risk	- 0.006	- 0.037	- 0.045	0.045	0.009	0.001	0.002	0.003	0.013*	0.009
	(0.115)	(0.123)	(0.121)	(0.131)	(0.138)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)
Liquidity ratio	0.002	0.003	0.003	0.003	0.003	0.000	0.000	- 0.000	0.000	- 0.000
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	- 0.030	- 0.019	- 0.015	- 0.037	- 0.049	- 0.004	- 0.005*	- 0.004	- 0.009**	- 0.008*
	(0.060)	(0.055)	(0.055)	(0.054)	(0.065)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Fixed year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	135	135	135	135	135	118	118	118	118	118
Number of banks	17	17	17	17	17	17	17	17	17	17
Adj. R^2 (%)	45.3	45.2	45.7	46	45.6	86.6	85.6	85.9	83.8	83
Adj. R^2 within (%)	32.7	32.6	33.2	33.5	33.1	44.3	40.3	41.4	32.6	29.4

Note: This table presents the estimations' result (equation 2) with fixed effects of the return on equity (ROE) and assets (ROA) on a series of independent variables by distinguishing the increases of share capital from other types of capital increases. Capital ratios are lagged by respectively one year and two years for ROE and ROA estimations. The definitions of the variables figure in table 1. The estimations have been made with the Stata software using the Newey-West method which provides robust standard errors in the presence of heteroscedasticity and autocorrelation of the error term for the coefficients estimated by the ordinary least squares method. The standard errors are indicated in brackets. The ***, ** and * represent the levels of statistical significance of 1%, 5% and 10% respectively.
Reading note: In the (1) specification, an increase of 1 percentage point of the capital ratio without issuing share capital at the *t*-1 date leads to an increase of 0.271 percentage points of the ROE, all else being equal. -0.367 indicates to what extent the relationship between capitalisation and profitability is different when the bank proceeds with an issuing of share capital. Capital ratio$_{t-1/t-2}$ refers to the one-year lag capital ratio in the specifications which explain the ROE, and to the two year lag capital ratio in the specifications which explain the ROA.
Sources: Annual data drawn from the accounting and prudential database of the French Prudential Supervision and Resolution Authority; unbalanced panel of 17 French banking groups over the period 1993-2012.

Table 5
Banks' capitalisation, capital buffer and profitability (estimations of Equation 3)

	Return on equity (ROE)					Return on assets (ROA)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Capital ratio$_{t-1/t-2}$	0.539					0.083***				
	(0.499)					(0.026)				
Capital ratio$_{t-1/t-2}$ × small capital buffer$_{t-1/t-2}$	- 0.374					0.065***				
	(0.421)					(0.024)				
Tier 1 / tangible assets$_{t-1/t-2}$		0.932*					0.085***			
		(0.531)					(0.026)			
Tier 1 / tangible assets$_{t-1/t-2}$ × small capital buffer$_{t-1/t-2}$		- 0.183					0.079***			
		(0.481)					(0.026)			
Tier 1/ tangible and off-balance sheet assets$_{t-1/t-2}$			1.522**					0.123***		
			(0.678)					(0.035)		
Tier 1/ tangible and off-balance sheet assets$_{t-1/t-2}$ × small capital buffer$_{t-1/t-2}$			- 0.158					0.073***		
			(0.449)					(0.024)		
Tier 1 regulatory ratio$_{t-1/t-2}$				0.767*					0.029	
				(0.419)					(0.027)	
Tier 1 regulatory ratio$_{t-1/t-2}$ × lower capital buffer$_{t-1/t-2}$				- 0.122					0.085**	
				(0.635)					(0.036)	
Total regulatory ratio$_{t-1/t-2}$					0.587**					0.032
					(0.287)					(0.020)
Total regulatory ratio$_{t-1/t-2}$ × lower capital buffer$_{t-1/t-2}$					- 0.092					0.011
					(0.660)					(0.034)
lower capital buffer$_{t-1/t-2}$	0.037	0.030	0.029	0.032	0.032	- 0.002	- 0.002*	- 0.002	- 0.006*	0.000
	(0.027)	(0.028)	(0.024)	(0.054)	(0.069)	(0.001)	(0.001)	(0.001)	(0.003)	(0.004)
Asset diversification	0.262*	0.258*	0.256*	0.292**	0.283**	0.006	0.007	0.007	0.007*	0.010**
	(0.149)	(0.143)	(0.144)	(0.138)	(0.139)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)
Loan share	- 0.259*	- 0.280**	- 0.301**	- 0.332**	- 0.300**	0.000	- 0.002	- 0.005	- 0.010	- 0.007
	(0.140)	(0.136)	(0.135)	(0.138)	(0.137)	(0.005)	(0.005)	(0.005)	(0.006)	(0.007)
Safety net	0.139	0.190	0.185	0.181	0.180	0.008	0.012*	0.011	0.002	0.003
	(0.142)	(0.138)	(0.142)	(0.137)	(0.144)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
Portfolio risk	- 0.008	- 0.047	- 0.049	0.065	0.026	- 0.003	- 0.002	- 0.000	0.015**	0.011
	(0.112)	(0.120)	(0.117)	(0.125)	(0.124)	(0.005)	(0.006)	(0.005)	(0.007)	(0.007)
Liquidity ratio	0.003	0.002	0.002	0.002	0.002	- 0.000	- 0.000	- 0.000	- 0.000	- 0.000
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	- 0.027	- 0.026	- 0.025	- 0.087	- 0.087	- 0.003	- 0.006**	- 0.006**	- 0.006	- 0.009**
	(0.056)	(0.053)	(0.052)	(0.069)	(0.073)	(0.003)	(0.002)	(0.003)	(0.004)	(0.004)
Fixed year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	135	135	135	135	135	118	118	118	118	118
Number of banks	17	17	17	17	17	17	17	17	17	17
Adj. R^2 (%)	44.8	45.2	46.1	45.8	45.8	87.3	86.9	87.3	85.6	83.6
Adj. R^2 within (%)	32.1	32.6	33.7	33.4	33.3	47.2	45.5	47.1	40.1	32.1

Note: This table presents the estimations' results (equation 3) with fixed effects of the return on equity (ROE) and assets (ROA) on a series of independent variables by distinguishing the banks which have a lower capital buffer from the others. Capital ratios are lagged by respectively one year and two years for ROE and ROA estimations. The definitions of the variables figure in table 1. The estimations have been made with the Stata software using the Newey-West method which provides robust standard errors in the presence of heteroscedasticity and autocorrelation of the error term for the coefficients estimated by the ordinary least squares method. The standard errors are indicated in brackets. The ***, ** and * represent the levels of statistical significance of 1%, 5% and 10% respectively.
Reading note: In the (1) specification, an increase of 1 percentage point of the capital ratio of the banks which have a larger capital buffer at the *t*-1 date leads to an increase of 0.539 percentage points of the ROE, all else being equal. -0.374 indicates to what extent the relationship between capitalisation and profitability is different when the bank has a small capital buffer. Capital ratio$_{t-1/t-2}$ refers to the one-year lag capital ratio in the specifications which explain the ROE, and to the two-year lag capital ratio in the specifications which explain the ROA.
Sources: Annual data drawn from the accounting and prudential database of the French Prudential Supervision and Resolution Authority; unbalanced panel of 17 French banking groups over the period 1993-2012.

retained earnings do not appear to be detrimental to banks' performance. This conclusion, which confirms for France some of those formulated by Berger and Bouwman (2013) and complements them in terms of analysis of capital buffers, comes to mitigate the frequent criticisms with regards to the potentially negative effects of prudential regulation on the banking system. Other than the need to integrate the following stages of the Basel III agenda which runs until 2019, future works could study the interaction with credit distribution and investigate in more detail the channels through which profitability is affected. □

BIBLIOGRAPHY

Admati, A. R., DeMarzo, P. M., Hellwig, M. F. & Pfeiderer, P. C. (2011). Fallacies, irrelevant facts, and myths in the discussion of capital regulation: why bank equity is not expensive. *Working paper Stanford University et Max Planck Institute*, Stanford, CA, et Bonn, Germany.

Aiyar, S., Calomiris, C. W. & Wieladek, T. (2016). How does credit supply respond to monetary policy and bank minimum capital requirements? *European Economic Review*, 82, 142–165.

Allen, F., Carletti, E. & Marquez, R. (2011). Credit market competition and capital regulation. *Review of Financial Studies*, 24, 4, 983–1018.

Banque centrale européenne (2010). Beyond ROE – how to measure bank performance. Appendix to the *Report on EU Banking Structures*, September 2010.

Berger, A. N. (1995). The relationship between capital and earnings in banking. *Journal of Money, Credit and Banking*, 27, 432–456.

Berger, A. N., Herring, R. J. & Szegö, G. P. (1995). The role of capital in financial institutions. *Working paper Wharton Financial Institutions Center* N° 95-01, Wharton (PA).

Berger, A. N. & Bouwman, C. H. S. (2013). How does capital affect bank performance during financial crises? *Journal of Financial Economics*, 109, 146–176.

Boot, A. W. A. & Thakor, A. V. (2000). Can relationship banking survive competition? *Journal of Finance*, 55(2), 679–713.

Calomiris, C. W. (2013). Reforming banks without destroying their productivity and value. *Journal of Applied Corporate Finance*, 25(4), 14–20.

Calomiris, C. W. & Kahn, C. M. (1991). The role of demandable debt in structuring optimal banking arrangements. *American Economic Review*, 81, 497–513.

Carney, M (2013a). Progress of financial reforms. http://www.financialstabilityboard.org/publications/r_130905.pdf

Carney, M (2013b). Crossing the threshold to recovery. http://www.bankofengland.co.uk/publications/Documents/speeches/2013/speech675.pdf

Chemmanur, T. & Fulghieri, P. (1994). Reputation, renegotiation and the choice between bank loans and publicly traded debt. *Review of Financial Studies*, 7, 476–506.

Cohen, B. H. & Scatigna, M. (2016). Banks and capital requirements: channels of adjustment. *Journal of Banking and Finance*, 69, 56–69.

Diamond, D. W. (1984). Financial intermediation and delegated monitoring. *Review of Economic Studies*, 51(3), 393–414.

Diamond, D. & Rajan, R. (2001). Liquidity risk, liquidity creation and financial fragility. *Journal of Political Economy*, 109(2), 287–327.

Fraisse, H., Lé, M. & Thesmar, D. (2015). The real effects of Bank Capital Requirements. *Débats économiques et financiers* 8. Autorité de contrôle prudentiel et de résolution.

Francis, W. B. & Osborne, M. (2012). Capital requirements and bank behavior in the UK: Are there lessons for international capital standards. *Journal of Banking and Finance*, 36, 803–816.

Hart, O. & Moore, J. (1995). Debt and seniority: an Analysis of the role of hard claims in constraining management. *American Economic Review*, 85, 567–585.

Holmstrom, B. & Tirole, J. (1997). Financial intermediation, loanable funds and the real sector. *Quarterly Journal of Economics*, 112(3), 663–691.

Keeley, M. C. (1990). Deposit insurance, risk and market power in banking. *American Economic Review*, 80(5), 1183–1200.

Leland, H. E. & Pyle, D. H. (1977). Informational asymmetries, financial structure, and financial intermediation. *Journal of Finance*, 32(2), 371–387.

Mehran, H. & Thakor, A. (2011). Bank capital and value in the cross-section. *Review of Financial Studies*, 24(4), 1019–1067.

Merton, R. C. (1977). An analytic derivation of the cost of deposit insurance and loan guarantees: an application of modern option pricing theory. *Journal of Banking and Finance*, 1(1), 3–11.

Miller, M. H. (1995). Do the M&M propositions apply to banks? *Journal of Banking and Finance*, 19, 483–489.

Modigliani, F. & Miller, M. H. (1958). The cost of capital, corporate finance and the theory of investment. *American Economic Review*, 48, 261–297.

Myers, S. C. & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, 13, 187–221.

Ross, S. A. (1977). The determination of financial structure: the incentive-signaling approach. *The Bell Journal of Economics*, 8(1), 23–40.

Stiroh, K. J & Rumble, A. (2006). The dark side of diversification: the case of US financial holding companies. *Journal of Banking and Finance*, 30, 2131–2161.

Thomas, S. (2002). Firm diversification and asymmetric information: evidence from analysts' forecasts and earnings announcements. *Journal of Financial Economics*, 64, 373–396.