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Bank Capital and Economic Activity

Paul-Olivier Klein

University of Lyon[*]

Rima Turk-Ariss

International Monetary Fund[†]

Abstract

Banks argue that holding higher capital will have adverse implications on their lending activities and thereby on economic growth. Yet, the effect of a stronger capital base on economic growth remains largely unsettled. We argue that better capitalized banks improve financial stability conditions and, in dire times, they are able to sustain credit to the economy thereby containing adverse macroeconomic implications. Using various methods, we test for the presence and strength of a financial stability channel and a bank lending channel by drawing evidence from 47 advanced and developing countries over close to two decades. We find that higher capital ratios improve financial stability and help sustain bank lending, ultimately exerting a positive influence on economic activity. These effects on real GDP growth are economically significant, reaching up to 1¼ percentage points for each percentage point acceleration in capital. Our main results are robust to various sensitivity checks, supporting the conclusion that safer banking systems do not bridle economic activity.

Keywords: Bank capital; Financial stability; Bank lending; Economic growth.

JEL Classification: E44, E51, G21, G28.

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[*] University of Lyon, iaelyon School of Management, Magellan, Lyon, France; paul-olivier.klein@univ-lyon3.fr
At the time of publication, Paul-Olivier has also joined the Central Bank of Ireland. This paper should not be reported as representing the views of the Central Bank of Ireland or the Eurosystem. The views expressed are those of the authors and do not necessarily reflect those of the Central Bank of Ireland or the Eurosystem.
[†] International Monetary Fund; rturk@imf.org. The views expressed are those of the authors and do not necessarily reflect the views of the IMF or IMF policy.

I. Introduction

Banks argue that holding greater capital would impede their ability to support the economy. Pfleiderer (2012) quotes the CEO of Deutsche Bank from 2009 that "More equity might increase the stability of banks. At the same time, however, it would restrict their ability to provide loans to the rest of the economy. This reduces growth and has negative effects for all". The strong aversion to holding more capital was apparent in 2014 when European banks resisted the 3 percent leverage ratio under Basel III and watered down new rules (The Economist, 1/18/2014).Academics also disagree whether raising capital requirements are helpful: Diamond and Rajan (2000) argue that banks are inherently fragile because they are susceptible to runs, whereas Admati, Demarzo, Hellwig, and Pfleiderer (2014) reject the pervasive view that high capital requirements are costly to society.

The link between financial system conditions and economic activity was formalized in the financial accelerator framework (Bernanke et al, 1999). Firms with weak financial positions, including banks, have to pay a higher external financing premium than firms with stronger financial footing (Bernanke, 2007). The global financial crisis supported the presence of a connection between banks' financial strength and their ability to raise market funding at low cost (Gambacorta and Shin, 2018). But how a change in the cost of funding affects uses of funds, such as bank lending, remains debated. Some papers report a positive effect between bank capital and lending (Buch and Prieto, 2014, Carlson et al., 2013; Woo, 2003), whereas others find a negative relationship (Aiyar et al., 2014), at least in the short-run. For instance, Puri, Rocholl, and Steffen (2011) and Campello, Graham, and Harvey (2010) show that negative shocks to bank capital due to declining asset quality led to reductions in bank credit. In addition, what is less investigated is the broader relationship between capital and economic activity, so that little is known about the linkages between bank financial strength and a direct economic outcome such as growth in real gross domestic product (GDP).

This paper aims to contribute to the scant and unsettled literature on the association between bank capital and economic activity. In their analysis of macrofinancial linkages for the United States, Bayoumi and Melander (2008) find that an exogenous fall in the capital-to-assets ratio by one percentage point reduces real GDP by some 1½ percent through its effects on credit availability. In contrast, Gross, Kok, and Zochowski (2016) show that economic activity in the European Union would be at risk to contract if banks were to hold higher capital ratios by shrinking their balance sheets. Somewhere between the two, Noss and Toffano (2016), who examine the relationship between the aggregate capital ratio and a few macro-financial variables during an expansion, report an insignificant impact from higher bank capital on GDP growth in the context of the United Kingdom.

We discuss two channels through which bank capital can affect economic growth, the financial stability channel and the bank lending channel. We first argue that better-capitalized banks give shareholders and managers enough "skin in the game" to manage the bank prudently, reducing ex-ante incentives to take risks (Thakor, 2018). By acting as a buffer against losses, financial stability increases, strengthening resilience to shocks and helping wither recessions, thereby spurring economic growth (Dagher et al, 2016). However, others have argued that holding more capital may also stifle a strong expansion period (Martinez-Miera and Suarez, 2012) or

hold back economic growth relative to countries that experience financial crises (Rancière, Tornell and Westermann, 2008). These opposing views suggest that the net impact of financial stability on economic activity is uncertain.

Second, higher capital could reduce banks' liquidity and transaction services or lead to less efficient contracting resolutions and higher agency costs, thereby curbing credit activity (Diamond and Rajan 2001), with detrimental effects on economic growth. Another view, however, casts doubt on the negative relationship between bank capital and lending. A stronger capital base increases a bank's capacity to expand its balance sheet, allowing it to extend more credit to the economy (Peek and Rosengren, 1997); it also lowers the healthy bank's funding costs which could increase liquidity creation and, in turn, positively affect economic growth. Overall, the combined effect of the financial stability and bank lending channels remains unsettled in the literature, so that the impact of a stronger capital base on economic growth is uncertain.

These two potential channels of transmission have guided our choice of empirical strategy. Our empirical field of analysis covers advanced and developing countries over close to two decades, and our strategy consists of exploiting variations in bank capital, rather than investigating changes in bank capital requirements per se.[3] Nor do we consider asset risk—our measure of bank capital is the simple ratio of equity to total assets. Whereas using required capital would moderate endogeneity concerns, the numerous regulatory changes over the past two decades to calculate risk-weighted assets render cross-country comparisons of capital ratios difficult. We mitigate these concerns by employing various empirical methods and robustness checks. We start by assessing the strength of the financial and lending channels using a panel vector autoregression (PVAR) system, and we complement the analysis using multivariate dynamic methods along with several robustness checks.

We find strong evidence in favour of both the financial stability and bank lending channels. When banks hold more capital, financial stability improves, and this is followed by higher levels of economic growth. Lending also increases when banks expand their capital base, similarly raising real GDP growth. These results are maintained when controlling for the economy's position along the business and financial cycle, using other indicators of economic activity, and considering a battery of robustness tests that challenge our methodological choices.

The rest of the paper is organized as follows. Section II develops the hypotheses. Section III presents the methodology and describes the data. Section IV discussed the main results. Section V provides additional findings. Section VI details number of robustness checks. Last, section VII concludes.

II. Hypotheses Development

[3] We do not examine how banks achieve higher bank capital ratios, such as by raising equity (internally through retained earnings or externally through new issuances) or cutting down lending.

We postulate that bank capital is likely to affect economic growth through two main channels: the financial stability channel and the bank lending channel. We elaborate each in turn below.

Capital requirements have been put forward to ensure bank resilience to economic and financial crises, as bank capital serves as a cushion to absorb unexpected future losses. Having equity capital reflect the riskiness of bank assets was at the root of the development of the Basel capital accords over time, even if the question of how much capital banks should hold to absorb losses from crises remains an open question (Dagher et al, 2016).[4] The primal objective is to insure banks against unforeseen losses and increase their probability of survival in normal and dire times; e.g., in the global financial crisis, banks with higher capital ratios were more likely to survive and gain market share (Berger and Bouwman, 2013). More capital also increases bankruptcy costs borne by bank shareholders, reducing ex-ante misaligned incentives to take risks (Thakor, 2014). As a result, better capitalized banks have more skin-in-the-game to screen loans (Coval and Thakor, 2005) and monitor borrowers (Holmstrom and Tirole, 1997). More broadly, better capitalized banks help reduce systemic risk-taking, thereby enhancing financial stability (Berger, Klapper, and Turk-Ariss, 2009; De Jonghe, 2010; Miles, Yang, and Marcheggiano; 2012; Martinez-Miera and Suarez, 2012; Thakor, 2018). Gauthier, Lehar, and Souissi (2012) show that properly-designed capital requirements can reduce the probability of systemic crises by 25 percent.

Achieving greater financial stability is by itself trivial if one does not care about economic growth (Thakor, 2014), suggesting that absence of financial stability, or financial instability, can engender adverse implications on the economy which number of studies document. Kupiec and Ramirez (2013) find that a bank failure involving one percent of system liabilities leads to a 6.5 percent reduction in GNP growth within three quarters. Atkinson, Luttrell, and Rosenblum (2013) estimate that the total cost of the subprime crisis represents up to 90 percent of one year's output in the US. Cooke and Koch (2014) also show that weakly capitalized banks slowed lending recovery after the 2007-2009 recession, conveying that better capitalized banks are helpful to speed-up the economic recovery.

Yet, both costs and benefits are likely to ensue from a financial crisis, so that their net cost matters (Thakor, 2014). In their analysis of financial crises over the past eight centuries, Reinhart and Rogoff (2014) underscore that strong economic growth follows periods of build-up of stability risks with rising bank leverage and rapid lending, at the expense of financial recessions that spread when the fuelled asset bubbles burst later on. Using a theoretical macroeconomic model where correlated risk-shifting by some banks incentivizes other banks to play it safe, Martinez-Miera and Suarez (2012) show that capital requirements increase stability at the cost of lowering credit and output in calm times. In a similar vein, Rancière, Tornell and Westermann (2008) find that countries with occasional financial crises experience greater economic growth than countries with stable financial systems. However, in a recent extensive review of the literature, Thakor (2018) concludes that the purported trade-off

[4] In a structural model that considers benefits from reducing crisis probability as well as tax benefits of debt, Miles, Yang, and Marcheggiano (2013) estimate the optimal capital requirements at 20 percent of risk weighted assets, or a leverage ratio falling between 7 and 10 percent.

between financial stability and growth is exaggerated, and that achieving both objectives is possible.

Overall, whereas the literature is conclusive on the positive role that high capital exerts on greater financial stability, its impact on economic growth is more uncertain. More stable financial systems avoid the destructive effects of financial crises on economic output, but they also prevent rapid economic growth that generally precedes crises.

Further, bank capital can affect economic output through the lending channel. A vast literature documents the positive impact of credit activity on economic growth (e.g. Cetorelli and Gambera (2001); Claessens and Laeven (2005)), and more broadly as part of the growth-finance nexus (e.g. Beck and Levine, 2004; Levine, 2005; Arcand, Berkes and Panizza, 2015; Benczur, Karagiannis and Kvedaras, 2019). But two competing views elaborated below explain how bank capital can affect lending behavior.

As mentioned in the introduction, one strand of the literature contends that higher capital requirements increase the costs of funds and lower liquidity creation and credit activity (Diamond and Rajan, 2001). In a world where the Modigliani-Miller theorem does not hold, a capital structure that is in favor of more equity can raise the cost of capital, increasing lending spreads (Basel Committee for Banking Supervision (BCBS, 2010); Kashyap et al. (2010); Hanson et al. (2011); Slovik and Cornede (2011); Baker and Wurgler (2013)). In turn, higher lending rates make it more expensive for borrowers to take on new loans, thereby reducing credit demand (Thakor and Furlong, 1995), though the effect on economic activity are hard to determine considering that borrowers may seek funding from other sources. Alternatively, loan risk may rise when lending rates increase due to adverse selection of lower-quality borrowers who are willing to pay higher spreads (Stiglitz and Weiss, 1981).

However, establishing a causal relationship between bank capital and lending is tough, due to difficulty in separating demand and supply effects. Peek and Rosengren (1997) disentangle these channels, finding that credit supply falls when bank capital levels decline. Bernanke (2007) argues that healthier banks (those with stronger capital buffers) are able to pay a lower external finance premium when raising funds compared with banks with weaker capital positions, which lowers their funding costs and could increase lending activity. Number of studies find that stronger capital positions ensure that credit provision remains stable and robust to economic downturns (Bernanke and Lown (1991); Woo (2003); Buch and Prieto (2014); Albertazzi and Marchetti (2010); Kapan and Miniou (2013)). Consistent with this second view, Berger and Bouwman (2009) find that better capitalized bank create more liquidity, lend more, and have a higher value, while also improving loan quality of their portfolios. Carlson et al (2013) document that banks with higher capital ratios had smaller contractions in lending during the crisis. Similar results for the period following the crisis are presented by Gambacorta and Shin (2018), and Donaldson, Piacentino, and Thakor (2018) likewise show theoretically that higher bank capital leads to more liquidity creation.

Somewhat conciliating the two competing views about the effect of bank capital on lending activity, Noss and Toffano (2016) factor in the role of the economic cycle and find that high capital ratios increase the cost of funding and reduce lending in an expansion period only, as

investors may perceive such increases as being unnecessary. More broadly, the relationship between bank capital and economic growth is complex, as highlighted in the survey by Martynova (2015) that focuses on the indirect effects of bank capital on lending, the cost of equity, and financial stability. Greater financial stability that comes from stronger capital buffers limits the ravages of financial crises, but that also slows down expansions by smoothing the economic cycle. Thus, the state of the economy is key in examining the relationship between bank capital ratio and economic growth.

Three papers have examined this research question empirically using different methodologies. Bayoumi and Melander (2008) investigate the effects of a negative shock to bank capital on the macroeconomy by tracing linkages between lending standards, credit availability, private spending, and income, taking into account feedback mechanisms. Recently, the link between bank capital and economic growth was analyzed more directly using a VAR approach based on strong identifying restrictions on model parameters. Gross, Kok, and Zochowski (2016) carry out simulations for the European Union based on assumptions about how banks will react to an increase in capital requirements. Noss and Toffano (2016) also use a VAR-based approach to identify shocks to capital consistent with a change in regulatory requirements. They restrict the direction of the response on a number of macroeconomic variables, including lending, bank equity prices, and market funding.

In this paper, we explore variations in bank capital ratios across countries and time to identify the impact of different levels of capital on economic activity. In our examination of the "bank capital-economic growth" nexus, we expect bank capital to exert a positive impact on economic growth through enhancing financial stability and stimulating credit activity.

III. Data and Methodology

3.1. Data

We retrieve annual data at the country level on our main dependent variable, real GDP growth, from the IMF's World Economic Outlook (WEO). We also incorporate in our sample variables on bank capital, financial stability, bank credit, and economic and financial conditions. Since our dependent variable, economic activity, is measured at the country-level, we relate it to aggregated independent variables rather than to bank-level variables.[5]

Our measure of bank capital is from the Global Financial Development Database (GFDD), calculated at an annual frequency.[6] It is the ratio of bank capital and reserves to total assets. Reserves encompass retained earnings, general and special reserves, provisions, and valuation adjustments. Capital includes tier 1 capital (paid-up shares and common stock) and specified types of subordinated debt. Total assets include all nonfinancial and financial assets. Our main measure of bank capital is not the concept of capital adequacy used in bank regulation.

[5] As detailed in Hofmann (2004), relating a macro-level dependent variable to micro-level independent variables requires aggregating the micro-level at the macro-level (that is, at the same level of analysis).
[6] We attempted to use monthly and quarterly data from Fitch database but ended up with only three countries in our sample offering enough data points to perform the analysis.

Regulatory measures of capital are difficult to compare across time and countries, as regulatory reforms brought significant changes to the definitions of both the numerator and the denominator of the capital adequacy ratio over the past two decades of our sample period. In contrast, our simple measure of the capital ratio should be broadly comparable across time and countries. Total assets in the denominator are not risk-adjusted, sidestepping comparability concerns in capital ratios that derive from the application of supervisory discretion in the approval of methods to calculate risk-weighted assets, and which inevitably leads to differences in risk weights used for similar exposures across banks, countries, and time. Further, movements in the simple capital ratio may be more meaningful than changes in regulatory measures of capital adequacy, as internal risk models may generate low measured risk during booms and high measured risk during busts. By being less sensitive to economic and financial cycles, variations in a simpler bank capital ratio as defined by the GFDD may better capture how changes to bank capital buffers affect economic activity over time. Based on data availability, our final sample encompasses 47 countries from 1998 to 2015. Appendix A lists the countries included in our analysis.

To assess the financial stability channel, we use the Financial Stress Index (*FSI*) by Balakrishnan et al. (2011). This index overcomes some limitations associated with other measures of financial stability, which are subject to accounting rules (e.g. NPL ratio), backward-looking (e.g. Z-score), disregard market conditions, or do not integrate the macroeconomic environment (Cihák et al., 2012). The FSI defines financial stress as a period when the financial system of a country is under strain and its ability to intermediate is impaired. The *FSI* primarily relies on price movements relative to past levels or trends of proxies of the presence of strains in financial markets and on intermediation. It captures the stress on three financial markets segments (banking, securities, and exchange markets), measured by their divergence from the underlying trend calculated in standard deviation units. A value of zero for the *FSI* reflects absence of financial strains and a value of one means that there is a one standard deviation unit from the average conditions in the underlying proxies, so that lower values of the *FSI* indicate greater financial stability. Balakrishnan et al. (2011) show that a value superior to one is associated with a higher probability of a crisis. The FSI has notably been used in Proaño, Schoder, and Semmler (2014).

To assess the strength of the credit channel, we use growth in private credit by deposit money banks (*Bank Credit Growth*) from the GFDD database. In the system GMM method, we control for different economic factors, all provided by the GFDD database: initial GDP (*Initial GDP*), growth in broad money (*M3 Growth*), *Inflation* (based on variation in the consumer price index), stock market capitalisation to GDP (*Capitalization to GDP*). In additional estimations, we control for cyclical economic conditions using the *Output Gap* (from the IMF) and for the position along the financial cycle using the *Credit Gap* (from the BIS).[7] We do not include them in the main set of estimations because of the absence of consensus in the literature on the construction of these two variables.[8] For robustness, we use employment growth and real GDP

[7] We note that the concept of the financial cycle is broader than what is proxied using credit gaps (Borio, 2014; Strohsal et al., 2019).

[8] In the case of the output gap for instance, Orphanides and van Norden (2005) question the efficiency of the output gap in forecasting the business cycle, while Berger, Morley, and Wong (2020), Jarociński and Lenza (2018)

growth *per capita* as alternative indicators of economic activity; the VIX, the standard deviation of stock returns and the banks' Z-score (higher values indicating greater stability) as alternative measure of financial stability; and growth in private credit as an alternative measure of lending. Table 1 offers descriptive statistics of all variables and Appendix B gives their definition along with their source. Table 2 shows the pairwise correlation across the main variables.

In Figure 1, we draw a scatter plot of capital ratios and economic growth, showing the linear relation between the variables. We observe positive relationships between bank capital and economic growth, suggesting a positive association between bank capital and economic activity. In Figure 1, an increase of one percentage point in the bank capital ratio is associated with additional economic growth of 0.26 percentage point.

3.2. Methodology

We first employ the PVAR methodology to estimate the impact of bank capital ratio on economic growth, and test for the presence of the financial stability and credit channels of economic activity. We follow the approaches of Love and Zicchino (2006), Love and Turk-Ariss (2014), Head, Lloyd-Ellis, and Sun (2014) and Abrigo and Love (2016). VAR methodologies model the relationship between endogenous variables as a function of the lags of the dependant variables and the lags of the other variables. A PVAR additionally incorporates individuals fixed effects, allowing to consider unobserved individual heterogeneity while modelling the relationship among variables of interest.

The PVAR investigating the relationship between bank capital ratios and economic growth takes the following generic form:

$$\boldsymbol{y_{it}} = \boldsymbol{\vartheta A y_{it}} + u_i + \varepsilon_{it} \tag{1}$$

Where *i* denotes the country and *t* the year. $\boldsymbol{y_{it}}$ is a matrix of endogenous variables, $\boldsymbol{A}$ is a vector of lag operators and $\boldsymbol{\vartheta}$ is the vector of the corresponding coefficients. u_i represents the country-level fixed-effect and ε_{it} is the time varying error term. Following the PVAR methodology of Abrigo and Love (2016), we employ the Helmert procedure to remove the forward mean of each individual effect. Parameters in equation 1 are then estimated using a system GMM (Arellano and Bover, 1995). We run a PVAR with four variables: bank capital ratio; financial stress, credit growth; and real GDP growth.

We deal with unit roots in the series used in a conservative manner, requiring the data series to be stationary employing both the Fisher Augmented Dickey-Fuller and the Phillips-Perron tests, both of which are suitable for unbalanced samples. Table 3 reports the results of those tests, where the null hypothesis is that all the series are not stationary and the alternative hypothesis is the absence of a unit-root. Our conservative approach results in using the first

provide Bayesian estimates that turn out to be more reliable than standard measures. As for the credit gap, Giese et al. (2014) and Drehmann and Yetman (2018), among others, point to limitations in its calculation, hindering its applicability to detect phases of the financial cycle.

difference for each of the variables *Capital Ratio*, *Bank Credit Growth*, *M3 Growth*, *Capitalisation to GDP*, and the *Credit Gap*.

To select the numbers of lags employed in the PVAR, we use the model selection criteria (MMSC) developed by Andrews and Lu (2001), that is based on the minimization of three indicators: MMSC-Bayesian information criterion (MBIC), MMSC-Akaike information criterion (MAIC), and MMSC-Hannan and Quinn information criterion (MQIC). We test to up to 4 lags and find that 2 lags minimize the three indicators.

We then estimate the impact of a change in bank capital ratios on other variables by drawing the Impulse-Response Functions (IRFs) based on the PVARs equations. IRFs represent the change in response variables to a one-standard deviation change in the impulse variable. Following previous work using PVAR, we use the Cholesky matrix decomposition to identify orthogonal shocks in the impulse variable.

An essential aspect of this approach is the ordering of variables in equation 1. Variables that first enter this equation exert a contemporaneous and lagged effects on the following variables. As a result, the most exogenous variables should enter the equation first. In contrast, variables that enter equation 1 after another variable cannot affect the previous variable contemporaneously, but only with a lag.

We consider a specific ordering of the variables that rests on theoretical motivation and Granger-causality tests (Table 4). The baseline ordering is as follows: bank capital ratio; financial stress; credit growth; and real GDP growth. To confirm that results are not sensitive to the ordering of variables, we also draw all potential alternative paths and compare them with the ones that were selected as a baseline.

In a second step, we apply a multivariate setting using a System GMM model to examine the relationship between bank capital ratios and economic growth. A system GMM has the advantage of modeling a dynamic growth process, instrumenting endogenous regressors, and being suitable for panels with few time periods and numerous individuals. Compared with the PVAR, it incorporates more control variables and offers coefficients that can be more meaningfully interpreted. We use Blundell and Bond (1998) system-GMM estimator, which extends Arellano and Bond (1991) GMM approach. We also correct the standard-errors using Windmeijer (2005) approach to allow inferences that are robust to serial-correlation and heteroscedasticity within panel data. The system GMM takes the following generic form:

$$y_{i,t} = \alpha_0 + \alpha_1 . y_{i,t-1} + \alpha_2 . Capital\ Ratio_{i,t-1} + \sum_{k=1}^{K} \gamma_k . Controls_{k,i,t-1} + \varepsilon_{i,t} \qquad (2)$$

The dependent variable is real GDP growth, which is modelled as a function of 9 control variables. We first incorporate the *FSI* and *Bank Credit Growth* variables, and then proxy for initial conditions using either the log of initial GDP or the World Bank's income classification. The dummy variable *High Income* takes the value of one for countries classified as high-income and the omitted category represents middle-income countries. We also control for the monetary environment using the growth of M3 and inflation, and for broader financial development using the ratio of stock market capitalization to GDP. Last, we account for

cyclical economic conditions using the output gap and for the position of the country along the financial cycle using the credit-to-GDP gap.

IV. Empirical Findings

This section presents and discusses the results of the PVAR and System GMM estimations.

4.1. PVAR Results

The PVAR method estimates the impact of a change in bank capital ratios on economic activity, proxied by economic growth, while the *FSI* and the credit growth variables are used to assess the presence and strength of the financial stability and the credit channels, respectively.

Table 4 presents Granger causality tests of the PVAR functions. The results indicate that the change in the bank capital ratio Granger causes the change in financial stability (a lower value for the *FSI* indicates greater financial stability in the country) and economic growth. In contrast, the *FSI* and economic growth do not Granger cause changes in capital ratios. This result underscores that changes in capital ratios are the most exogenous among other variables in the PVAR system. It also supports the view that financial stability and economic growth are driven by variations in bank capital ratios rather than the opposite. As for credit growth, both the changes in credit growth and in capital ratios Granger cause each other.

Using the PVAR estimates from the baseline ordering of variables, we plot the corresponding IRFs in Figure 2. We find that an increase in the change in bank capital ratios is associated with a positive effect on economic growth. Changes in the capital ratio by one additional percentage point raise real GDP growth by ½ percentage point (or 0.47) one year later. This effect is both statistically and economically significant, reaching close to a cumulative 1 percentage point (0.96) over 3 years and 1¼ percentage points (1.26) over 6 years.

This total effect can be disentangled into the financial stability and the credit growth channels. An increase of one percentage point in the capital ratio is followed by an increase of around 2 percentage points in credit growth the year after. This finding concurs with studies that show a positive impact of the capital ratio on bank lending (Bernanke and Lown (1991 and 2007); Woo (2003); Buch and Prieto (2014); Albertazzi and Marchetti (2010); Kapan and Miniou (2013); Mehran and Thakor (2011); Gambacorta and Shin (2018)). The effect occurs with a lag of one year, which reflects the time of adjustment for banks to adapt lending portfolios to their capital base. Regarding the financial stability channel, an increase in the capital ratio is associated with a contemporaneous decrease in financial stress. This impact on financial stress remains negative (stated differently, the improvement in financial stability continues) over the following period, confirming the positive and long-lasting impact of higher bank capital ratios on financial stability, which helps avert costly financial crises.

In the first column of Figure 2, we also observe that increases in both bank credit and financial stability are positively associated with economic growth. The IRFs also inform on the respective effect of credit growth and financial stability on one another. An increase in financial stability leads to an increase in credit growth. As for a rise in credit growth, it leads to a

temporary increase in financial stress (lower financial stability) but is followed by a permanent decrease in financial stress (greater financial stability) in the years after.

Overall, improvements in bank capital ratios are associated with a greater financial stability and more bank lending. These two effects tend to reinforce each other and both have a positive impact on economic growth.

Table 5 reports the forward error variance decomposition of the respective PVAR functions for the effect of bank capital ratios on economic growth.[9] Overall, 5.3 percent of the variability of economic growth is explained by the change in capital ratios. Changes in credit growth and the financial stress explain 12.9 percent and 21.7 percent of the variability in economic growth, respectively. Variation in capital ratios explain 5.1 percent of the change in the FSI and 2.4 percent of the change in the credit growth.

4.2. System GMM

We next examine the relationship between bank capital and economic activity in a multivariate setting using a system GMM approach. The system GMM is a useful complementary method to the PVAR to confirm our results, as it allows controlling for additional variables and providing for a more meaningful economic interpretation of the estimated coefficients.

Table 6 reports the system GMM results using economic growth as the explained variable.[10] The first column only considers the role of the change in the bank capital ratio and the lagged value of the GDP growth. An acceleration in the capital ratio by one percentage point is associated with an additional 0.72 percentage point of economic growth in the short-run, and 1.26 percentage points in the long-run. The shot-run effect is slightly higher though roughly similar to the one estimated using the PVAR approach (0.47 percentage point) while the long-run effect is the same as the one after 6 years in the PVAR setting (1.26 percentage point). In columns 2, 3 and 4, we progressively incorporate the financial stability and the bank lending channels to the specification, first separately and then jointly. An increase in financial stress associates with a decrease in economic growth, in line with previous findings on the positive role of financial stability (Creel, Hubert, and Labondance, 2015).

The interpretation of the negative coefficient on the change in bank credit growth merits consideration, as one should not read it as a negative association between bank credit growth and economic growth. Recall that, to accommodate unit roots conservatively in our panel, we use the difference in bank lending growth as explanatory variable, so that an increase in the variation of credit growth (or acceleration in credit growth) leads to a decrease in economic growth. This result is in line with the vast literature on the detrimental impact of excessive bank lending or credit boons on growth. Among others, Jordà, Schularick, and Taylor (2011),

[9] It is worth noting that this decomposition measures the explanatory power of each variable in the model. This is not similar to the coefficients reported in the IRFs, which measure the magnitude of the effect.

[10] The conventional tests of overspecification and serial correlation that are usually run with a GMM model indicate that the system is well-specified (see Table 6).

Aikman, Haldane, and Nelson (2014), and Alessi and Detken, (2018) document that an acceleration in credit contributes to the build-up of financial imbalances and is a good predictor of crises, eventually leading to sever output losses. This finding is also in line with a non-linear effect of bank lending on economic growth (Arcand, Berkes, and Panizza, 2015). When including the two different channels in column (3), the correlation between capital ratios and economic growth remains positive, with a coefficient of similar magnitude.

Next, columns 5 and 6 add several control variables to account for different aspects of the economic environment. In column 5, we control for the change in the growth of broad money, inflation, and the change in the stock market capitalisation. Several studies have considered the impact of these variables on economic growth, which are also likely to alter or mitigate the effect of bank capital ratios on economic growth. We obtain consistent results. A change in bank capital ratios correlates positively and significantly with economic growth. In these specifications, the coefficient on bank capital is close to the one estimated using the PVAR approach, with an increase of one percentage point in the change in capital ratios associated with higher economic growth by 0.59 percentage point.

In column 6, we further control for the business and financial cycles using the Output Gap and the Credit Gap, respectively.[11] We run a separate estimation with these two variables (rather than including them in all models) due to data availability because 9 countries drop out from our sample. We use the contemporaneous value of the Credit Gap, as considering the lag value results in a significant AR(2) process. The results are consistent with other models. The impact of a change in the bank capital ratio remains positive and significant, with an effect estimated at 0.63 percentage point.

A positive output gap associates with lower economic growth in the subsequent year. When the economy is overheating (experiencing slack), activity is likely to slow down (accelerate) the following year, in line with the evolution of business cycles. With respect to Credit Gap, its coefficient is insignificant, though this does not imply no role for the position along the financial cycle. Indeed, credit cycles are already controlled for in our specifications using the growth in bank lending, as in Aikman, Haldane, and Nelson (2014), which can explain the absence of significance of the Credit Gap variable.

V. Extensions

In this section, we present the results of four additional tests. First, we employ the risk-weighted capital ratio as dependant variable. Next, we explore the role of economic development in our sample,which we divide by income groups. We then investigate whether the relationship is altered in the presence of crises. Last, we explore a potential non-linear impact of bank capital on economic growth and evaluate the effect beyond the minimum capital ratio ("leverage ratio") put in place in Basel III.

5.1. Regulatory Capital Ratio

[11] We do not control for the level of credit-to-GDP because this variable has a unit root.

The regulatory capital ratio is an alternative measure of leverage compared with the simple or non-risk-weighted capital-to-assets ratio that we used in the previous analysis (also referred to as leverage ratio in Basel III). We prefer the non-risk weighted capital-to-assets ratio for two main reasons. First, employing risk-weighted-assets pose a problem of comparability issues in the time-series and in the cross-section, that is, across banks, countries, and time. Second, there is a large literature emphasising the limited informativeness of the regulatory capital ratio. For instance, Demirguc-Kunt et al. (2013) find that the non-risk-weighted capital ratio (the leverage ratio) better reflects the volatility of stock returns. Acharya et al. (2014) show that the use of risk-weighted-assets bias banks' risks measurement during stress tests scenarios. Beltratti and Paladino (2016) show that the build-up of risk before 2008 is not visible in the risk-weighted capital ratio. More globally, Dowd (2015), among others, show that the patterns of the risk-weighted and non-risk-weighted capital ratio follow *opposite trends*, – probably due to banks "gaming" strategies (see for instance Behn et al., 2021). In our sample, the two proxies of bank capital—the simple capital ratio and the regulatory capital ratio— indeed exhibit different descriptive statistics (see Table 1): the former ranges from 2.4 to 15 percent whereas the latter ranges from 2.4 to 31 percent. Also, while these two variables are statistically positively correlated, their correlation coefficient is not larger than 0.5.

In this section, and due to the differences between risk-weighted and non-risk-weighted capital ratios, we are interested to see if our results hold with the regulatory capital ratio. We re-estimate the PVAR in equation (1) and reproduce a new set of IRFs in Figure 3 (similar to those in Figure 2 when using the simple bank capital ratio, with the same ordering of variables). We find that the cumulative positive effect of an increase in the change in regulatory bank capital on economic growth is stronger than before: after 6 years, it reaches 1.5 point of GDP growth, though the IRF exhibits a slightly different path. Initially, there is a negative but short-lived negative reaction of real GDP growth to one additional percentage point increase in the change in regulatory capital; real GDP growth increases one year later by 0.4 percentage point, reaching close to a cumulative 1.2 percentage point over 3 years and 1.5 percentage points over 6 years. Further, unlike the baseline results, improvements in regulatory bank capital have a short-lived negative impact on bank lending that quickly dissipates to turn positive instead. The positive impact of regulatory capital on financial stability is also maintained, though its full effect is felt only one year later (unlike the immediate impact of the simple bank capital ratio), probably because markets put less faith in regulatory measures of capital.

The Panel VAR approaches suggests a similar effect of regulatory capital ratio on economic growth, compared with non-risk-weighted capital ratio. We complete this analysis with a FEVD of the IRF, a Granger Causality test and a System GMM; table 7 reports the results. The FEVD of the impact of the regulatory capital ratio shows a similar pattern as the non-risk-weighted capital ratio: changes in risk-weighted capital ratio explains 8.2% of the forward error variance of real GDP growth. However, the Granger causality test depicts a different picture. Variations in risk-weighted capital ratio do not significantly Granger-cause real GDP growth. This suggests the absence of a direct causality. The system GMM results reinforces this view. While changes in the risk-weighted capital ratio exerts a positive and significant impact on economic growth in the first four models, adding macroeconomic covariates lead to an unsignificant coefficient, suggesting that these variables capture the effect of the regulatory capital ratio on GDP growth.

Taken together, these results elicit two comments. First, the risk-weighted capital ratio has a similar positive impact on economic growth, as identified through the panel VAR approach. Hence, our main message holds for regulatory capital ratio: increasing the risk-weighted capital ratio benefits to economic activity. Second, we also show that, contrary to the non-risk-weighted capital ratio, this is not necessarily a causal link. The absence of a significant Granger causality and an unsignificant coefficient in the system GMM regression with additional macroeconomic controls suggest on the opposite that the risk-weighted capital ratio might capture, but not cause, changes in GDP growth. These results are in line with the limited informativeness of the risk-weighted capital ratio, as documented in the literature.

5.2. Impact by Income Groups

We investigate whether our findings differ for countries with various levels of economic development. Recent studies have demonstrated that institutional and economic development matter for the impact of finance on economic growth (*e.g.*, Arcand, Berkes and Panizza, 2015). In table 8, we subdivide the sample between high-income and middle-income countries, using the World Bank classification and re-estimate the main system GMM for each subgroup. We find that the strong positive relationship between changes to bank capital ratios and economic growth is sustained across income levels, though the magnitude of the estimated coefficient is slightly larger for high-income countries.

5.3. Crisis periods

We use the Word Bank's identification of banking crises to divide our sample in two subsamples—crisis and non-crisis periods—and re-estimate the system GMM. The results presented in Table 9 point to a new finding. The positive coefficient on changes in bank capital loses significance in the non-crisis sample, whereas it is larger in magnitude compared with the previous results. This finding suggests that the role of bank capital in strengthening the resilience of banks is more important in crisis than in normal times.[12] One explanation could be that the positive signalling role of bank capital about the financial health of banks is more important when investors and markets in general are nervous because of a banking crisis.

5.4. Thresholds and Non-Linear Impacts

Whereas holding more equity capital increases bank resilience to shocks, excessive capital build-up could undermine growth. We test for a non-linear relationship between changes to bank capital ratios and economic growth. For a parametric estimation of a threshold of bank capital, we incorporate a quadratic term of changes in the capital ratio into the baseline estimation. The associated parameter estimate shown in the first column in Table 10 is found to be insignificant. The absence of such association between changes in bank capital and economic growth in our sample is also confirmed by the results of the Lind and Melhum (2010) test that formally assesses the presence or the absence of a U-shaped relationship (with a p-

[12] This result might suggest the existence of an underlying parameter instability that might affect the previous Granger causality test (see Ross, 2005). To consider this possibility, we compute Ross's (2005) robust statistics and still find that changes in capital significantly impact GDP growth using the ExpW∗ (the exponential Wald test), MeanW∗ (the mean Wald test), and QLR∗ (the Quandt likelihood-ratio test). The p-value of the Nyblom∗ (the Nyblom test) is equal to 0.13.

value of 0.257 and t-value of 0.65). This finding is not evidence against a threshold beyond which bank capital is detrimental to growth, because our specification looks at the accumulation in bank capital rather than capital levels per se.

Yet, capital build-up from initially very low or very high levels may correlate differently with on economic growth. To detect potential non-linearities in this relationship, we divide the sample into three groups based on the level of the capital ratio for each country-year observation: less than 8%, between 8% and 13%, and above 13%. The results are reported in the last three columns of Table 10. The key finding is that the significance of the positive coefficient on the capital ratio does not vary across all three subsamples. It appears that, in our sample, there is no threshold above which greater capital accumulation becomes detrimental to economic activity. To the contrary, the coefficient on the change in bank capital increases at higher levels of bank capital, suggesting that the association with real GDP growth becomes stronger for better capitalized banks.

We observe that the coefficient on the financial stress index (FSI) decreases in economic and statistical significance and turns insignificant at higher thresholds of bank capital. This suggests that the financial channels matters less for economic growth as the level of bank capital increases. When banks are highly capitalised, they can more easily absorb shocks and the economy become more resilient to shocks stemming from financial instability. In parallel, acceleration in bank credit growth has no significant effect on economic growth at low levels of bank capital; the effect is negative for banks with capital ratios lying between 8 and 13 percent, and positive beyond that. These results suggest that, when banks are highly capitalized, the economy becomes more responsive to increases in lending activity. All in all, a surge in bank capital contributes to a more resilient economic activity via both the lending and the stability channel.

5.5. Excess Capital

Banks can hold excess capital that is above the required level of capital, revealing information about the level of risk aversion by managers. As Basel III introduced a minimum of 3% of capital relative to total asset (the “leverage ratio”),wWe are interested to see if capital ratios that are higher than this requirement are beneficial to economic activity – or instead if the benefits are mostly reaped from levels of capital below the regulatory requirement. Finding economic benefits beyond the 3% leverage ratio would, for instance, promote arguments in favor of an increase in the minimum capital requirements.

To assess this point, we adopt a spline regression approach. A spline regression is a semi-parametric technic that provides different estimates of the slope of the linear relationship between two variables for different intervals of the independent variable. It has notably been used by Morck et al. (1988) Davies et al. (2005) and Klein and Weill (2017), among others.

Specifically, we define two variables, *Insufficient Capital* and *Excess Capital* as follow:

$$Insufficient\ Capital\ = \begin{cases} Capital\ Ratio \text{ if } Capital\ Ratio < 3\% \\ 3\% \text{ if } Management\ Stake \geq 3\% \end{cases}$$

$$Excess\ Capital\ = \begin{cases} 0 \text{ if } Capital\ Ratio < 3\% \\ Capital\ Ratio - 3\% \text{ if } Capital\ Ratio > 3\% \end{cases}$$

We perform a System-GMM regression, employing *Real GDP Growth* as the dependent variable and the lag and first difference of *Insufficient Capital* and *Excess Capital* as main independent variables. The coefficient on *Insufficient Capital* informs on the relationship between real GDP growth and capital ratio from 0% to 3%, and the coefficient on *Excess Capital* informs on the relationship above 3%. We employ the same set of control variables as in the main model. Results are reported in column 5 of table 10. The coefficient on *Insufficient Capital* is non-significant, whereas the coefficient on *Excess Capital* is positive and significant. This suggests that the economic benefits associated with higher capital ratios start after the minimum requirement of 3%. Combined with the thresholds and non-linearity result, it strongly suggests that the higher the capital ratio the more benefits accrue for economic activity. This finding reinforces the case for higher minimum requirements than the current 3% leverage rule, as part of macroprudential policy regulation.

VI. Robustness Checks

In this section, we first check the sensitiveness of the results to a different ordering of the variables in the PVAR method. We also offer alternative variables to measure economic activity, financial stability, and credit growth in both the PVAR and the System-GMM approach.

6.1. Alternative IRFs Order

We assess the sensitivity of the results to the ordering of the variables in the PVAR by drawing IRFs for all the possible paths. For brevity, we show in Figure 4 only the IRFs of an impulse in bank capital ratios and the associated change in economic growth, using various orderings of the variables. Consistent with previous findings, we observe a positive association between a change in bank capital ratios and economic growth, and of similar magnitude. The ordering of the variables does affect the timing of these reactions, with the effect occurring only one year or two years later, depending on the different assumed paths. This shows that, while the order does matter in defining the interactions between the variables—which justifies the need to test for alternative paths—it does not affect our finding on the overall effect of bank capital on economic activity, confirming the robustness of our result.

6.2. Alternative PVAR variables

For robustness, we replace economic growth with employment growth in the PVAR as an alternative measure of economic activity and plot the corresponding IRFs in Figure 5. We observe that an increase in the capital ratio by one percentage point is associated with a gradual improvement in employment growth, which is higher by 0.4 percentage point two years after the initial shock. This effect is more progressive than the one in Figure 2. Over three years, it reaches 0.45 percentage points, and over 6 years it increases to 0.5 percentage points. Its magnitude is also less than halved and, as shown in Figure 4, it is principally channelled through greater financial stability. The immediate positive impact of higher capital ratios on

reducing financial stress persists one year after the shock. But the acceleration in capital ratios displays in Figure 4 a more erratic effect on changes in credit growth, which rise immediately to spike two years later, followed by a trend reversal, turning negative before progressively converging to zero.

In Figure 5, acceleration in credit growth associates with greater employment growth, in line with Haltenhof, Lee, and Stebunovs (2014) who establish a causal link between an increase in credit supply and lower unemployment. Lower financial stress likewise correlates with higher employment growth. Also, an increase in credit growth is associated with an increase in financial stress and, conversely, an increase in financial stress is associated with a decrease in credit growth. Overall, we observe that an increase in capital ratios is associated with a greater employment growth, confirming our main results.

Next, we employ the *Real GDP Growth Per Capita*, as an alternative measure of economic activity (instead of the *Real GDP Growth*), that takes into account population growth. We report the IRF in (a) of Figure 6. We only display the impulse in capital ratio and the response in real GDP growth per capita. The results are similar to the ones using *Real GDP Growth*, with a positive effect reaching 1.13 percentage points after 6 years.

Last, we also check the sensitivity of the results to using other variables to assess the strength of the financial stability and lending transmission channels. We use three alternative variables to FSI: the VIX, following the large literature relating VIX to financial stability (e.g., Friedrich and Guérin, 2020; Miranda-Agrippono and Rey, 2020); the standard deviation of yearly stock returns (Laeven and Levin, 2009); and the country-level bank Z-score (Berger, Klapper, and Turk-Ariss, 2009; Fink et al., 2009; Uhde and Heimeshoff, 2009; Creel, Hubert and Labondance, 2015). We do not use these variables as main measures of financial instability for the following reasons: the VIX is not a country-specific measure of risk, limiting its effect for peripherical countries and reducing the PVAR efficiency; the standard deviation of stock returns is only one factor of financial instability (e.g., Illing and Liu, 2006); the bank Z-score is backward looking and affected by differences in accounting standards. Still, these variables offer useful robustness checks. The IRF (b), (c), and (d) in Figure 6 reports the results for an impulse in capital ratio and a response in real GDP growth. In all cases, an increase in capital ratio leads to a significant increase in real GDP growth. After 6 years, the increase in real GDP growth in percentage points are: 1.83pp (b – VIX); 2.27pp (c- SD Stock Returns); 0.757pp (d – Z-Score).

We use one alternative variable to identify the lending channel and replace Bank Credit Growth with Private Credit Growth, which is a larger measure of credit growth, that integrates other financial institutions than banks. It is scaled by GDP. Figure 6 (e) shows the corresponding IRF of the impulse in capital ratio and the response in real GDP growth. Here again, the results are consistent with previous findings, further confirming the positive impact of capital ratios on economic activity. The effect after 6 years reaches 1.22pp increase in real GDP growth.

6.3. Alternative System-GMM Variables

We next turn to robustness tests of the System-GMM approach. Table 11 displays the estimation results. In the first column, we report the estimation results of replacing economic growth with employment growth. As in the PVAR, the change in the capital ratio correlates positively with employment growth. A one-point increase in the capital ratio change is associated with an increase of 02 percentage point in employment growth, confirming the positive correlation between bank capital and economic activity. This positive and significant sign is maintained when adding in column 2 proxies of the economic and financial cycle, *Output Gap* and *Credit Gap*.

Additional sensitivity checks consist of using other variables for the dependent variable and for the financial and lending channels alternatively. Again, we employ the real GDP per capita as an alternative dependent variable; the VIX, yearly standard deviation of stock returns, and banking sector Z-score as alternative financial stability variables; and private credit growth to GDP as an alternative lending measure. As reported in columns 3 to 7 of Table 11, the effect of bank capital ratios on economic activity is similar and consistent with previous results.

6.4. Alternative Models

Additionally, we address the concern that system GMM results could be driven by a large number of instruments considered in the estimation (Moral-Benito, 2013). We re-run our baseline estimations using Dynamic OLS, Feasible Modified OLS, and panel fixed effects, and present the results in Table 12. We find that all our main results are broadly maintained, except that the role of the change in credit growth is weaker in the Dynamic OLS estimations.

As final robustness check, we challenge the use of a PVAR model by employing the local projection approach. The local projection allows to model shocks that dynamically affect macroeconomic variables through identified transmission channels. While its rationale is similar to that of the PVAR approach (Plagborg-Møller and Wolf, 2019), it specifically accommodates non-linear or state dependent patterns. Local projections represent the impact of a shock in one variable on another variable, *conditional* on the channel through which the shock occurs. We follow the approach of Jorda (2005), that has now been largely employed in the economic literature (e.g. Acemoglu, et al., 2019; Ebeke and Siminitz, 2018; Jorda, Schularick and Taylor, 2013). We model a shock in the capital ratio, which works through the two main channels of financial stability and credit growth, to affect economic activity. We use the same main variables (Capital Ratio, FSI, Credit Growth, and Real GDP Growth), a standard OLS with panel fixed-effects at the country-level, two lags, and a projection horizon of 6 years. Figure 7 illustrates the resulting local projections. The first figure reports the impact of a shock in capital ratio on economic growth, through its impact on FSI and credit growth. The two next pictures detail each channel: the impact of the shock on credit growth and financial stability, respectively. The results indicate that our previous findings are maintained: an increase in bank capital raises economic growth, including by reducing financial stress and improving credit in the long-run.

VII. Conclusions

We assess the relationship between bank capital ratios and economic activity, considering the presence of two channels: the financial stability and the bank lending channel. We use both a PVAR and a system GMM, carefully choosing the way that the variables enter the estimations and requiring them to be stationary under 2 tests. Our results that are drawn from 47 countries over close to 2 decades indicate that higher capital ratios improve financial stability and lending activity. An increase in bank capital ratios ultimately exerts a positive influence on economic activity (proxied using both growth in real GDP and growth in employment). In particular, higher changes in bank capital ratios by one percentage point gradually lift real GDP growth, which improves by ½, 1, and 1¼ percentage points, respectively, after one, 3, and 6 years. Such effect of magnitude greater than one-for-one over time is economically significant.

Our results are in line with the extensive evidence compiled by Thakor (2018) that, among others, better capitalized banks increase lending more (reduce it less during crises) than less capitalized banks, are safer (less likely to fail), and create less systemic risk. The positive association between bank capital and economic growth also supports the view that the steady-state costs of higher capital requirements are low while the benefits can be substantial (BCBS, 2010).[13]

Our findings are relevant to policymakers as they seek to ensure that banks build up enough capital buffers to withstand future shocks, without undermining economic activity. While the benefits of higher capital are widely understood, a key concern from the Basel III regulation was that raising capital requirements might damage economic growth. The issue was so intensely debated that the global post-crisis Basel III capital reform package was finalized only in December 2017, seven years after it was first introduced. What this paper shows is that, when banks hold higher levels of equity capital, economic activity is not stifled. To the contrary, we find strong evidence in favour of higher levels of economic growth as well as employment growth when banking systems are better capitalized.

[13] Other benefits not explored in this paper pertain to shareholder returns (Thakor, 2018). Banks that hold more capital earn higher risk-adjusted returns during bad times than banks with lower capital ratios, while earning similar returns during other times (Bouwman, Kim, and Shin (2018)).

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Table 1 - Descriptive Statistics

This table provides descriptive statistics for the variables in the study. Appendix A lists country coverage and Appendix B provides the definitions of variables.

	N	Mean	Median	Std. dev.	Minimum	Maximum
Real GDP Growth	706	2.9	2.9	3.3	-9.1	14.2
Capital Ratio	706	7.6	7.1	2.6	2.4	15.0
FSI	706	-0.08	-0.45	2.18	-6.89	10.75
Bank Credit Growth	702	9.1	8.3	15.6	-42.1	85.1
Initial GDP (log)	706	1308.8	1299.7	80.0	1179.3	1512.8
M3 Growth	700	8.5	8.2	12.8	-34.7	51.2
Inflation	706	3.8	2.7	5.7	-15.8	69.7
Capitalization to GDP	681	66.8	54.6	48.8	4.9	265.1
Output Gap	682	-0.1	-0.1	2.7	-23.1	13.4
Credit Gap	586	2.7	3.4	14.8	-48.6	82.8
Capital/RWA	706	14.0	13.5	2.9	2.5	30.9
Banking Crisis	539	0.17	0	0.38	0	1
Employment Growth	687	1.2	1.2	2.2	-8.9	17.7
Real GDP Growth per Capita	706	2.12	1.99	3.15	-9.70	13.61
VIX	706	20.94	21.98	6.24	12.81	32.69
SD Stock returns	706	0.84	0.77	0.39	0.01	2.89
Z-Score	703	11.8	10.5	6.4	-0.9	42.1
Private Credit Growth	702	9.2	8.1	15.6	-41.8	85.1

Table 2 – Pairwise Correlation Matrix

The table below displays the pairwise correlation between the main variables. The significance level at 0.10, 0.05 and 0.01 is indicated by *, ** and *** respectively.

	Real GDP Growth	Employment Growth	Capital Ratio	FSI	Bank Credit Growth	Initial GDP (log)	M3 Growth	Inflation	Capitalization to GDP	Output Gap	Credit Gap
Real GDP Growth	1.00										
Employment Growth	0.50***	1.00									
Capital Ratio	0.20***	0.15***	1.00								
FSI	-0.27***	-0.04	-0.07*	1.00							
Bank Credit Growth	0.46***	0.22***	0.09**	-0.16***	1.00						
Initial GDP (log)	-0.08**	-0.17***	-0.02	-0.01	0.01	1.00					
M3 Growth	0.47***	0.23***	0.04	-0.16***	0.84***	0.02	1.00				
Inflation	0.11***	0.09**	0.21***	0.11***	0.06	0.01	0.07*	1.00			
Capitalization to GDP	0.06*	0.23***	-0.22***	-0.06	0.01	0.01	0.04	-0.18***	1.00		
Output Gap	0.28***	0.22***	0.04	0.12***	0.44***	0.01	0.33***	0.08**	0.08**	1.00	
Credit Gap	-0.17***	-0.14***	-0.08*	0.13***	0.14***	-0.05	0.06	0.02	-0.11**	0.19***	1.00

Table 3 – Unit Root Tests

The table below display the Dickey-Fuller and the Philips-Perron unit-root test on the variables used in the estimation. The null hypothesis is the presence of a unit root. The significance level at 0.10, 0.05 and 0.01 is indicated by *, ** and *** respectively.

	Dickey-Fuller	Philips-Perron
Real GDP Growth	-11.87***	-5.16***
ΔReal GDP Growth	-29.79***	-9.33***
Capital Ratio	0.15	1.64
ΔCapital Ratio	-19.9***	-1.68*
FSI	-8.39***	-2.01**
ΔFSI	-21.2***	-5.55***
Bank Credit Growth	-8.19***	1.99
ΔBank Credit Growth	-25.68***	-7.16***
M3 Growth	-9.93***	-0.45
ΔM3 Growth	-25.88***	-8.9***
Inflation	-10.4***	-3.02***
ΔInflation	-28.12***	-8.52***
Capitalization to GDP	-4.05***	-0.4
ΔCapitalization to GDP	-15.28***	-3.33***
Output Gap	-8.61***	-6.53***
ΔOutput Gap	-18.66***	-8.41***
Credit Gap	3.59	2.45
ΔCredit Gap	-7.11***	-4.64***
Employment Growth	-11.87***	-5.15***
ΔEmployment Growth	-26.82***	-10.56***
Z-Score	-5.19***	0.33
ΔZ-Score	-23.7***	-6.81***
Private Credit Growth	-7.82***	2.86
ΔPrivate Credit Growth	-26.66***	-6.46***

Table 4 – Real GDP Growth, Granger Causality Tests

The table below displays the Granger causality test of the main panel VAR estimation. The significance level at 0.10, 0.05 and 0.01 is indicated by *, ** and *** respectively.

	Chi2	D.f.	P-value
ΔCapital Ratio			
FSI	4.24	2	0.12
ΔBank Credit Growth	11.64***	2	0.003
Real GDP Growth	2.67	2	0.263
All	61.32***	6	0
FSI			
ΔCapital Ratio	10.49***	2	0.005
ΔBank Credit Growth	21.41***	2	0
Real GDP Growth	8.017**	2	0.018
All	95.62***	6	0
ΔBank Credit Growth			
ΔCapital Ratio	9.57***	2	0.008
FSI	72.34***	2	0
Real GDP Growth	40.23***	2	0
All	126.74***	6	0
Real GDP Growth			
ΔCapital Ratio	6.15**	2	0.046
FSI	111.76***	2	0
ΔBank Credit Growth	13.80***	2	0.001
All	142.53***	6	0

Table 5 – Forward Error Variance Decomposition

The table below displays the FEVD of the main IRF path.

	Real GDP Growth	FSI	ΔBank Credit Growth	ΔCapital Ratio
Real GDP Growth	0.602	0.217	0.129	0.053
FSI	0.004	0.924	0.02	0.051
ΔBank Credit Growth	0.109	0.116	0.75	0.024
ΔCapital Ratio	0.003	0.025	0.033	0.94

Table 6 – Real GDP Growth, System GMM

System-GMM regressions. The dependent variable is real GDP growth. The t-statistic based on Windmeijer (2005) correction of variance is reported in parentheses.*, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Real GDP Growth$_{t-1}$	0.423***	0.406***	0.507***	0.480***	0.336***	0.631***
	(6.44)	(5.09)	(7.19)	(5.87)	(4.00)	(10.31)
ΔCapital Ratio $_{t-1}$	0.724***	0.654***	0.755***	0.669***	0.593**	0.612***
	(3.98)	(3.95)	(4.38)	(4.36)	(2.24)	(3.11)
FSI$_{t-1}$		-0.297***		-0.339***	-0.213*	-0.235*
		(-4.46)		(-5.71)	(-1.85)	(-1.93)
ΔBank Credit Growth$_{t-1}$			-0.029***	-0.037***	-0.049**	-0.074***
			(-3.23)	(-4.21)	(-2.55)	(-2.91)
High Income					-1.819***	-0.372
					(-4.11)	(-1.03)
Initial GDP (log)					-0.002	-0.001
					(-0.77)	(-0.65)
ΔM3 Growth$_{t-1}$					0.001	0.037
					(0.05)	(1.40)
Inflation$_{t-1}$					-0.039	0.025
					(-0.73)	(0.90)
ΔCapitalization to GDP$_{t-1}$					0.004	-0.005
					(0.28)	(-0.38)
Output Gap $_{t-1}$						-0.578***
						(-4.07)
ΔCredit Gap						0.068
						(1.12)
Constant	1.547***	1.539***	1.288***	1.303***	4.992**	2.124
	(6.52)	(5.68)	(5.42)	(4.85)	(2.05)	(1.31)
N	599	599	595	595	578	486
No. of groups	47	47	47	47	47	38
Chi²	51.89***	273.69***	71.00***	261.01***	219.18***	360.06***
Hansen Statistic	46.80	46.31	43.72	44.15	44.39	36.34
AR 1	-4.43***	-4.45***	-4.53***	-4.47***	-3.66***	-4.24***
AR 2	-0.54	-0.31	-0.19	0.21	-0.36	1.47

Table 7 – Regulatory Capital Ratio

The table below reports results employing the change of Capital/RWA (regulatory capital) instead of Capital/Assets (referred to in Basel III as leverage ratio). Panel A reports the Forward Error Variance Decomposition. Panel B reports the Granger Causality test of Capital/RWA on the other VAR variables. Panel C presents System-GMM regressions. The dependent variable is real GDP growth. The t-statistic based on Windmeijer (2005) correction of variance is reported in parentheses. We do not report the additional controls, that are the same as for the main model. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively.

Panel A: FEVD

	Real GDP Growth	FSI	ΔBank Credit Growth	ΔCapital/RWA
Real GDP Growth	0.559	0.228	0.132	0.082
FSI	0.01	0.92	0.019	0.05
ΔBank Credit Growth	0.134	0.113	0.744	0.009
ΔCapital/RWA	0.008	0.052	0.012	0.928

Panel B: Granger Causality Test

	Chi2	D.f.	P-value
ΔCapital/RWA			
FSI	25.399***	2	0
ΔBank Credit Growth	2.723	2	0.26
Real GDP Growth	1.649	2	0.44
All	45.547***	6	0

Panel C: System GMM regressions.

	(1)	(2)	(3)	(4)	(5)
Real GDP Growth$_{t-1}$	0.417***	0.410***	0.491***	0.482***	0.325***
	(6.04)	(5.39)	(6.72)	(6.12)	(3.48)
ΔCapital/RWA$_{t-1}$	0.243**	0.280**	0.244**	0.271***	0.010
	(1.97)	(2.40)	(2.14)	(2.66)	(0.05)
FSI$_{t-1}$		-0.320***		-0.358***	-0.269***
		(-4.80)		(-5.83)	(-2.89)
Δbank Credit Growth$_{t-1}$			-0.023***	-0.033***	-0.049*
			(-2.81)	(-4.09)	(-1.94)
Controls	No	No	No	No	Yes
Constant	1.540***	1.483***	1.306***	1.261***	5.656**
	(5.74)	(5.28)	(4.97)	(4.64)	(2.29)
N	593	593	589	589	572
No. of groups	47	47	47	47	47
Chi²	36.46***	347.11***	52.87***	332.95***	246.96***
Hansen Statistic	46.17	43.95	46.42	45.09	43.64
AR 1	-4.79***	-4.86***	-4.97***	-4.84***	-4.33***
AR 2	-1.45	-1.08	-1.19	-0.58	-1.07

Table 8 – Subdivision by Income Group

System-GMM regressions. The dependent variable is real GDP growth. We divide the sample based on the income level, following the World Bank classification. The t-statistic based on Windmeijer (2005) correction of variance is reported in parentheses. *, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively.

	(1)	(2)
	High Income	*Middle Income*
Real GDP Growth$_{t-1}$	0.262	0.302**
	(1.24)	(2.05)
ΔCapital Ratio $_{t-1}$	0.858***	0.739***
	(3.39)	(2.61)
FSI$_{t-1}$	-0.338***	-0.378**
	(-3.22)	(-2.18)
ΔBank Credit Growth$_{t-1}$	-0.022	-0.029
	(-0.64)	(-0.92)
Initial GDP (log)	-0.002	-0.002
	(-0.82)	(-0.47)
ΔM3 Growth$_{t-1}$	0.013	0.016
	(0.58)	(0.63)
Inflation$_{t-1}$	-0.008	0.009
	(-0.03)	(0.26)
ΔCapitalization to GDP$_{t-1}$	-0.004	0.030
	(-0.20)	(1.26)
Constant	3.551	5.137
	(1.25)	(0.99)
N	355	223
No. of groups	28	19
Chi²	288.71***	89.94***
Hansen Statistic	27.35	17.10
AR 1	-3.33***	-3.06***
AR 2	-1.14	1.02

Table 9 – Crisis Periods

System-GMM regressions. The dependent variable is real GDP growth. Banking Crisis is defined using the World Bank definition (see Appendix B). The t-statistic based on Windmeijer (2005) correction of variance is reported in parentheses.*, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively.

	(1)	(2)
	Banking Crisis	*No Banking Crisis*
Real GDP Growth$_{t-1}$	0.145	0.343*
	(0.67)	(1.88)
ΔCapital Ratio $_{t-1}$	0.917***	0.994
	(4.89)	(1.14)
FSI$_{t-1}$	-3.935***	-2.122**
	(-4.13)	(-2.12)
ΔBank Credit Growth$_{t-1}$	-0.000	-0.002
	(-0.02)	(-0.68)
High Income	0.098	0.109
	(1.54)	(1.15)
Initial GDP (log)	-0.029	-0.089
	(-1.19)	(-0.68)
ΔM3 Growth$_{t-1}$	0.107***	0.010
	(4.04)	(0.15)
Inflation$_{t-1}$	-0.031	-0.137
	(-0.27)	(-0.32)
ΔCapitalization to GDP$_{t-1}$	-0.185**	-0.174
	(-2.26)	(-1.52)
Constant	3.978	5.515*
	(0.90)	(1.72)
N	78	351
No. of groups	22	45
Chi²	286.27	150.13
Hansen Statistic	16.26	37.12
AR 1	-1.91*	-2.89***
AR 2	-0.13	0.14

Table 10 – Thresholds and Non-Linear Impacts

System-GMM regressions. The dependent variable is real GDP growth. The t-statistic based on Windmeijer (2005) correction of variance is reported in parentheses.*, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
	Quadratic Term	*Capital Ratio<8%*	*Capital Ratio>=8% & <13%*	*Capital Ratio>=13%*	*Spline Regression*
Real GDP Growth$_{t-1}$	0.360**	0.411***	0.257**	0.608***	0.383***
	(2.11)	(3.54)	(2.56)	(2.78)	(5.82)
ΔCapital Ratio $_{t-1}$	0.828*	0.588*	0.736***	1.310***	
	(1.72)	(1.81)	(2.97)	(2.94)	
ΔCapital Ratio^2 $_{t-1}$	0.560				
	(1.03)				
Insufficient Capital					7.569
					(1.42)
Excess Capital					0.802***
					(2.64)
FSI$_{t-1}$	-0.448	-2.147***	-0.920*	0.000	-0.316**
	(-1.14)	(-3.88)	(-1.80)	(.)	(-2.34)
ΔBank Credit Growth$_{t-1}$	0.051	0.001	-0.005**	0.007*	-0.038*
	(0.57)	(0.53)	(-2.03)	(1.72)	(-1.95)
High Income	-3.103**	0.016	0.090*	-0.059**	-1.697***
	(-2.23)	(0.42)	(1.68)	(-2.35)	(-3.99)
Initial GDP (log)	-0.000	-0.022	-0.003	-0.135	-0.002
	(-0.17)	(-0.72)	(-0.04)	(-1.09)	(-0.81)
ΔM3 Growth$_{t-1}$	-0.077	0.008	0.017	0.185***	-0.027
	(-0.89)	(0.52)	(0.87)	(3.30)	(-1.15)
Inflation$_{t-1}$	-0.372	-0.102	-0.800***	0.020	-0.039
	(-1.18)	(-0.89)	(-3.00)	(0.07)	(-0.66)
ΔCapitalization to GDP$_{t-1}$	-0.024	-0.056*	-0.106*	0.052**	-0.001
	(-0.74)	(-1.91)	(-1.73)	(2.46)	(-0.09)
Constant	5.310	1.454	8.629***	-6.142	4.789**
	(1.49)	(0.48)	(2.61)	(-1.15)	(2.11)
N	578	348	210	20	578
No. of groups	47	34	31	6	47
Chi²	108***	130.62***	85.14***	104.54***	246.02***
Hansen Statistic	42.72	30.57	21.16	0.00	45.32
AR 1	-2.57***	-3.14***	-3.54***	-1.45	-4.06***
AR 2	0.50	0.08	0.10	0.26	-0.00

Table 11 – Alternative Variables System GMM

System-GMM regressions. The dependent variable is real GDP growth. The t-statistic based on Windmeijer (2005) correction of variance is reported in parentheses.*, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Employment Growth	*Employment Growth*	*Real GDP Growth per Capita*	*Real GDP Growth*	*Real GDP Growth*	*Real GDP Growth*	*Real GDP Growth*	*Real GDP Growth*
Employment Growth$_{t-1}$	0.368***	0.374**						
	(4.84)	(2.12)						
Real GDP Growth$_{t-1}$				0.305***	0.397***	0.282***	0.275***	0.360**
						(3.12)	(2.97)	(2.11)
Real GDP Growth per Capita$_{t-1}$			0.307***					
			(3.40)					
ΔCapital Ratio $_{t-1}$	0.172**	0.174***	0.593**	0.946***	1.015***	0.624*	0.779**	0.828*
	(1.99)	(2.62)	(2.19)	(4.57)	(4.84)	(1.79)	(2.51)	(1.72)
ΔCapital Ratio^2 $_{t-1}$								0.560
								(1.03)
FSI$_{t-1}$	-0.211***	-0.204***	-0.240*				-0.234**	-0.448
	(-2.66)	(-3.72)	(-1.96)				(-2.01)	(-1.14)
ΔBank Credit Growth$_{t-1}$	0.023	-0.004	-0.048**	-0.057***	-0.042*	-0.054***		0.051
	(1.05)	(-0.22)	(-2.42)	(-2.77)	(-1.76)	(-2.79)		(0.57)
High Income	-0.600***	-0.392*	-1.559***	-1.922***	-1.887***	-2.072***	-1.904***	-3.103**
	(-2.71)	(-1.73)	(-3.66)	(-4.19)	(-4.13)	(-4.50)	(-4.21)	(-2.23)
Initial GDP (log)	-0.002*	-0.002	0.000	-0.001	-0.000	-0.002	-0.002	-0.000
	(-1.88)	(-1.27)	(0.21)	(-0.29)	(-0.19)	(-0.80)	(-0.87)	(-0.17)
ΔM3 Growth$_{t-1}$	-0.002	0.002	0.002	0.026	0.048*	0.031*	0.011	-0.077
	(-0.14)	(0.09)	(0.12)	(1.53)	(1.74)	(1.75)	(0.51)	(-0.89)
Inflation$_{t-1}$	-0.034	-0.029***	-0.056	-0.037	-0.053	-0.053	-0.027	-0.372
	(-0.96)	(-2.91)	(-0.91)	(-0.75)	(-0.82)	(-0.95)	(-0.61)	(-1.18)
ΔCapitalization to GDP$_{t-1}$	-0.006	0.006	0.002	-0.001	-0.020	0.016	-0.002	-0.024
	(-0.98)	(0.56)	(0.13)	(-0.03)	(-0.92)	(1.06)	(-0.12)	(-0.74)
Output Gap $_{t-1}$		-0.042						
		(-0.83)						
ΔCredit Gap		0.020						
		(0.75)						
VIX				-0.055				
				(-1.44)				
SD Stock Returns					0.119			
					(0.28)			
Z-Score$_{t-1}$						0.034		
						(0.62)		
ΔPrivate Credit Growth$_{t-1}$							-0.053*	
							(-1.77)	
Constant	3.996**	3.126*	1.884	5.153*	3.323	5.644**	5.524**	5.310
	(2.51)	(1.68)	(0.82)	(1.81)	(1.39)	(2.08)	(2.15)	(1.49)
N	565	476	578	578	578	577	578	578
No. of groups	45	37	47	47	47	47	47	47
Chi²	155.03***	150.21***	147.24***	157.08***	206.03***	143.06***	172.54***	108***
Hansen Statistic	36.22	32.05	45.38	43.41	44.99	44.64	45.08	42.72
AR 1	-3.04***	-3.25***	-3.64***	-3.98***	-3.77***	-3.83***	-3.42***	-2.57***
AR 2	-0.41	-1.52	-0.40	-0.24	-0.05	-0.46	-0.58	0.50

Table 12 – Alternative Models

Dynamic OLS and Feasible Generalised Least Squares regressions. The dependent variable is real GDP growth. For Dynamic OLS, two lags and two leads of each variable is included but not reported, and *High Income* and *Initial GDP* are dropped due to collinearity. Robust t-statistics are reported in parentheses.*, **, and *** denote an estimate significantly different from 0 at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Dynamic OLS	*Dynamic OLS*	*FGLS*	*FGLS*	*Panel FE*	*Panel FE*
Real GDP Growth$_{t-1}$	0.434***	0.877***	0.235***	0.645***	0.125***	0.441***
	(5.43)	(21.19)	(6.60)	(18.98)	(2.89)	(8.66)
ΔCapital Ratio $_{t-1}$	0.335***	0.110**	0.489***	0.346***	0.442***	0.306**
	(2.73)	(2.45)	(5.51)	(4.00)	(3.59)	(2.54)
FSI$_{t-1}$	-0.179*	0.039	-0.361***	-0.188***	-0.378***	-0.224***
	(-1.85)	(1.29)	(-10.63)	(-5.45)	(-6.72)	(-4.01)
ΔBank Credit Growth$_{t-1}$	0.027*	-0.004	-0.019*	-0.031***	-0.026*	-0.032**
	(1.82)	(-0.40)	(-1.89)	(-3.26)	(-1.95)	(-2.44)
High Income	*omitted*	*omitted*	-2.035***	-0.404**	omitted	omitted
			(-9.87)	(-2.28)		
Initial GDP (log)	*omitted*	*omitted*	-0.001	-0.001	omitted	omitted
			(-1.53)	(-1.18)		
ΔM3 Growth$_{t-1}$	-0.008	0.006	0.001	0.005	0.012	0.009
	(-0.44)	(0.77)	(0.11)	(0.56)	(0.91)	(0.73)
Inflation$_{t-1}$	-0.162***	-0.051**	-0.060***	-0.004	-0.029	0.008
	(-3.07)	(-2.43)	(-2.71)	(-0.19)	(-1.14)	(0.31)
ΔCapitalization to GDP$_{t-1}$	0.017	0.010**	0.012**	0.006	0.021***	0.015**
	(1.51)	(2.36)	(2.57)	(1.32)	(2.68)	(2.12)
ΔOpenness $_{t-1}$		-1.926***		-0.734***		-0.568***
		(-33.49)		(-15.86)		(-10.22)
ΔCredit Gap		0.006		0.040***		0.057***
		(0.58)		(2.84)		(2.84)
Constant	2.905	-0.043	5.334***	2.461**	2.516***	1.366***
	(1.48)	(-0.08)	(4.69)	(2.15)	(12.73)	(6.72)
N	384	327	578	486	578	486

Figure 1 - Capital Ratios and Real GDP Growth

The graph below relates bank capital ratios to growth in real GDP. Each dot represents a country-year observation, with 706 observations and 47 countries, from 1998 to 2015. The solid line fits the result of a linear prediction of the relationship between the real GDP growth and bank capital ratio.

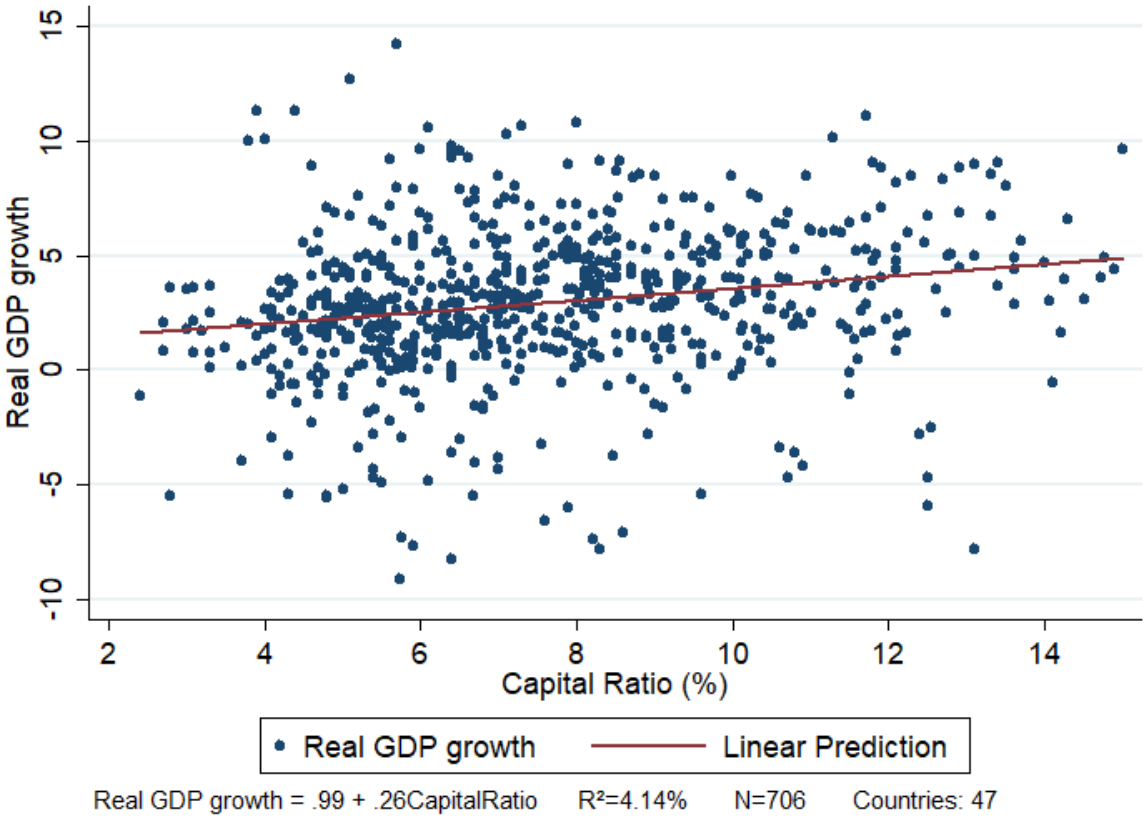


Figure 2 – Real GDP Growth, Main IRFs

The figures below display the IRFs of the main path (ΔCapital Ratio, FSI, ΔCredit, Real GDP Growth). Each IRF indicates the impulse and the response variable. The horizontal axis represents the years and the vertical axis shows the standardized response.

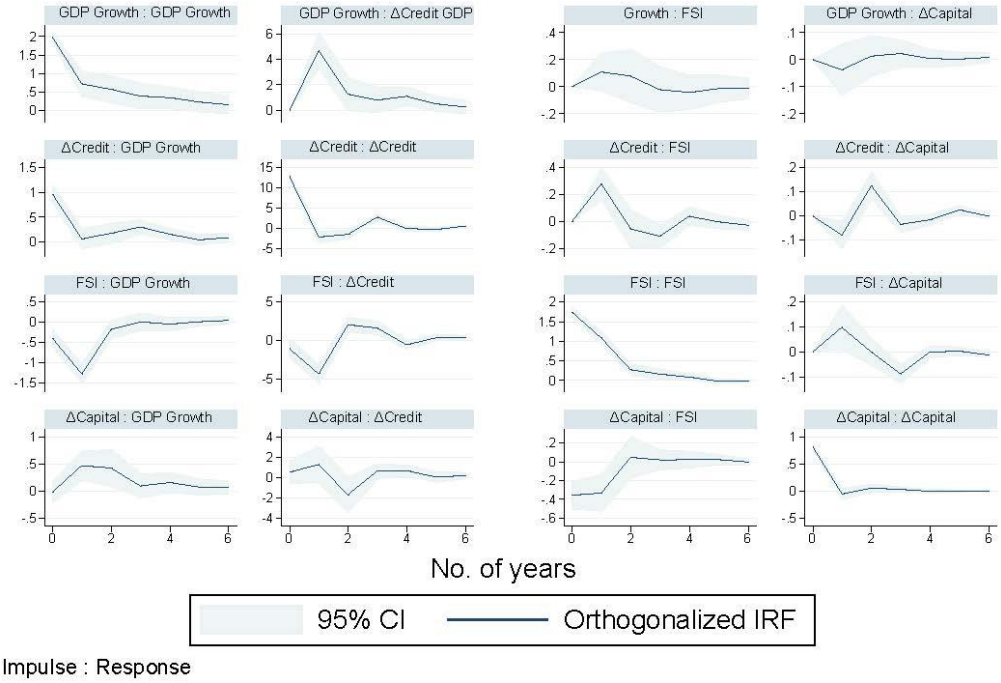
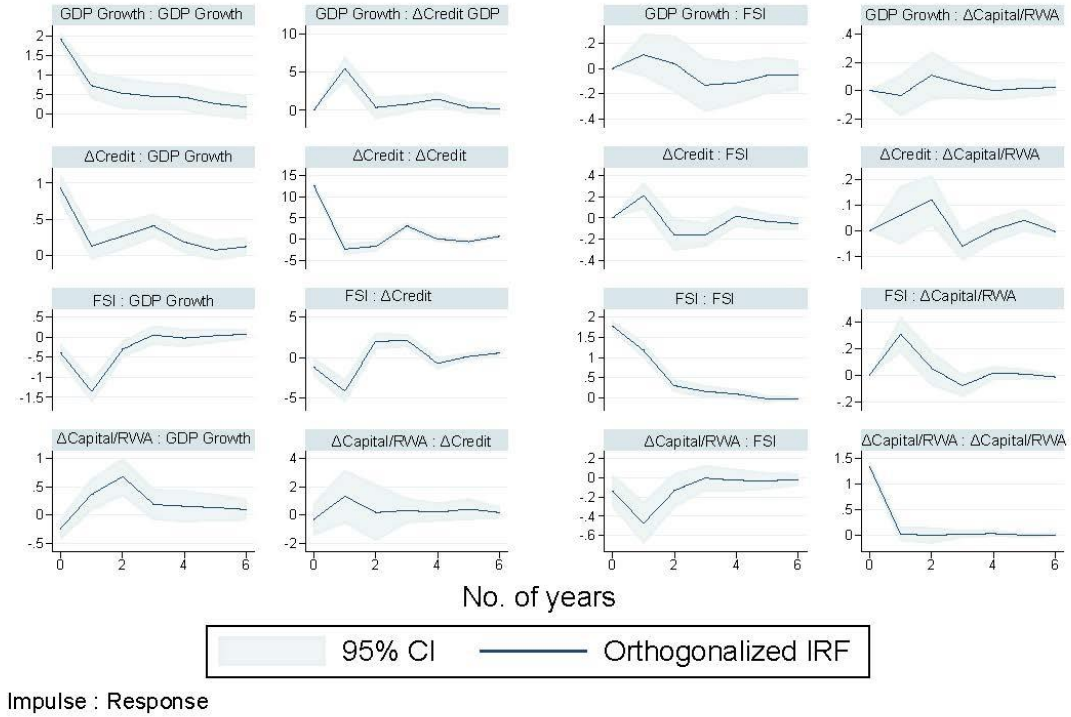


Figure 3 – Risk-Weighted Capital Ratio

The figures below display the IRFs using the risk-weighted Capital Ratio instead of the Capital Ratio. The other variables of the PVAR (FSI, ΔCredit, Real GDP Growth) remain the same. We employ our main ordering of the variables: Capital, FSI, Credit and Economic Growth. Each IRF indicates the impulse and the response variable. The horizontal axis represents the years and the vertical axis shows the standardized response.



Impulse : Response

Figure 4 – Real GDP Growth, Alternative IRFs Paths

The figures below display the alternative ordering of the variables for the different IRFs paths. We only show the impact of an impulse in the variation of the capital ratio on the real GDP Growth.

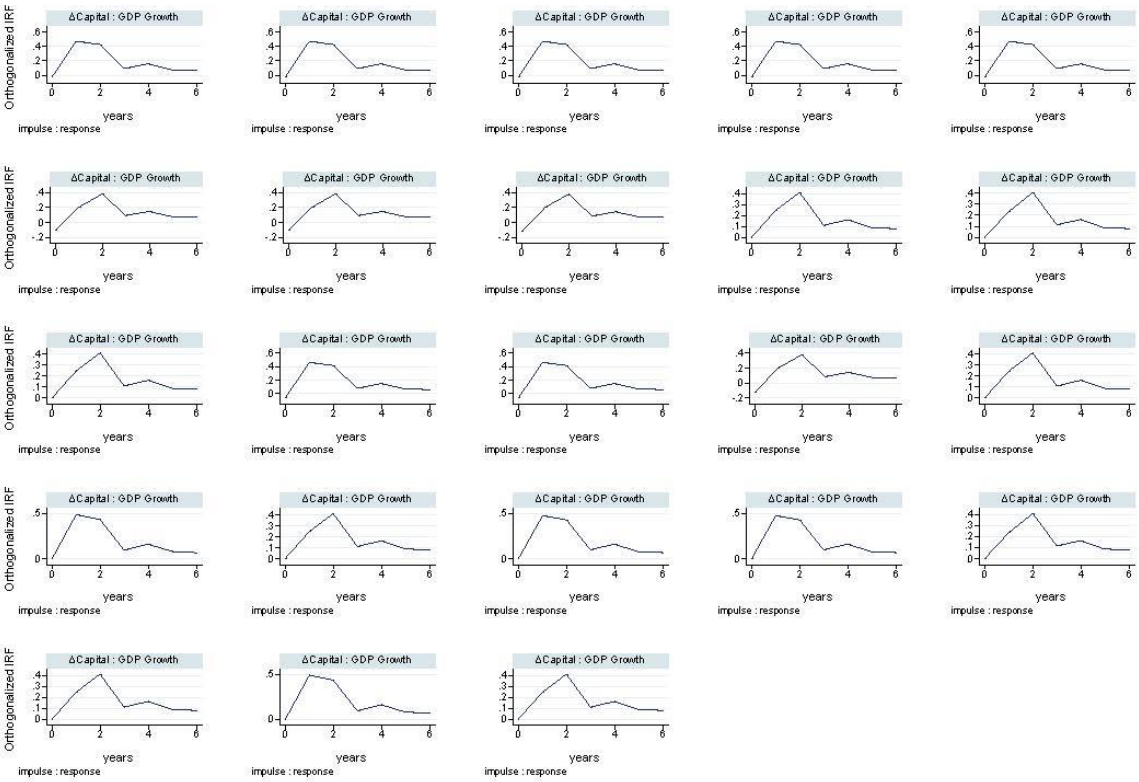


Figure 5 – Employment Growth, IRFs

The figures below display the IRFs of the main path (ΔCapital Ratio, FSI, ΔCredit, Employment growth). Each IRF represents the impulse and the response variable. The horizontal axis represents the years and the horizontal axis the standardized response.

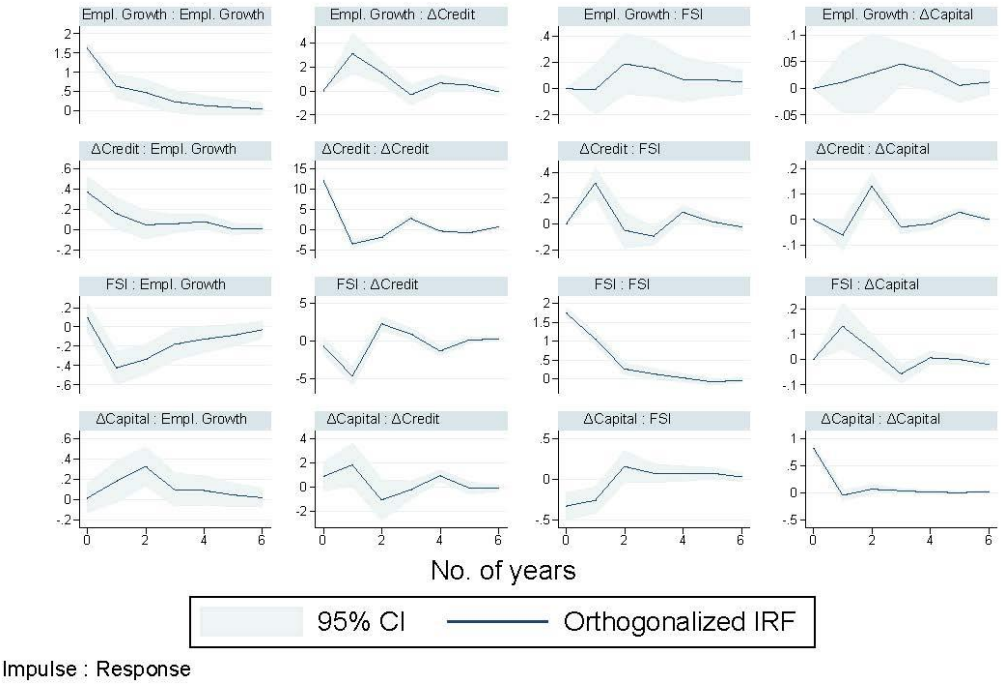
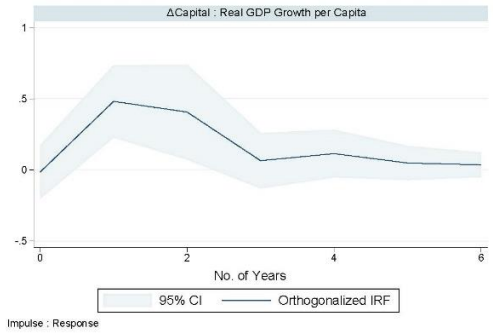


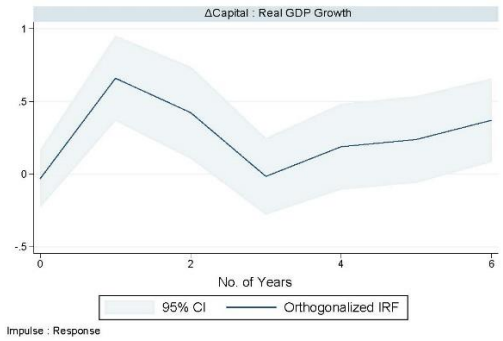
Figure 6–Alternative Variables, IRFs

The figures below display the orthogonalized IRFs of Panel VAR using alternative variables for financial stability and credit growth. Each VAR changes only one variable at a time; the other variables remain the same as in the main IRFs. The change in variables are as follow: (a) employs real GDP growth *per capita* instead of real GDP growth; (b) employs the VIX instead of the FSI; (c) employs the standard deviation of stock returns instead of the FSI; (d) employs the banking sector Z-score instead of the FSI; (e) employs the variation in Private Credit as an alternative variable for credit growth. We only report the IRF of an impulse in capital ratio and a response in real GDP growth (per capita) and omit the other IRFs.

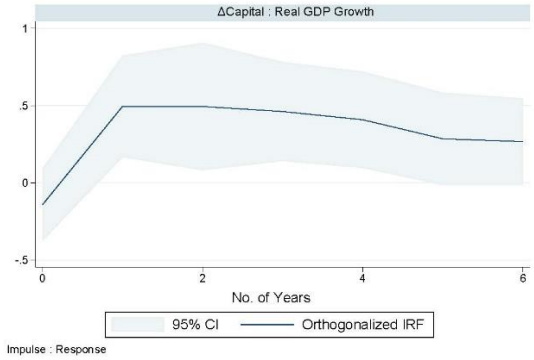
(a)
Real GDP Growth per Capita



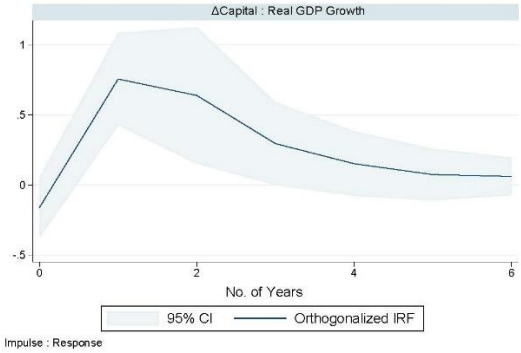
(b)
VIX



(c)
SD of Stock Returns



(d)
Banking Sector Z-Score



(e)
Private Credit Growth

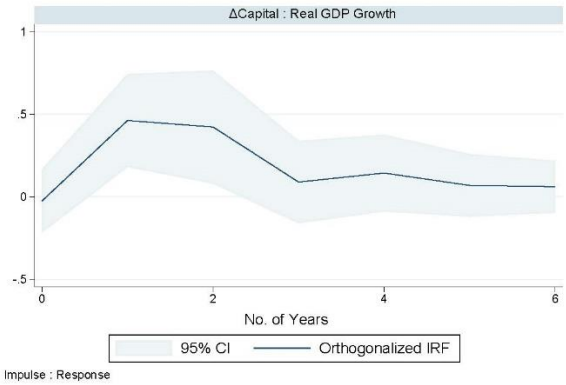
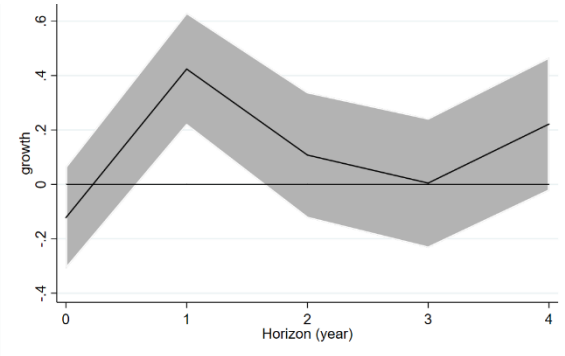
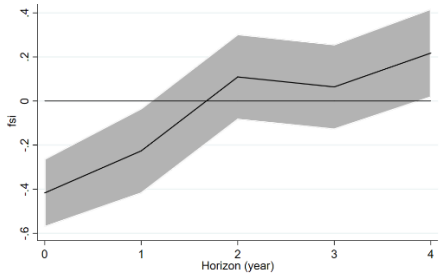


Figure 7 – Local Projections

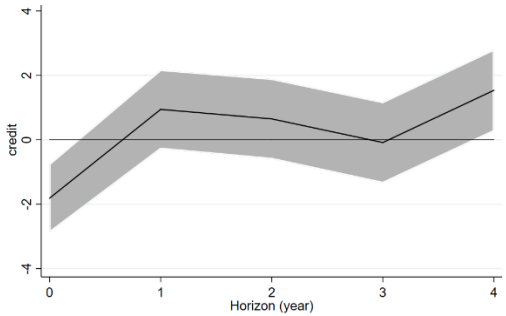
The figures below display the local projections, employing our main variables (ΔCapital Ratio, FSI, ΔCredit, Employment growth). The first graph displays the impact of a shock in capital ratio on economic growth, through the two channels, financial stability and credit growth. The two next pictures detail each channel: the impact of the shock on credit growth and financial stability, respectively. The horizontal axis represents the years and the horizontal axis the standardized response.



Response of Growth
Shock in Capital Ratio



Response of FSI
Shock in Capital Ratio



Response of Credit
Shock in Capital Ratio

Appendix A – List of Countries

List of the countries included in the analysis. Names follow the World Bank's denomination.

Argentina	Korea
Australia	Malaysia
Austria	Mexico
Belgium	Netherlands
Brazil	Norway
Bulgaria	Pakistan
Canada	Peru
Chile	Philippines
China	Poland
Colombia	Portugal
Czech Republic	Romania
Denmark	Russia
Egypt	Slovak Republic
Finland	Slovenia
France	South Africa
Germany	Spain
Greece	Sri Lanka
Hungary	Sweden
India	Switzerland
Indonesia	Thailand
Ireland	Turkey
Israel	United Kingdom
Italy	United States
Japan	

Appendix B – Variables and Definitions

Variable	Description	Source
Real GDP Growth	Annual growth in real gross domestic product (GDP), in percent.	World Economic Outlook (WEO)
Employment Growth	Annual employment growth, in percent.	WEO
Capital Ratio	Ratio of bank capital and reserves to total assets. Capital and reserves include funds contributed by owners, retained earnings, general and special reserves, provisions, and valuation adjustments. Capital includes tier 1 capital (paid-up shares and common stock), which is a common feature in all countries' banking systems, and total regulatory capital, which includes several specified types of subordinated debt instruments that need not be repaid if the funds are required to maintain minimum capital levels (these comprise tier 2 and tier 3 capital). Total assets include all nonfinancial and financial assets. In percent.	GFDD
FSI	The FSI is a composite measure of three sub-indices of financial stress, which serve to capture three financial market segments (banking, securities markets, and exchange markets) relative to past trends. For advanced economies (AE), the FSI is a composite of 7 measures: banking-sector beta from a standard capital asset pricing model, TED spreads, inverted term spreads, stock market returns, time-varying stock market return volatility, sovereign debt spreads, and exchange market volatility). For emerging economies (EE), the *FSI* considers 5 measures: banking-sector beta from a standard capital asset pricing model, stock market returns, time-varying stock market return volatility, sovereign debt spreads, and an exchange market pressure index. In units.	Balakrishnan et al. (2011)
Bank Credit Growth	Growth in private credit by deposit money banks, calculated using private credit by deposit money banks to GDP, in percent..	GFDD
Income Group	Dummy variable for the income group classification of countries, with three categories represented: High-Income, Upper-Middle-Income and Lower-Middle-Income.	World bank
Initial GDP (log)	First period GDP per country, current USD.	GFDD
M3 Growth	Growth in money supply, calculated using Liquid liabilities to GDP, in percent.	GFDD
Inflation	Annual variation of the consumer price index.	GFDD
Capitalization to GDP	Stock market capitalization to GDP, in percent.	GFDD
Output Gap	Economic output gap as calculated by the IMF, in percent.	WEO
Credit Gap	Credit-to-GDP gap calculated as deviation of credit from its trend, in percent.	Bank of International Settlements
Capital/RWA	It is the ratio of total regulatory capital to its assets held, weighted according to risk of those assets. Note that due to differences in national accounting, taxation, and supervisory regimes, these data are not strictly comparable across countries.	GFDD
Banking Crisis	Dummy variable for the presence of banking crisis (1=banking crisis, 0=none)	GFDD
Insufficient Capital	Spline regression variable. Takes the value of *Capital Ratio* if *Capital Ratio* < 3% and takes the value of 3% if *Capital Ratio* >=3%.	GFDD, authors.
Excess Capital	Spline regression variable. Takes the value of 0 if *Capital Ratio* <3% and takes the value (*Capital Ratio* – 3%) if *Capital Ratio* >=3%	GFDD, authors.
Real GDP Growth per Capita	Real GDP growth per capita.	WEO
VIX	Average VIX prices. VIX prices are obtained from the CBOE. It represents the implied volatility of monthly options on the S&P500.	Yahoo Finance
SD Stock Returns	Yearly standard deviation of stock market returns of the country main index. Country-specific stock returns are obtained from Balakrishnan et al. (2011).	Balakrishnan et al. (2011)
Z-Score	Indicator of financial stability, calculated as $\left(ROA + \left(\frac{Equity}{Assets}\right)\right) / \sigma_{ROA}$; where σ_{ROA} is the standard deviation of ROA. In units.	GFDD

Private Credit Growth	Growth in Private credit by deposit money banks and other financial institutions, calculated using private credit by deposit money banks and other financial institutions to GDP, in percent.	GFDD