Is the Cost of a Safer Banking System Lower Economic Activity?

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Abstract

The effect of a stronger bank capital base on economic growth remains unsettled in the literature. We investigate the presence and strength of two transmission channels—financial stability and bank lending channels—to shed more light on the association between bank capital and economic activity. Drawing evidence from 47 advanced and developing countries over close to two decades and using a PVAR and a system GMM, we find that higher capital ratios improve financial stability and lending activity, ultimately exerting a positive influence on economic activity. The effect on real GDP growth is economically significant, reaching up to 1¼ percentage points for each percentage point acceleration in capital increases. Our main results are robust to various sensitivity tests, supporting the conclusion that safer banking systems do not bridle economic activity.

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

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I. Introduction

Bank capital is a crucial dimension of balance sheet health. It is intended to serve as a cushion to absorb unexpected future losses, thereby protecting bank franchise value. With the advent of the global financial crisis, the regulatory agenda set to strengthen financial institutions' ability to absorb economic and financial shocks, including by requiring banks to build larger buffers of high-quality capital. Whereas the issue of how much capital banks should hold to absorb losses from crises remains an open question (Dagher et al, 2016), the literature generally concurs that a stronger capital base helps safeguard the safety of banks. In contrast, there is no consensus on the implications of holding more capital on bank lending and let alone on the relationship between bank capital and economic activity.

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 have to pay a higher external financing premium than firms that are on a stronger financial footing, and banks are no exception in that respect (Bernanke, 2007). The global financial crisis supported the presence of such 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 highly debated. Some papers report a positive effect between bank capital and lending (Buch and Prieto, 2014, Carlson et al., 2013; Woo, 2003), and others find a negative one (Aiyar et al., 2014), at least in the short-run. Yet, what is much less investigated is the 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 GDP.

This paper aims to shed more light on the association between bank capital and economic activity. Unlike the widely discussed role of bank capital on financial stability and lending activity, the impact of bank capital on economic growth remains unsettled, and the related literature remains scant. For instance, Bayoumi and Melander (2008) analyzed macrofinancial linkages for the United States, finding 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. Gross, Kok, and Zochowski (2016) show that, in the European Union, economic activity would be at risk to contract only when banks achieve higher capital ratios by shrinking their balance sheets. In contrast, Noss and Toffano (2016), who examine the relationship between the aggregate capital ratio and a few macro-financial variables system 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. First, better-capitalized banks increase financial stability, which increases resilience to shocks and helps wither recessions, thereby spurring economic growth. While this effect counters adverse effects of a financial crisis, it could also stifle a strong expansion period, so that the net impact on the economic activity is uncertain. Second, bank capital affects credit activity in the economy, which in turn affects economic growth. Overall, the effect of these two channels—financial stability and bank lending—

remains unsettled in the literature, so that the final impact of a stronger capital base on economic growth is uncertain.

These two potential channels of transmission have guided our choice of empirical strategy. We investigate their presence across many countries over close to two decades and first assess their strength using a panel vector autoregression (PVAR) system. We then complement our analysis using multivariate dynamic analyses and conduct several robustness checks. In the process, we exploit variations in bank capital, rather than investigate changes in bank capital requirements per se. We also 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. Nor do we consider asset risk (our measure of bank capital is the simple ratio of equity to total assets), because the numerous regulatory changes over the past two decades to calculate risk-weighted assets render cross-country comparisons of capital ratios difficult.

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 have a wider capital base, similarly raising economic activity. Unlike previous work, our results are applicable in the context of a very large number of advanced and developing countries and are maintained when controlling for the economy's position along the business and financial cycle.

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 results; and section V concludes.

II. Hypotheses Development

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

Capital requirements have been put forward to ensure bank resilience to economic and financial crises. The importance of more and better equity capital was at the root of Basel I and Basel II regulations and it was further developed under Basel III. The primal objective is to insure banks against unforeseen losses and increase their probability of survival is normal and dire times (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 stronger incentives 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 (2014); Thakor (2018)).

In turn, achieving greater financial stability is by itself trivial if one does not care about economic growth (Thakor, 2014), suggesting that its absence, or financial instability, can engender adverse implications on the economy. 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. Better capitalized banks also help speed-up the recovery of the economy; Cooke and Koch (2014) show that weakly capitalized banks slowed lending recovery after the 2007-2009 recession.

Yet, both costs and benefits are likely to ensue from a financial crisis, suggesting that it is important to take into account their net cost (Thakor, 2014). In their analysis of financial crises over the past eight centuries, Reinhart and Rogoff (2014) underline a recurring pattern of high leverage in banking institutions, rapid lending, and strong economic growth, all of which fuel asset prices bubbles that later engender financial recession when they burst. Using a theoretical macroeconomic model, Martinez-Miera and Suarez (2013) 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 between financial stability and growth is exaggerated, and that achieving both is possible.

As a whole, 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 fast economic growth that generally precedes crises.

Further, bank capital affects economic output through the lending channel. A vast literature underlines the positive impact that credit access and lending activity have on economic growth (e.g. Cetorelli and Gambera (2001); Claessens and Laeven (2005)). However, two competing views explain how bank capital affects lending behavior. Diamond and Rajan (2001) argue that higher capital requirements increase the costs of funds and lower liquidity creation and credit activity. Under the assumption that the Modigliani-Miller theorem does not hold, a capital structure 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); 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)).

On the opposite side of the spectrum, a number of studies find that stronger capital positions ensure a stable provision of credit that is robust to economic downturns (Bernanke and Lown (1991); Woo (2003); Buch and Prieto (2014); Albertazzi and Marchetti (2010); Kapan and Miniou (2013)). Bernanke (2007) argues that healthier banks (those with stronger capital buffers) are able to pay a lower external finance premium to raise funds compared with banks with weaker capital positions, which lowers their funding costs and could increase lending activity. 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. Similar results are presented by Gambacorta and

Shin (2018) following the subprime crisis, and Donaldson, Piacentino, and Thakor (2018) show theoretically that higher bank capital leads to more liquidity creation. Somehow conciliating the two competing views, Noss and Toffano (2016) put to the forefront the role of the economic cycle, whereby high capital ratios in expansion periods may be perceived by investors as unnecessary, thereby increasing the cost of funding and reducing lending.

Overall, there is no immediate answer as to how bank capital should affect economic growth. The complexity of this relationship is highlighted in the survey by Martynova (2015), which focuses on the indirect effects of bank capital on lending, the cost of equity, and financial stability. Greater financial stability that accompanies strong capital buffers limits the ravages of financial crises, but it also slows down expansions by smoothing the economic cycle. As a consequence, it is also essential to control for the state of the economy when examining the relationship between bank capital ratio and economic growth.

Three papers that have ventured to answer this research question empirically using different methodologies. Bayoumi and Melander (2008) investigate the effects of a negative shock to bank capital on the macroeconomy within an empirical framework that traces linkages for different components of private spending, starting from lending standards, credit availability, and private spending to income, while 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 do not make identifying assumptions regarding a shock to bank capital, but rather explore variations in bank capital ratios across countries and time. 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 favouring 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.

Our measure of bank capital is from the Global Financial Development Database (GFDD), calculated at an annual frequency.[1] It is the ratio of bank capital and reserves to total assets. Reserves encompass retained earnings, general and special reserves, provisions, and valuation

[1] 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.

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 measure of bank capital is not the concept of capital adequacy used in bank regulation. 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 concerns about differences in risk weights for similar exposures across banks and countries, as well as from the degree of supervisory discretion in the approval of methods to calculate risk-weighted assets. Further, movements in our capital ratio may be more meaningful than changes in regulatory measures of capital adequacy, as internal model indicators 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 (Cihák et al., 2012) and has notably been used in Proano, Schoder and Semmlera (2013). Financial stress is defined 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* indicates greater financial stability. Balakrishnan et al. (2011) show that a value superior to one is associated with a higher probability of a crisis.

To assess the credit channel, we use the 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*). We also 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). For robustness, we use employment growth as an alternative indicator of economic activity, the banks' Z-score (higher values indicating greater stability), and growth in private credit. 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 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

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 first employ our PVAR methodology. 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.

Our PVAR investigates the relationship between bank capital ratios and economic growth. It takes the following generic form:

$$\boldsymbol{y_{it}} = \boldsymbol{\vartheta A y_{it}} + u_i + \varepsilon_{it} \qquad (1)$$

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 adopt a conservative approach to deal with unit roots in the series used. We address this issue by running the Fisher Augmented Dickey-Fuller and the Fisher 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. We require the data series to be stationary employing both the Dickey-Fuller and Phillips Perron tests. This results in using the first difference of the *Capital Ratio*, *Bank Credit Growth*, *M3 Growth*, *Capitalisation to GDP*, and the *Credit Gap*.

To estimate the impact of a change in bank capital ratio on the other variables, we draw 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.

In our approach, we consider a specific ordering of the variables, based on theoretical motives and Granger-causality tests (Table 4). Our baseline path considers the following ordering: bank capital ratio; financial stress; credit growth; real GDP growth. To confirm that our results are not sensitive to the ordering of variables, we also draw all potential alternative paths and compare them with the ones that we selected as a baseline.

In a second step, we use a System GMM model to identify the relationship between bank capital ratios and economic growth in a multi-variate setting. 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 correct the standard-errors using Windmeijer (2005) approach. The system GMM takes the following generic form:

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

We use real GDP growth as dependent variable and consider 9 control variables. First, we incorporate the *FSI* and *Bank Credit Growth* variables. We then proxy for initial conditions using either the log of initial GDP or the World Bank's income classification, with the dummy variable *High Income* taking the value of one for countries classified as high-income and the omitted category representing middle-income countries. We control for the monetary environment using the growth of M3 and inflation, and for broader financial conditions 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. As discussed previously, the *FSI* and the credit growth variables are used to assess the presence and strength of the financial stability and the credit channels, respectively.

We first present the Granger causality tests of the PVAR functions in Tables 4. Table 4 shows 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 underpins the view 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, we plot the corresponding IRFs in Figure 2 considering our baseline ordering of variables. 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 more percentage point raise real GDP growth by ½ percentage point (0.47) one year later. This effect is both statistically and economically significant, reaching close to a cumulative 1percentage 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.

Turning to the first column in Figure 3, we 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. Overall, 5.3% 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% and 21.7% of the variability in economic growth, respectively. Variation in capital ratios explain 5.1% of the change in the FSI and 2.4% of the change in the credit growth.

4.2. System GMM

We now turn to our system GMM approach to examine the relationship between bank capital and economic activity in a multivariate setting. The system GMM is a useful complementary method to the PVAR to confirm our results, control for additional variables, and allow for a more economically meaningful interpretation of estimated coefficients.

Table 6 reports the system GMM results using economic growth as the explained variable. The first column only considers the role of the change in the bank capital ratio and the lagged value of the GDP growth. An increase of one percentage point in the change of the capital ratio is associated with an additional 0.724 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 the financial stress leads to a decrease in economic growth, which is line with the previous literature 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), 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 impact of capital ratios on 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. The effect of a change in bank capital ratios on economic growth remains positive and significant. 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 an higher economic growth by 0.59 percentage point.

In column 6, we further control for the Output Gap and the Credit Gap to control for the business and financial cycles, respectively.[2] We run a separate estimation with these two variables (rather than including them in all models) because 9 countries drop out from our sample due to data availability. For the Credit Gap, we use the contemporaneous value, as considering the lag value results in a significant AR(2) process. The results are consistent with

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

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 the year before results in lower economic growth during 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 Credit Gap.

Finally, we investigate whether our findings differ for countries with various levels of economic development. Recent studies have demonstrated that institutional and economic development matters for the impact of finance on economic growth (*e.g.* Arcand, Berkes and Panizza, 2015). In table 7, we subdivide the sample between high-income and middle-income countries, using the World Bank classification. We then re-estimate the main system GMM with real GDP growth as dependent variables for each subgroup. The level of income does not exert an impact on the relation between bank capital ratio and economic growth. The effect of bank capital on economic growth remains significant in columns 1 and 2, though it is slightly more pronounced for high-income countries.

V. Robustness Analyses

In this section, we offer two types of robustness tests. We first challenge the ordering of the variables in the PVAR approach. Second, we offer alternative variables to measure economic activity, financial stability, and credit growth in both the PVAR and the System-GMM approach.

5.1. PVAR Robustness Tests

We assess the sensitivity of our results to the ordering of the variables of the IRFs by drawing all the possible paths. For brevity, we only show an impulse in bank capital ratios and the associated change in economic growth in Figure 3. The results are consistent with our previous findings. Overall, we observe a positive effect of a change in bank capital ratios on economic growth. 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 paths. That said, all results indicate a positive effect of capital ratios on economic activity, with a similar magnitude as before.

As additional robustness tests, we select alternative variables in the PVAR and plot the corresponding IRFs. Figure 4 reports the IRFs using the same variables as in Figure 2 but replacing economic growth with employment growth, as an alternative measure of economic activity. Focusing on the bottom line of the relationship between capital ratios and employment growth, we observe that an increase in the capital ratio by one percentage point is associated with a gradual rise 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 from capital ratios to economic growth in Figure 2. Over three years, it reaches 0.45 percentage points, and over 6 years 0.5 percentage points. Its magnitude is less than half the size of that on economic growth and, as explained below, it is principally channelled through greater financial stability.

In this PVAR specification, the impact of higher capital ratios on credit growth is more erratic than when considering economic growth. An increase in capital ratios leads to an immediate increase in bank lending that spikes two years later. This effect then reverses and become negative, to progressively converge to zero. As for the impact on financial stability, a capital ratio increase leads here again to an immediate decrease in financial stress (greater financial stability), which persists one year after the shock, confirming the positive impact on financial stability observed in Figure 2.

Both higher credit growth and lower financial stress are associated with greater employment growth. In parallel, the IRFs in Figure 4 suggest that 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 find that an increase in capital ratio is associated with an increase in employment growth, confirming our main result.

We also select two other variables to assess the two transmission channels of financial stability and lending. We use the country-level bank Z-score as proxy for financial stability (Berger, Klapper, and Turk-Ariss (2009); Fink et al., 2009; Uhde and Heimeshoff, 2009; Creel, Hubert and Labondance, 2015) and growth in private credit in general—and not only banking credit—as proxy for the lending channel. Figure 5 shows the corresponding IRFs. Here again, the results are consistent with previous findings. When using the different variables, we do observe a positive impact of capital ratio on economic activity.

5.2. System-GMM Robustness Tests

We next turn to the robustness of the System-GMM approach. Table 8 displays the estimation results. We first replace economic growth by employment growth. The results are reported in the first column. We observe a positive impact of the capital ratio change on employment growth. An increase of 1 point in the capital ratio change is associated with an increase of 0.17 percentage point in employment growth. This result confirms the positive impact of bank capital ratio on economic activity. In column 2, we add our two measures of economic cycle, *Output Gap* and *Credit Gap*. The positive and significant sign of the *Capital Ratio* coefficient confirms the positive impact of bank capital on economic activity.

Our second sensitivity check is to test the robustness of our result by using alternative variables for financial stability and credit growth. Again, we consider the banks' Z-score as a different proxy for the financial stability and the overall private financial credit as an alternative variable for the lending channel. Here, we maintain growth in real GDP as our measure of economic activity. The results are reported in columns 3 and 4, respectively. The effect of the capital ratio on the economic growth is similar and consistent with the previous results.

Finally, we test for a non-linear relationship between bank capital ratios and economic growth (column 5). Very low or very high level of capital ratios may exert a different impact on economic growth. We do not find any evidence of a quadratic effect of capital ratio on economic growth. We employ the Lind and Melhum (2010) test to formally assess the presence or the absence of a U-shaped relationship, and the results confirm the absence of such an association with a p-value of 0.257 (t-value=0.65).

VI. 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).[3]

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.

[3] 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
Employment Growth	687	1.2	1.2	2.2	-8.9	17.7
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	Z-Score	Private Credit Growth
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		
Z-Score	0.08**	0.16***	0.03	-0.05	-0.08**	0.20***	-0.03	-0.12***	0.22***	-0.06	-0.11**	1.00	0.08**
Private Credit Growth	0.46***	0.22***	0.11***	-0.18***	0.97***	0.01	0.84***	0.05	0.01	0.44***	0.12***	-0.08**	0.46***

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.

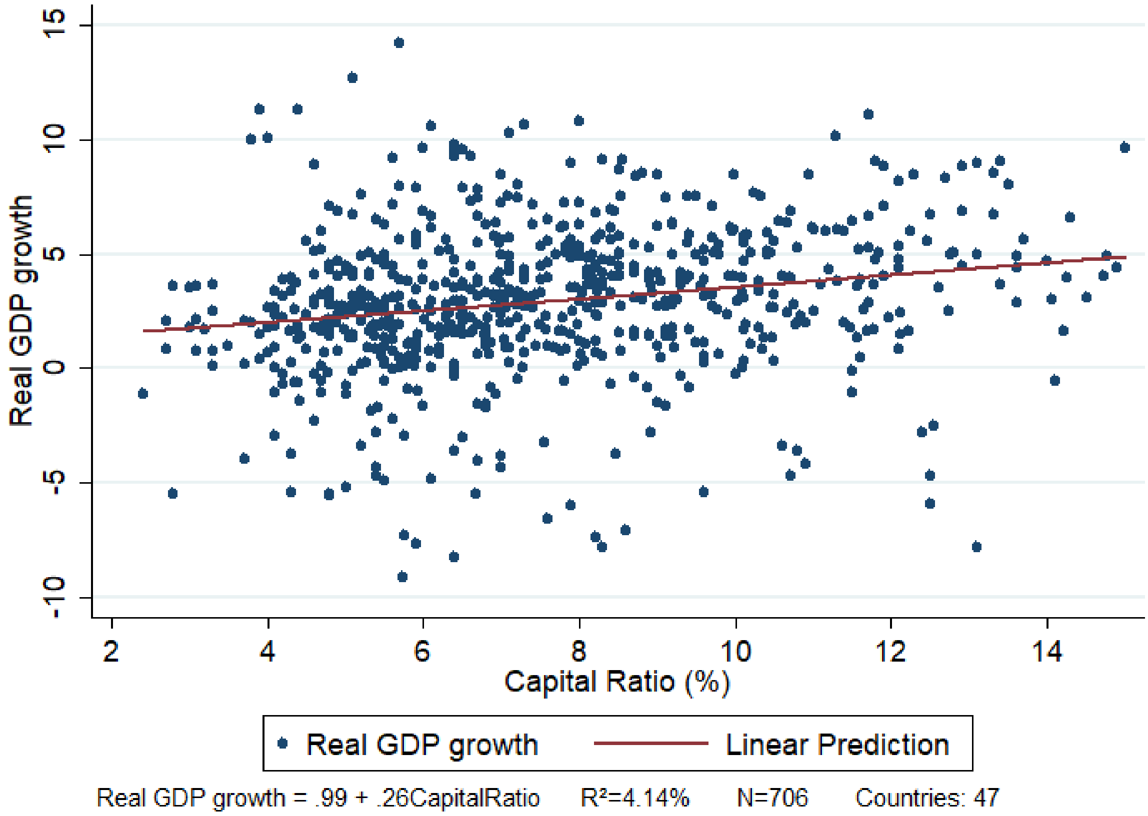


Table 3 – Unit Root Tests

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

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 represents the impulse and the response variable. The horizontal axis represents the years and the horizontal axis the standardized response.

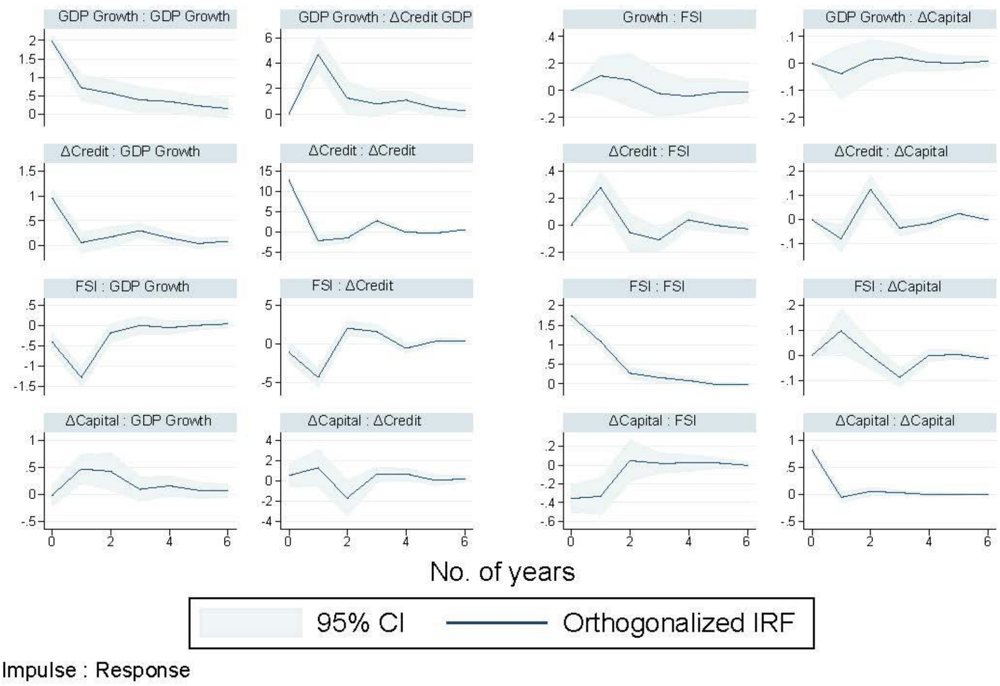


Table 5 – Forward Error Variance Decomposition

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 –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	35	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

Figure 3 – 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.

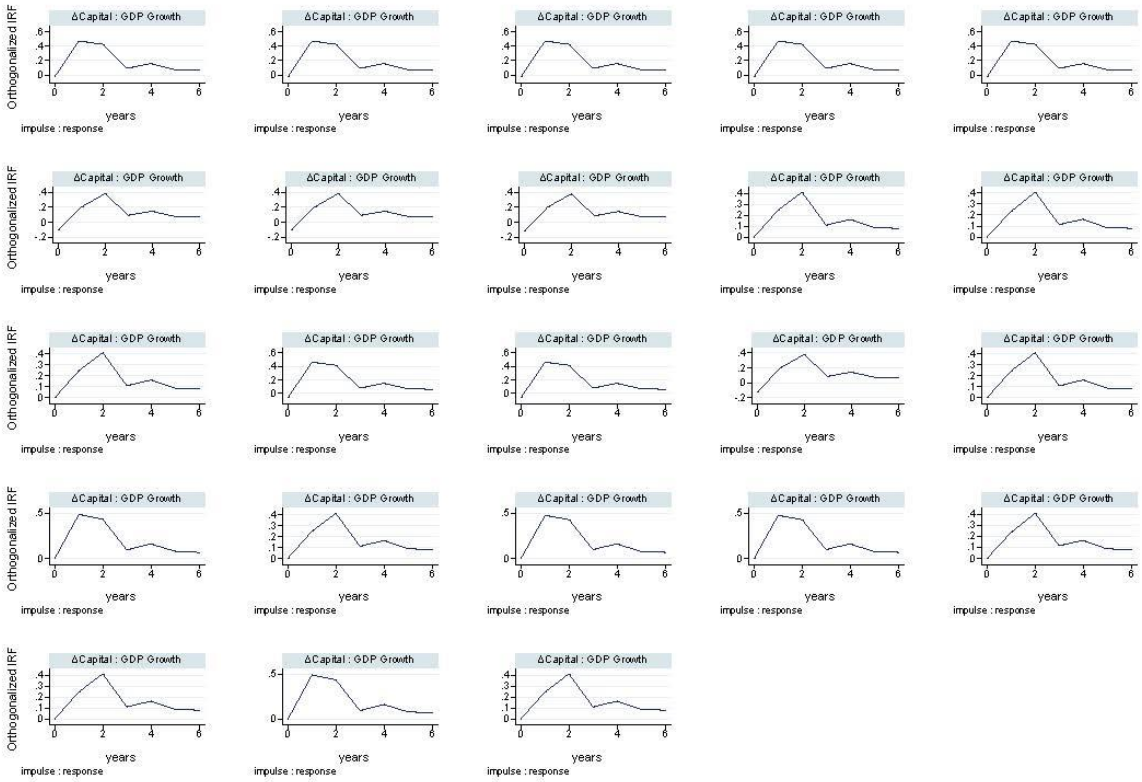


Figure 4 – Employment Growth, IRFs

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.

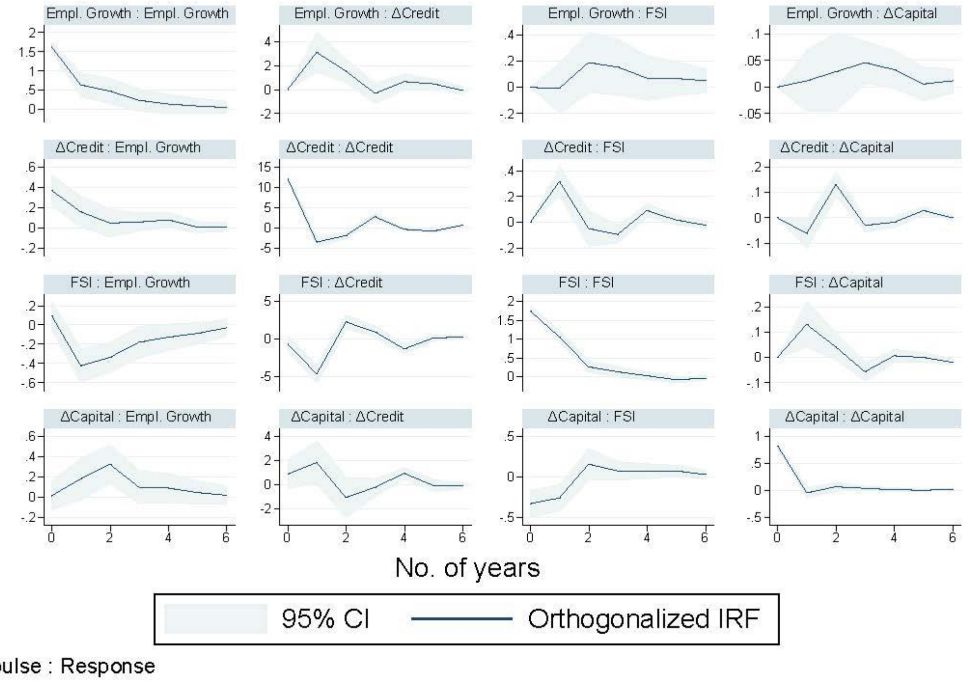
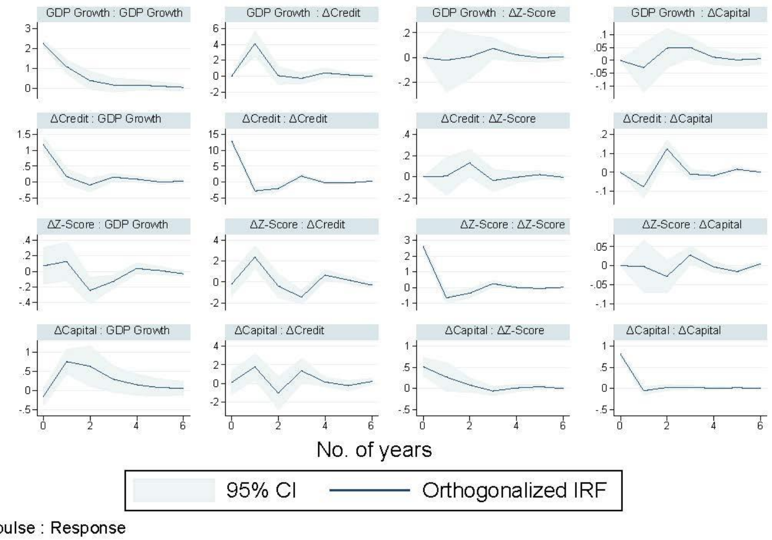


Figure 5–Alternative Variables for the Stability and Lending Channels

The figure below displays the orthogonalized IRFs of panel var using alternative variables for financial stability and credit growth. The figure on the left shows the IRFs with Z-score as an alternative variable for financial stability; the figure on the right shows the IRFs with variation in Private Credit as an alternative variable for credit growth.



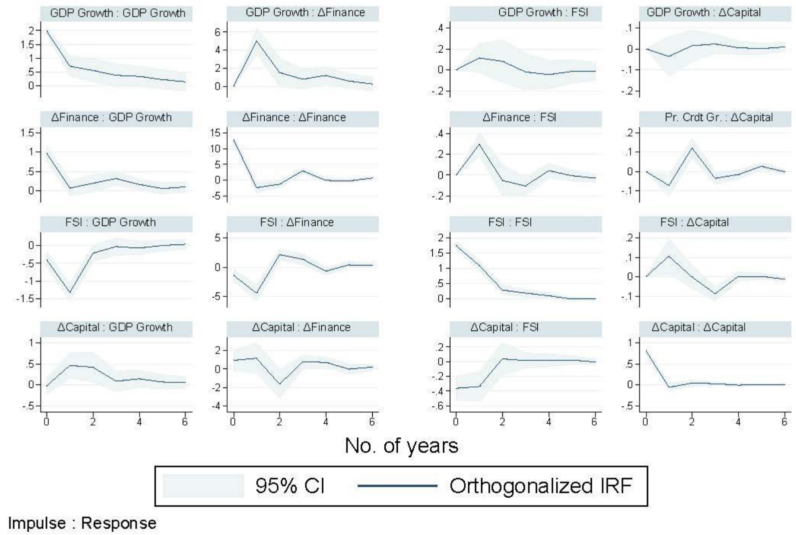


Table 8 – Alternative Variables System GMM

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)
	Employment Growth	Employment 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$_{t-1}$			0.282***	0.275***	0.360**
			(3.12)	(2.97)	(2.11)
ΔCapital Ratio $_{t-1}$	0.172**	0.174***	0.624*	0.779**	0.828*
	(1.99)	(2.62)	(1.79)	(2.51)	(1.72)
ΔCapital Ratio^2 $_{t-1}$					0.560
					(1.03)
FSI$_{t-1}$	-0.211***	-0.204***		-0.234**	-0.448
	(-2.66)	(-3.72)		(-2.01)	(-1.14)
ΔBank Credit Growth$_{t-1}$	0.023	-0.004	-0.054***		0.051
	(1.05)	(-0.22)	(-2.79)		(0.57)
High Income	-0.600***	-0.392*	-2.072***	-1.904***	-3.103**
	(-2.71)	(-1.73)	(-4.50)	(-4.21)	(-2.23)
Initial GDP (log)	-0.002*	-0.002	-0.002	-0.002	-0.000
	(-1.88)	(-1.27)	(-0.80)	(-0.87)	(-0.17)
ΔM3 Growth$_{t-1}$	-0.002	0.002	0.031*	0.011	-0.077
	(-0.14)	(0.09)	(1.75)	(0.51)	(-0.89)
Inflation$_{t-1}$	-0.034	-0.029***	-0.053	-0.027	-0.372
	(-0.96)	(-2.91)	(-0.95)	(-0.61)	(-1.18)
ΔCapitalization to GDP$_{t-1}$	-0.006	0.006	0.016	-0.002	-0.024
	(-0.98)	(0.56)	(1.06)	(-0.12)	(-0.74)
Output Gap $_{t-1}$		-0.042			
		(-0.83)			
ΔCredit Gap		0.020			
		(0.75)			
Z-Score$_{t-1}$			0.034		
			(0.62)		
ΔPrivate Credit Growth$_{t-1}$				-0.053*	
				(-1.77)	
Constant	3.996**	3.126*	5.644**	5.524**	5.310
	(2.51)	(1.68)	(2.08)	(2.15)	(1.49)
N	565	476	577	578	578
No. of groups	45	37	47	47	47
Chi²	155.03***	150.21***	143.06***	172.54***	108***
Hansen Statistic	36.22	32.05	44.64	45.08	42.72
AR 1	-3.04***	-3.25***	-3.83***	-3.42***	-2.57***
AR 2	-0.41	-1.52	-0.46	-0.58	0.50

Appendix A – List of Countries

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

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

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
Real GDP Growth per Capita	Real GDP growth per capita.	WEO
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