# Revisiting the impact of bank capital requirements on lending and real activity

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**Abstract**

Several studies undertaken in the aftermath of the 2007-2009 crises found a relatively small impact of an increase in capital requirements on lending and real activity both in the short- and long-run. The calibrations of some recent equilibrium models deliver a significantly larger impact of changes in capital requirements on lending and real activity than these earlier studies. This paper revisits the issue reviewing the recent literature and providing novel evidence using international data panels at a firm and country level. This new evidence and the counterfactual experiments of some calibrated equilibrium models suggest that the negative short-run and long-run impact of an increase in capital requirements on bank lending and real activity is significantly larger than previously thought.

*The views expressed in this paper are those of the author(s) and do not necessarily represent those of the IMF or IMF policy.

## I. INTRODUCTION

In the aftermath of the 2007--09 financial crisis several studies produced estimates of the short-term and long-term impact of increases in bank regulatory capital on bank lending and real activity, prompted by the need to assess the potential costs of the new Basel capital regulation, whose implementation is still in progress (see e.g. BCBS, 2015). A set of first assessments promoted by central banks resulted in the Macroeconomic Assessment Group study (MAG, 2010), the BCBS (2010) study, and an update of the latter by Angelini et al. (2011), These earlier studies concluded that permanent and significant increases in capital requirements would result in relatively small declines in bank lending, and modest declines in real activity. A string of more recent studies has delivered new quantitative estimates using calibrated equilibrium models with which counterfactual experiments can be performed. A common result of these studies is that increases in capital requirements may have a sizeable negative impact on bank lending and real activity, even though quantitative estimates differ remarkably, and in some of these models large declines in lending and real activity are shown to be welfare improving.

This apparent divergence between earlier assessments and those of the recent set of equilibrium models motivates my re-visitation of these important issues for policy. Some key motivating questions are: What explains the difference of these quantitative assessments? Are they due to misspecifications or difficulties of interpretation of empirical reduced-form estimations? Do they arise from an exaggerated role of the quantitative importance of the financial frictions around which some of the equilibrium models are constructed? This paper does not claim to provide a definite answer to these questions. More modestly, its objectives are to revisit the issue with the aim of contributing to advance the debate.

This paper is divided in two parts. In the first part, I briefly update earlier reviews of the empirical literature, and then focus on those recent papers that deliver quantitative results of equilibrium models. The aim is to clarify some of the key mechanisms that generate their quantitative results and compare them. In the second part, I present novel evidence on the short-term and long-term impact of an increase in capital requirements on lending and real activity. I deliberately use statistical specifications very similar to those used in an earlier empirical literature for comparative purposes. The contribution here is the use of large international data panels at a firm and country level, including data of the 2007-2009 crisis and beyond. The statistical models are admittedly reduced-form and it is notoriously difficult to attribute a casual interpretation to their results, which can be better addressed by feasible "natural experiments". However, the key point of my investigation is to use the evidence obtained from these estimates as a benchmark useful to judge—in a sort of "back-testing" mode—the extent to which some properties of the data are broadly consistent with the quantitative implications of the equilibrium models I review. Put it more emphatically, What degree of confidence should policy makers assign to models whose counterfactual experiments deliver quantitative results too far away from even the most extreme historical evidence?

My review of the literature leads to two conclusions. First, the short-term negative impact on lending and some measures of real activity seems sizeable, as documents by recent empirical analyses based on "natural" experiments, and larger than previous estimates. Second, counterfactual experiments of recent equilibrium models generate a significant negative impact of an increase in capital requirements on lending and real activity in the long-term. However, quantitative estimates across these models differ significantly.

The empirical analysis delivers two main results. First, the *short-term* impact of an increase in capital ratios on bank lending and real GDP growth is sizeable. The estimated magnitudes are consistent with previous estimates of a relatively large literature, as well as with those of more recent studies based on "natural experiments". Second, the *long-term* impact of changes in capital ratios on steady state levels of bank lending, bank lending growth  real GDP growth rates is sizeable as well. The estimated magnitudes are close to those obtained by counterfactual experiments of some calibrated equilibrium models, but are too far away from those of some other equilibrium models.

All in all, the results of the counterfactual experiments of those recent equilibrium models that deliver estimates not too far away from the evidence I obtain suggest that the negative short- and long-term impact of an increase in capital requirements on bank lending and real activity is significantly larger than previously thought.

The remainder of this paper is composed of four sections. Section II presents a brief review of the quantitative results of the literature, focusing on the most recent contributions based on calibrated equilibrium models. Section III and IV present the empirical analysis and results using international bank-level panel dataset and country-level panel dataset respectively. Section V concludes.

## II. A Brief Literature Review

In this section I briefly review the quantitative results of an earlier literature based on reduced-form empirical models and some equilibrium modes, and compare them with those of more recent studies that present counterfactual experiments performed with calibrations of equilibrium models.[1]

### A. Earlier studies

In their review of the literature assessing the impact of capital requirements on bank lending, spreads and cost of capital, Kashyap et al. (2010) reached two main conclusions: a) in the short-run, a phasing of increased capital requirements might prompt banks to fulfill them by reducing lending significantly, rather than issuing equity or increasing retained earnings though reductions of dividends distributions; and b) in the long-run the effects of tightened capital regulation were viewed difficult to assess and further research was called for. However, they provided some indirect evidence, finding a fairly small impact of a 10% increase in capital ratios on loan rates. This result suggested to them that the likely impact on lending and real activity might be small. [2]

Some recent empirical studies based on "natural experiments" seem to confirm the significant short-run negative impact of capital requirements on bank lending found in the earlier reduced-form empirical literature. Using UK bank data, Aiyar et al. (2014a, 2014b) find that an increase in capital requirements of one percentage point reduces the growth rate in real lending by 4.6 percent and credit growth by 6.5-7.2 percent. Using the recapitalization exercise of 2011-2012 by the European Banking Authority (EBA), where the EBA announced to implement capital ratios higher than previously anticipated in the

[1] A systematic review of the theoretical papers on banking and bank regulation which are the basis of some of the set-ups of the equilibrium models I review is outside the scope of this paper. Excellent recent reviews of the theory are in Gersbach et al. (2014, 2105).

[2] Recent work by Baker and Wurgler (2015) obtain significantly different results which are broadly in line with the results I am going to show momentarily.

transition to Basel III, Mesonnier and Monks (2014) find that and increase in the regulatory ratio by one percentage point was associated with a reduction in banks' credit growth by 1.2 percent. In an interesting study based on French data that includes an estimate of the impact of capital requirements on banks as well as firms, Brun et al. (2013) find that a one percentage point increase in capital requirements leads to a reduction in lending between 3 and 8 percent, with a an attendant significant negative impact on firms' investment and employment.

The assessment of the long-term impact of increases in regulatory capital ratios has been relatively less explored. Rochet (2014) reviews earlier studies based on a two step approach, consisting in, first, assessing the impact of increased capital requirements on lending rates, and then gauging how the resulting change in lending rates affects measures of real activity. The MAG (2010) study, which perhaps is the most comprehensive in this category, estimates that a one percentage point increase in the target ratio of capital would lead to a decline in the level of GDP of about 0.15 percent relative to a predicted estimate of the current level. In addition, such a decline in real activity would likely occur far away in time, namely about eight years after the start of implementation. These estimates imply that the long-run real effects of an increase in capital requirements may be very small. .

### B. Recent equilibrium models

To the best of my knowledge, Van Den Heuvel (2008) is the first study that uses a quantitative general equilibrium model to estimate the impact of capital requirements on real activity and welfare. In his model, banks provide liquidity valued by households, but also choose the risk of their portfolio undertaking some risk-shifting due to deposit insurance. In this set-up, capital requirements limits bank risk-shifting, but they are also costly because they reduce banks' ability to create liquidity. Calibrating parameters with US banking data, he finds that the welfare cost of Basel II capital adequacy regulation is equivalent to a permanent loss in consumption of between 0.1% and 1%, with output and consumption declining. The conclusion of this study is that Basel II capital requirements are too high.

The 2007-2009 crisis prompted a systematic assessment of the impact of increases in capital requirements by the Basel Committee on Banking supervision (BCBS, 2010), followed by Angelini et al (2011), who report the simulation results of 13 equilibrium models, including some workhorse DSGE models. The approach of this study is commendably eclectic, as the median across different estimates is considered to take into account model uncertainty. In Table 4 of p.13, Angelini et al (2011) report the loss of steady state output following a set of conjectured increases in capital requirements, measured relative to the level of output under no change in regulation. Overall, they find that a one percentage point increase in the capital ratio translates into a mere 0.09 percent median output loss. This fairly small number matches the evidence in MAG (2010) mentioned earlier, and are at utterly at variance with the earlier estimates by Van Den Heuvel (2008).

De Nicolò et al. (2012, 2014) assess the impact of capital regulations—as well as that of liquidity requirements—on bank lending and metrics of efficiency and welfare in a fully dynamic set-up. They study an industry composed of homogenous and infinitely lived banks (barring default) that make fully dynamic choices of risky investment subject to decreasing returns. Banks are financed by short-term debt, deposits and equity, undertake costly maturity transformation as in Diamond and Dybvig (1983), are exposed to credit and liquidity risks, and deposits are insured. In essence, the model aims at capturing all key features of banks emphasized by the theoretical banking literature. Financial frictions are the standard financing frictions considered in the corporate finance literature, such as equity issuance costs and borrowing constraints on short term debt.

Calibrating the model using US banking data, one key result of De Nicolò et al. (2012, 2014) is the finding of an inverted U-shaped relationship between bank lending and capital requirements, which translates into an inverted U-shaped relationship between welfare and capital requirements. According to their calibration, when capital requirements of the Basel II type are in the 1-2 percent range, banks find it optimal to fulfill them through an increase in lending, which allows them to increase retained earnings through increased revenues. The quantitative impact of an increase in required capital from 0 to 2-3 percent is a notable 15 percent increase in lending. However, once the capital requirement crosses the 3 percent threshold, banks find it optimal to fulfill them through a decrease in lending, since building up equity through increased investment so as to accumulate retained earnings becomes too costly, primarily because of decreasing returns to investment relative to the cost of capital. In their calibration (De Nicolò et al., 2014, Table 5), they find that an increase in the capital ratio from 4 to 12 percent results in a decline in lending by about 2.4 percent.[3] Beyond the 3 percent capital ratio threshold, welfare declines monotonically with capital requirements.

Corbae and D'Erasmo (2014) focus on the impact of changes in capital requirements on bank risk, bank failures, and market structure in a model of banking industry dynamics

[3] It is worth mentioning that in this set up, risk-shifting is not necessary (although it may be sufficient) to produce a non-monotonic relationship between steady state levels of bank lending and capital requirements.

with heterogeneous banks. In their calibration based on U.S. data, they find that a rise in capital requirements from 4 to 6 percent generates an 8 percent fall in bank lending.

Several recent papers have studied general equilibrium set-ups focusing on the relationship between measures of welfare and capital requirements in steady state, as in the original Van den Heuvel (2008) paper. A common feature of these studies is that they generate an inverted U-shaped relationship between welfare and capital requirements similar to that found in De Nicolò et al. (2012, 2014). However, the mechanism generating such result is slightly different: higher capital requirements reduce bank lending but also inefficient investments arising from risk-shifting. As a result, lending and output decline and lending rates increase, but the productivity of the projects financed increases, typically leading to higher consumption and generally higher social benefits. Yet, social benefits turn out to be bounded by diminishing returns, so that beyond some capital ratio threshold, higher capital ratios produce negative net benefits, perhaps because of diminishing returns to risk-shifting. Some of these models have used their welfare metrics to identify an "optimal" level of a capital requirement.

In Christiano and Ikeda (2013), banks embedded in a DSGE model exert effort to select project quality, and restrictions to leverage force banks to exert more effort to increase the efficiency of investment. Leverage restrictions reduce spreads and improve productivity in the economy via general equilibrium effects. In their calibration based on US data, Christiano and Ikeda (2013) find that when the capital ratio rises from 5 to 6 percent, steady state welfare jumps by the equivalent of a permanent 1.19 percent increase in consumption, although bank lending and output decline significantly. This welfare result is the opposite of what found by Van den Heuvel (2008).

In Martinez-Miera and Suarez (2014), banks trade-off higher return from correlated exposures with the risk of losing their charter value in unfavorable realizations of the return on such exposures. Their calibration delivers an "optimal" capital ratio of 14 percent. When this ratio increases from 7 percent to the "optimal" 14 percent level, bank credit declines by about 20 percent and a model measure of GDP by 8 percent. In reality, the size of these declines is typically associated with banking crises. Yet, in their model welfare improves.

Nguyen (2014) introduces banks in a model of endogenous growth, with two sets of banks that invest in two separate islands and cannot diversify. Under the standard asymmetric information assumption of unobservable actions and limited liability, banks in the island with less productive investment opportunities always risk-shift and are highly levered, while banks in the island with better investment opportunities never risk shift and have lower leverage. By reducing risk shifting, capital regulation increases productivity and consumption, resulting in higher exit rates of the banks in the less productive island, but overall output is reduced. He finds that the "optimal" level of minimum Tier 1 capital requirement is 8 percent, which is a value substantially higher than that prescribed by Basel III regulation. Increasing capital requirements to reach this "optimal" level would improve welfare by an amount equivalent to more than 1 percent of lifetime consumption. Yet, bank lending and output decline significantly.

In Clerc et al. (2014), banks allocate funds to two sectors, business and real estate. As in several of the papers just reviewed, in this model capital requirements reduce risk-shifting and increase the quality of the investment projects financed is at work. Their calibration implies an optimal steady state regulatory capital ratio of about 10 percent for loan exposures, and about 5 percent for real estate exposures. In steady state, they find an inverted-U shaped relationship between model GDP and household consumption similar to that found by De Nicolò et al. (2012, 2014) between capital requirements and bank lending. Yet, the turning point is much higher.

Finally, Begenau (2015) presents a model which can be viewed as an extension of Van den Heuvel (2008) set-up, since household value bank liquidity and capital requirements control for the level of risk shifting. Calibrating the model using US data, she finds an inverted-U shaped relationship between bank lending and capital requirements, as in De Nicolò et al (2012, 2014). Yet, her "optimal" regulatory capital ratio in steady state is 14 percent, which is a value matching what found by Martinez-Miera and Suarez (2014), it is almost double than the 8 percent found by Nguyen (2104), and it is more than tripled than that implied by Van Den Heuvel (2008) model.

Summing up, the equilibrium models just reviewed generate a broadly consistent *qualitative* picture of the long term impact of an increase in capital requirements on lending and real activity: lending and real activity typically decline and a non-monotonic, and there exists an inverted-U shaped relationship between bank lending, welfare, and capital requirements. Yet, quantitative assessments differ substantially. In Van den Heuvel (2008) and De Nicolò et al. (2014), the level of regulatory capital ratios beyond which either lending or welfare declines is found relatively small, and surely below Basel II ratios. In the other papers I reviewed, by contrast, the range of estimates of an "optimal" capital ratio is well above the ratios prescribed by even Basel III standards, although there are non-trivial differences within these estimates.

Can some empirical evidence throw light on the differences in quantitative results of these counterfactual policy experiments? I turn to data next.

## III. CAPITAL RATIOS AND BANK LENDING: BANK-LEVEL DATA

In this section I use a version of the statistical specification originally introduced by Hancock et al. (1995, 1998), and recently implemented by Flannery and Rangan (2008) and Berrospide and Edge (2010) with US bank data, and Francis and Osborne (2012) with UK bank data.

I proceed in two steps. First, I estimate the impact of deviations of bank capital levels relative to the estimated capital target on loan *growth*: this estimate quantifies the short-term impact of changes in capital on loan growth. Second, I estimate the impact of changes in the target *level* of capital on *levels* of bank loans: this estimate quantifies the long-term impact of changes in bank capital target on levels of bank loans. Following Kashyap et al. (2010), I also estimate simple regressions of the net interest margin (net interest income over earning assets) on capital ratios to gauge the extent to which variation in capital ratios are associated with a proxy measure of the spread of the cost of bank credit relative to a bank's cost of funds.

### A. The statistical model

Denote with $\ln EA_{tt}$ the log equity-to-asset ratio and with $\ln L_{it}$ the (log) level of loans of bank *i* at date *t,* with $\Delta \ln EA_{it} \equiv \ln(EA_{it} / EA_{it-1})$ and $\Delta \ln L_{it} \equiv \ln(L_{it} / L_{it-1})$ the relevant growth rates, and with $\ln EA_{it}^{*}$ and $\ln L^{*}_{it}$ the targets of the (log) capital ratio and the (log) loan level respectively. The dynamics of $\ln EA_{tt}$ and $\ln L_{it}$ is assumed to follow partial adjustment processes described by:

$$\Delta \ln EA_{it} = \lambda_{EA}(\ln EA_{it}^{*} - \ln EA_{it-1}) + \varepsilon_{it} \qquad (1)$$

$$\Delta \ln L_{it} = \lambda_{L}(\ln L^{*}_{it} - \ln L_{it-1}) + \eta_{it} \qquad (2)$$

The target (log) capital ratio $\ln EA_{it}^{*}$ is assumed to be a function of a set of variables $X_{it}$, to be specified below:

$$\ln EA_{it}^{*} = \alpha_i + \gamma_t + \beta X_{it} \qquad (3).$$

The target (log) loan level $\ln L_{it}^{*}$ is assumed to be a linear function of variables $X_{it}$ *and* of both the (log) level of target capital and the deviation of the (log) level of target capital from actual values.

$$\ln L_{it}^{*} = a_{Li} + \gamma_{Lt} + \beta_L X_{it} + A_L \ln EA_{it}^{*} + B_L(\ln EA_{it}^{*} - \ln EA_{it-1}) \qquad (4)$$

Inserting (3) in (1), the dynamics of $\ln EA_{it}$ is given by:

$$\Delta \ln EA_{it} = A_{EAi} + B_{EAt} + C_{EA} X_{it} - \lambda_{EA} \ln EA_{it-1} + \varepsilon_{it} \qquad (5),$$

where $\mathrm{A}_{EAi} \equiv \lambda_{EA}\alpha_i$, $\mathrm{B}_{EAt} \equiv \lambda_{EA}\gamma_t$ and ;$C_{EA} \equiv \lambda_{EA}\beta$

Inserting (4) in (2) yields:

$$\Delta \ln L_{it} = \lambda_L \{(a_{Li} + \gamma_{Lt} + \beta_L X_{it} + A_L \ln EA_{it}^{*} + B_L(\ln EA_{it}^{*} - \ln EA_{it-1}) - \ln L_{it-1}\} + \eta_{it} \quad (2')$$

Inserting in Equation (2') $\ln EA_{it}^{*}$ from (3) and $(\ln EA_{it}^{*} - \ln EA_{it-1})$ from (1) yields:

$$\Delta \ln L_{it} = \mathrm{A}_{Li} + \mathrm{B}_{Lt} + C_L X_{it} + \lambda_L \lambda_{EA}^{-1} B_L \Delta \ln EA_{it-1} + e_{it} \qquad (6),$$

where $\mathrm{A}_{Li} \equiv \lambda_L(a_{Li} + A_L\alpha_i)$, $\mathrm{B}_{Lt} \equiv \lambda_L(\gamma_{Lt} + A_L\gamma_t)$, $C_L \equiv \lambda_L(\beta_L + A_L\beta)$, and $e_{it} = \eta_{it} - \lambda_L \lambda_{EA}^{-1}\varepsilon_{it}$

Equations (5) and (6) are used to assess the *short-term* impact of changes in capital on $\Delta \ln L_{it}$. Specifically, the change in $\Delta \ln L_{it}$ for a one unit change in $\Delta \ln EA_{it}$ is $\lambda_Y \lambda_{EA}^{-1} B_L$, where $B_L$ is the change in $\ln L_{it}^{*}$ due to the divergence between target and actual capital levels. Estimation of (5) and (6) is carried out by standard panel two-stage-least squared

(2SLS) Instrumental Variable (IV) estimation, using as instruments for $\Delta \ln EA_{it}$ the fixed bank effects $A_{EAi}$, the time effects $B_{EAt}$, and the variables in $X_{it}$ and $\ln EA_{it-1}$.

To estimate the *long-term* impact of changes in bank capital on $\ln L_{it}$, I simply assume that the targets of bank capital and lending are achieved in every period, essentially dropping the adjustment process assumption. Under this assumption, Equation (3) and (4) become simple regressions of the form:

$$\ln EA_{it} = \alpha_i + \gamma_t + \beta X_{it} + u_{it} \qquad (3s)$$

$$\ln L_{it} = a_{Li} + \gamma_{Lt} + \beta_L X_{it} + A_L \ln EA_{it} + v_{it} \qquad (4s)$$

An estimate of the elasticity of bank lending to the bank capital ratio is given by $\mathrm{E}_L \equiv A_L$. Regressions (2s) and (4s) are estimated by standard panel 2SLS- IV regressions, using as instruments for $\ln EA_{it}$ the fixed bank effects $\alpha_i$, the time effects $\gamma_t$, and the variables in $X_{it}$

The vector $X_{it}$ includes variables of the same type employed by Flannery and Rangan (2008) and Berrospide and Edge (2010). These variable are: the log of total assets (LnTA), as a proxy of bank size, capturing potential diversification benefits that may translate in lower capital targets; the return on assets (ROA), which reflects banks' choices on how to allocate earnings to either capital (retained earnings) or dividends; a proxy measure of charter value, given by an estimate of Tobin Q (market capitalization plus total liabilities to total assets, TobinQ), capturing the potential for higher capitalization that banks may choose to protect a valuable charter (see e.g. Keeley, 1990); and a proxy measure of market assessment of risk of default, given by the square equity return as a proxy of equity return volatility (see e.g. Atkenson et al. 2013).

As mentioned above, I complete the analysis by estimating a simple regression relating the capital ratio to the interest rate margin $NIM_{it}$ :

$$NIM_{it} = a_{NIMi} + \gamma_{NIMt} + \ln(L_{it} / TA_{it}) + C \ \ln EA_{it} \ + v_{it} \quad (7)$$

Equation (7) is a standard OLS regression with fixed bank and time effects.

### B. Data and results

Estimation of the impact of changes in capital requirements on bank lending is carried out using a panel of a large set of publicly traded banks around the world. The data are taken from the Wordscope database retrieved from Datastream. It consists of consolidated account and market data for a panel of about 1,400 publicly traded banks in 43 advanced and emerging market economies for the period 1982-2013.

Table 1 reports summary statistics of the data, splitting the sample in three sub-samples: U.S. banks (including about 740 banks, depending on data availability), banks in advanced economies excluding the U.S. (marked Advanced ex. US, about 440 banks, depending on data availability), and banks in Emerging market economies (about 220 banks, depending on data availability). This panel dataset is unbalanced due to mergers and acquisitions, but all banks active in each period are included in the sample to avoid survivorship biases.

Table 2 reports the estimation results of regressions (5) and (6) and the relevant estimates of $E_S = \lambda_Y \lambda_{EA}^{-1} B_L$ and $B_L$.[4] Looking first at the estimates of Equation (5) (columns 1, 3, 6), note that: a) the coefficient of bank size is not significant for the U.S. sample, consistent with the results in Flannery and Rangan (2008), but it is negative and significant for the other two subsamples; b) a higher ROA corresponds to higher capital in all samples, as it may be expected; and c) contrary to the "charter value hypothesis", Tobin Q enters negatively and significantly in all regressions.

The estimates of Equation (6) (columns 2, 4 and 6) exhibit a fairly uniform qualitative picture across all sub-samples: the impact of an increase in the capital ratio on loan growth is negative and significant. To get a sense of magnitudes, consider the estimate of the $B_L$ coefficient for the U.S. sample, which equals –0.136. This estimate implies that a bank with a capital ratio of 10 percent and a target ratio raised to 11 percent (i.e. by 10 percent) would reduce the target loan level by about 1.36 percent in the next period relative to a bank that does not need to change its target (see Equation (4)) . These estimates are significantly larger than those obtained by Berrospide and Edge (2010) and by the central bank studies reviewed earlier. The relevant estimates for the other sub-samples are lower than those for the US sample, but still fairly large.

Table 3 reports the estimation results of regressions (3s) and (4s) for the three sub-samples. The elasticity of bank lending to bank capital is negative: it equals about –0.41 for the US sample, about –1.74 for the Advanced economies (ex. US), and about –1.82 for

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[4] Note that for the US sample, time fixed effects control for all common sources of variability within the country. Estimates for the Advanced (ex US) and Emerging market samples with GDP growth and inflation added to time fixed effects deliver results very close to those obtained without controlling for them.

Emerging economies. This means that a 10 percent increase in the capital ratio may result in a 4 percent decline in loans supplied by US banks, and a much steeper drop in bank lending in the other two sub-samples.

Lastly, Table 4 reports the regressions with $NIM_{it}$ as the dependent variable: for all sub-samples, higher capital ratios are positively and significantly associated with higher net interest margins, with the Emerging market sample exhibiting the largest impact, followed by the Advanced (ex US) sample.

In sum, the analysis of this bank-level panel dataset delivers two main results:

1. The *short-term* negative impact of an increase in capital ratios on loan growth is sizeable: it is larger than previous estimates for the U.S. bank sample, its magnitude is in line with estimates of the studies reviewed earlier for some European bank samples, and it is largest for Emerging market banks;

2. The *long-term* impact of changes in capital ratios on bank loans is significant and relatively large, ranging from a 0.4 percent decline (US sample) to a 1.8 percent decline (Emerging market) in the level of loans for a 10 percent increase in the capital ratio.

## IV. Capital ratios, bank lending and real activity: Country-level data

In this section I link the approach used previously to the connection between growth and financial depth analyzed by the literature on growth and financial development. This literature has identified several channels through which financial development can have a positive impact on growth, with financial deepening being a key driver of countries' growth prospects (see e.g. Levine, 2005). A large empirical literature has estimated a variety of specifications of statistical models of growth, with measures of financial depth found to have a significant positive impact on growth (for a recent review of this literature, see Beck et al., 2014).

Here I use a simple approach to obtain an estimate of the likely quantitative impact of changes in capital requirements on real activity. First, I estimate the impact of bank capitalization on bank credit-to-GDP growth (a measure of banking depth of a country). Then, I estimate the change in real per-capita GDP growth due to the change in bank credit growth to GDP resulting from a change in bank capitalization.

## A. The statistical model

Bank credit to the private sector to GDP in country $i$ t date $t$, denoted by $BC_{it}$, is used as an aggregate measure of the choices of the provision of credit of banks in a country. Standardization by GDP controls for demand factors.

I assume that growth of bank credit to the private sector depends on four factors: profitability, measured by the return on assets ($ROA_{it}$), which captures banks' opportunities to expand activities, including lending; a measure of risk, proxied by the volatility of returns on assets ($ROAV_{it}$), which may negatively affect growth opportunities; the degree of development of financial markets, captured by a proxy measure of financial markets depth, denoted by $FM_{it}$, which may affect bank growth choices by the existence of alternative sources of finance for borrowers; and bank regulatory capital, defined as equity capital to risk-weighted assets as of Basel II, denoted by $EAR_{it}$. In doing so, I basically treat aggregate bank lending to the private sector relative to GDP as the lending choice of the "representative" bank of a country.

Let the growth of the ratio of bank credit to the private sector to GDP be denoted by $B_{it} = \ln(BC_{it} / BC_{it-1})$. The first equation of the statistical model is a bank credit growth regression of the following form:

$$B_{it} = a_i + b \ln EAR_{it} + c_1 ROA_{it} + c_2 ROAV_{it} + c_3 \ln FM_{it} + d \ln BC_{it-1} + e_{it} \quad (8)$$

The second equation connects bank credit growth to real activity. Denoting with $RGDPPC_{it}$ real per capita GDP, and with $G_{it}$ real *per-capita* GDP growth, defined as $G_{it} = \ln(RGDPPC_{it} / \ln RGDPPC_{it-1})$, the statistical model for $G_{it}$ is:

$$G_{it} = \alpha_i + \beta B_{it} + \gamma Y_{it} + \delta \ln RGDPPC_{it-1} + \varepsilon_{it} \quad (9)$$

According to Equation (9), the growth rate of per-capita real GDP in country $i$, $G_{it}$, is a linear function of the growth rate of the ratio of bank credit to the private sector to GDP, and a set of country specific characteristics, denoted by $Y_{it}$. In the current specification, I include the rate of inflation, denoted by $INF_{it}$ as a control of the macroeconomic environment, which has been widely used in empirical studies.

Estimates of Equations (8) and (9) are used to assess the *short-term* impact of changes in capital on $G_{it}$. Substituting (8) into (9), the change in the growth rate of country $i$ for a one unit *temporary* increase in the regulatory capital ratio is:

$$e_{Sit} \equiv \frac{dG_{it}}{dEAR_{it}} = \frac{\beta b}{EAR_{it}}.$$

Note that the impact of a shock to the regulatory capital ratio is declining in the actual capital level, as it may be expected. Estimation of (9) and (10) is carried out by standard 2SLS-IV estimation with fixed and time effects, using as instruments for $B_{it}$ the fixed bank effects $a_i$, and the set of variables $(EAR_{it}, ROA_{it}, ROAV_{it}, \ln FM_{it}, \ln BC_{it-1})$.

To estimate the *long-term* impact of changes in bank capital on $G_{it}$, I assume that the long-run relationship between regulatory capital, bank credit growth to GDP, and real per-capita GDP growth in the cross-section is approximated by inserting time averages of all variables in Equations (8) and (9), and assuming constant (steady state) growth rates. Denoting time averages by dropping the time subscripts, and imposing constant growth rates for each country in Equation (8) and (9) yields:

$$B_i = \frac{1}{1+d}(a_i + b\ln EAR_i + c_1 ROA_i + c_2 ROAV_i + c_3 \ln FM_i) \quad \text{(8s)}$$

$$G_i = \frac{1}{1+\delta}(\alpha_i + \beta B_i + \gamma X_i + \delta \ln RGDPPC_i) \quad \text{(9s)}$$

Therefore, a measure of the change in the long-run growth rate of country $i$ for a one unit *permanent* increase in the regulatory capital ratio is:

$$e_{Li} \equiv \frac{dG_{it}}{dEAR_i} = \frac{dG_{it}}{dB_i}\frac{dB_i}{dEAR_i} = \frac{\beta b}{EAR_i(1+d)(1+\delta)}.$$

Note that because the impact on growth of an increase in the regulatory capital ratio is decreasing in the level of this ratio, the distribution of $e_L$ across countries depends on the distribution of average regulatory capital ratios, which reflect the level of capital as well as the composition of assets by risk, as captured by the Basel II measures of risk weighted assets.

As before, I complete the analysis by estimating a simple regression relating the regulatory capital ratio to the interest rate margin $NIM_{it}$:

$$\Delta NIM_{it} = a_{NIMi} + \gamma_{NIMt} + \beta INF_{it} + \delta \ln(L_{it} / TA_{it}) + C \ \ln EAR_{it} + \rho NIM_{it-1} + v_{it} \quad (10)$$

Equation (10) is a standard OLS regression with fixed country and time effects.

### B. Data and results

The empirical analysis is carried out using a panel dataset on aggregate banking variables and GDP growth for 89 countries during 1998-2011. The source of the data is the Global Financial Development Database developed at the World Bank.[5] This database collects a wide array of data from different sources for a large set of economies, including measures of credit of financial institutions and financial markets relative to the size of the economy (financial depth), as well as aggregate indicators of bank balance sheets and real GDP. The size of the sample I use is limited by the availability of regulatory capital ratios, whose series starts in 1998.

Table 5 reports summary statistics of the data (Panel A) and the percent breakdown of available observations by country income group (Panel B). As shown in this latter panel, the sample includes a large fraction of observations for high-income and medium-high-to-medium-low income countries, albeit the representation of low income countries is minor. In the sequel, estimation is carried out for the whole sample, as well as using two subsamples: the first sub-sample includes all high-income countries, while the second one includes the remaining countries (classified as medium to low income).

Table 6 reports the estimation results of regressions (8) and (9) for the entire sample and the two subsamples mentioned above. Looking first at the estimates of Equation (8) (columns 1, 3, 6), note that: a) the coefficient of bank capital is negative and significant in all regressions, and coefficients are fairly similar across the two sub-samples; b) for both sub-samples, the volatility of earnings impacts negatively on bank lending growth, although the relevant coefficient is marginally significant for the high income country sample; and c) the

[5] Data and documentation can be found at http://data.worldbank.org/data-catalog/global-financial-development)

coefficient of financial market depth enters positively and significant in these bank credit growth regressions, suggesting that developments of both bank lending growth and financial markets developments are complementary. The estimates of Equation (9) (columns 2, 4 and 6) indicate that the impact of bank credit growth on real GDP per-capita growth is positive and significant, and it is comparatively larger for high income countries relative to medium to low income ones.

Table 7 summarizes the distribution of estimated measures of the impact of a 2 percent increase in the regulatory capital ratio on real GDP per-capita growth in the short- and long-run obtained using the estimated coefficients of Equations (8) and (9). A 2 percent increase in the regulatory capital ratio is estimated to result into a short-term decline of annual growth between 0.48 and 0.88 percent, and a long-term decline of annual steady state growth between 0.60 and 1 percent. These estimates are about four times larger than the earlier central bank estimates across models (see Angelini et al., 2011, Table 4).

Lastly, Table 8 reports the regressions with $NIM_{it}$ as the dependent variable: for both the whole sample and the two sub-samples. Higher capital ratios are positively and significantly associated with higher net interest margins, with the largest positive impact witnessed for the Emerging market sample, as previously found using bank-level data.

Summing up, the analysis of the country-level panel dataset delivers two main results:

1. The *short-term* negative impact of an increase in capital ratios on real GDP per-capita growth is sizeable, and it is largest for high income countries than medium to low income ones;

2. The *long-term* negative impact of changes in capital ratios on annual real GDP per capita growth is sizeable as well, ranging from about 0.6 percent (Low to income countries)

to between 0.6 and 1 percent (High income countries) for a 2 percent increase in the regulatory capital ratio.

## V. Conclusions

This paper has revisited the impact of capital requirements on lending and real activity by reviewing the earlier empirical literature and the quantitative results from recent equilibrium models, and by presenting novel empirical estimates on the short-term and long-term impact of an increase in capital requirements on lending and real activity using international data panels at a firm and country level.

The counterfactual experiments of recent equilibrium models I reviewed generate a negative long-term impact of an increase in capital requirements on lending and real activity significantly larger than that obtained in the previous literature. One possible explanation for such difference in results is that these more recent models embed financial frictions significantly stronger than those embedded in previous models, resulting in calibrations that produce larger effects on "real" quantities. However, the quantitative results of these models differ substantially: while the quantitative results of the models by Van den Heuvel (2008), De Nicolo et al. (2014), and Corbae and D'Erasmo (2014) seem broadly consistent with the empirical evidence I just presented, those of all the other recent models produce quantitative results significantly larger than such evidence. This suggests that these latter models may embed financial frictions whose quantitative importance is overstated.

My empirical results on the *short-term* impact of capital requirements on bank lending and real activity are consistent with some of the more recent empirical papers that have been able to implement versions of "natural experiments" using country-specific datasets. Differences of quantitative results with some results of the earlier literature might be in part due to my use of larger samples for a longer time span, which includes the financial crisis of 2007-2009. My empirical results on the *long-term* impact of capital requirements on bank lending and real activity are quantitatively slightly larger than those obtained for the short-term impact. Differences with the results of earlier literature might due to my use of estimates based on quantities, rather than using the two step approach that evaluates long term changes in lending and real activity through predicted long-term changes in loan rates.

In their review, Kashyap et al. (2010) made an important distinction between flow and stock effects as related to short-term and long-term outcomes respectively. They observed that while increases in capital requirements implemented too abruptly might likely cause a significant impact on lending and real activity because banks would respond by contracting assets, in the long-term these effects might be more muted, since stocks of assets and their composition would be restored at new levels after the transition. This might occur if banks' optimal steady state "targets" of asset and liability composition—i.e. their business models—are invariant to changes in capital regulation. The empirical evidence on long-term effects I just presented suggests that this might not be the case. Recent evidence by Baker and Wurgler (2015), as well as my simple regressions on bank net interest margins, are consistent with this conclusion. To be sure, more research developing quantitative equilibrium models is needed, and a battery of robustness tests for my estimates is also in progress with preliminary reassuring results. Therefore, both the results of the counterfactual experiments of recent equilibrium models and the evidence just presented suggest that the negative impact of an increase in capital requirements on bank lending and real activity in the short- as well as the long-term appears larger than previously thought.

An important concluding note is in order. The debate and relevant research on the impact of capital requirements on bank lending and real activity has been mainly and traditionally focused on what *levels* of minimum (risk-weighted) capital ratios might be best for different types of banks' exposures. Comparatively less attention has been devoted to the issue of the *implementation mechanisms* of given required capital ratios, assuming implicitly that established required levels and implementation mechanisms are independent. A key result in De Nicolò et al. (2014) is that a resolution procedure contingent on observed bank capitalization in the form of "prompt corrective action" is shown to dominate non-contingent capital requirements in terms of calibrated measures of both bank efficiency and welfare. This result suggests that explicitly including *how* a given capital regulation is implemented might deliver a more comprehensive, and perhaps different perspective on what might be the most desirable *levels* of bank capital requirements.

**Table 1.** ***Summary Statistics of the bank-level panel dataset***

| | | U.S. | | | Advanced (ex.US) | | | Emerging | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Variable** | **Obs** | **Mean** | **Std. Dev.** | **Obs** | **Mean** | **Std. Dev.** | **Obs** | **Mean** | **Std. Dev.** |
| Log(Total Assets) | LnTA | 11630 | 13.58 | 1.65 | 9671 | 16.49 | 2.05 | 3644 | 15.62 | 1.93 |
| Equity/Total Assets | EA | 11551 | 10.13 | 5.78 | 9631 | 5.90 | 4.62 | 3586 | 10.70 | 9.49 |
| Retun on Assets | ROA | 11455 | 0.69 | 0.88 | 9571 | 0.42 | 0.73 | 3375 | 0.93 | 1.11 |
| Tobin Q | TobinQ | 10177 | 1.04 | 0.07 | 8854 | 1.02 | 0.07 | 3163 | 1.18 | 2.17 |
| Standard deviation of Equity Return | ERSD | 10389 | 30.18 | 44.24 | 8372 | 26.79 | 29.44 | 3065 | 42.20 | 44.19 |

**Banks by Country**

| Advanced (ex.US) | Obs. | Emerging | Obs. |
|---|---|---|---|
| AUSTRALIA | 263 | ARGENTINA | 118 |
| AUSTRIA | 251 | BRAZIL | 83 |
| BELGIUM | 71 | CHILE | 120 |
| CANADA | 255 | CHINA | 218 |
| DENMARK | 795 | COLOMBIA | 119 |
| FINLAND | 84 | CROATIA | 71 |
| FRANCE | 413 | HONG KONG | 22 |
| GERMANY | 394 | INDONESIA | 514 |
| GREECE | 480 | ISRAEL | 150 |
| HONG KONG | 248 | KAZAKHSTAN | 94 |
| IRELAND | 171 | MALAYSIA | 274 |
| ITALY | 408 | MEXICO | 73 |
| JAPAN | 3,139 | PHILIPPINES | 311 |
| NETHERLANDS | 196 | RUSSIAN FEDERATION | 235 |
| NORWAY | 407 | SOUTH AFRICA | 145 |
| POLAND | 253 | TAIWAN | 413 |
| PORTUGAL | 90 | THAILAND | 347 |
| SINGAPORE | 138 | TURKEY | 275 |
| SOUTH KOREA | 450 | UKRAINE | 62 |
| SPAIN | 155 | | |
| SWEDEN | 114 | Total (by assets) | 3644 |
| SWITZERLAND | 655 | | |
| UNITED KINGDOM | 241 | | |
| Total (by assets) | 9671 | | |

**Table 2.** ***Bank-level panel IV regressions (short-term impact)***

$$\Delta \ln EA_{it} = A_{EAi} + B_{EAt} + C_{EA} X_{it} - \lambda_{EA} \ln EA_{it-1} + \varepsilon_{it} \quad (5)$$

$$\Delta \ln L_{it} = \mathrm{A}_{Li} + \mathrm{B}_{Lt} + C_L X_{it} + \lambda_L \lambda_{EA}{}^{-1} B_L \Delta \ln EA_{it} + e_{it} \quad (6)$$

| | U.S | | Advanced (ex.US) | | Emerging | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **VARIABLES** | **ΔLnEA** | **ΔLnL** | **ΔLnEA** | **ΔLnL** | **ΔLnEA** | **ΔLnL** |
| ΔLnEA | | **-16.89*****| | **-10.46***** | | **-8.477***** |
| | | [0.00] | | [0.00] | | [0.00] |
| LnTA | -0.0172 | 40.73*** | -0.0574*** | 41.26*** | -0.0744*** | 56.19*** |
| | [0.129] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| ROA | 0.124*** | 3.112*** | 0.154*** | 3.442*** | 0.0810*** | 2.133*** |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| LnTobinQ | -0.559*** | 7.114** | -0.483*** | 19.26*** | -0.152 | 7.723*** |
| | [0.00] | [0.0181] | [0.00] | [0.00] | [0.131] | [0.00] |
| ERSD | -8.30e-06 | -0.0107** | -0.000163 | 0.00685 | 7.75e-06 | 0.0126 |
| | [0.955] | [0.0197] | [0.707] | [0.196] | [0.966] | [0.105] |
| LnEA(-1) | -0.327*** | | -0.383*** | | -0.452*** | |
| | [0.00] | | [0.00] | | [0.00] | |
| LnL(-1) | | -40.65*** | | -37.66*** | | -50.92*** |
| | | [0.00] | | [0.00] | | [0.00] |
| LnTA(-1) | | | | | | |
| Constant | 0.691*** | -15.98*** | 1.275*** | -61.56*** | 1.950*** | -85.79*** |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Observations | 9,267 | 9,052 | 7,940 | 7,137 | 2,622 | 2,327 |
| Number of banks | 744 | 741 | 466 | 439 | 256 | 225 |
| R-squared (within) | 0.328 | 0.500 | 0.317 | 0.591 | 0.362 | 0.612 |
| $B_L$ | | **-0.136** | | **-0.106** | | **-0.075** |

Robust pval in brackets
*** p<0.01, ** p<0.05, * p<0.1

**Table 3.** ***Bank-level panel IV regressions (long-term impact)***

$$\ln EA_{it} = \alpha_i + \gamma_t + \beta X_{it} + u_{it} \qquad (3s)$$

$$\ln L_{it} = a_{Li} + \gamma_{Lt} + A_L \ln EA_{it} + v_{it} \qquad (4s)$$

| | US | | Adv. (ex US) | | Emerging | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **VARIABLES** | **LnEA** | **LnL** | **LnEA** | **LnL** | **LnEA** | **LnL** |
| LnTA | -0.0683*** | | -0.158*** | | -0.114** | |
| | [0.00] | | [0.00] | | [0.0218] | |
| ROA | 0.146*** | | 0.199*** | | 0.0909*** | |
| | [0.00] | | [0.00] | | [0.00] | |
| LnTobinQ | -0.765*** | | -0.669*** | | -0.202 | |
| | [0.00] | | [0.00] | | [0.170] | |
| ERSD | -0.000703*** | | -0.000663 | | -0.000175 | |
| | [0.00] | | [0.109] | | [0.411] | |
| **LnEA** | | **-0.407*** ** | | **-1.742*** ** | | **-1.817*** ** |
| | | [0.00] | | [0.00] | | [0.00] |
| Constant | 2.559*** | 11.41*** | 3.654*** | 16.93*** | 3.492*** | 16.83*** |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Observations | 9,400 | 9,275 | 8,049 | 7,393 | 2,690 | 2,511 |
| Number of banks | 744 | 743 | 468 | 445 | 257 | 238 |
| R-squared (within) | 0.226 | 0.716 | 0.254 | 0.426 | 0.139 | 0.233 |

Robust pval in brackets
*** p<0.01, ** p<0.05, * p<0.1

## Table 4. *Bank-level panel regressions: Net Interest Margin*

$$\Delta NIM_{it} = a_{NIMi} + \gamma_{NIMt} + \delta \ln(L_{it} / TA_{it}) + C \ \ln EA_{it} \ + \rho NIM_{it-1} + v_{it} \qquad (7)$$

| | **U.S.** | **Advanced (ex. US)** | **Emerging** |
|---|---|---|---|
| | (1) | (2) | (3) |
| VARIABLES | DNIM | DNIM | DNIM |
| **LnEA** | **1.181***** | **1.420***** | **4.651***** |
| | [0.00] | [0.00] | [0.00] |
| INF | -0.149*** | -0.518*** | -0.340*** |
| | [0.00] | [0.00] | [0.00] |
| Ln(L/TA) | 0.835*** | -0.535*** | 0.0738 |
| | [0.00] | [0.00] | [0.722] |
| | 4.418*** | 8.176*** | -0.107 |
| L.NIM | [0.00] | [0.00] | [0.966] |
| Observations | 9,122 | 7,035 | 2,348 |
| Number of banks | 743 | 438 | 236 |
| R-squared (Within) | 0.248 | 0.289 | 0.149 |

pval in brackets
*** p<0.01, ** p<0.05, * p<0.1

## Table 5. *Summary Statistics of the Country-level panel dataset*

***Panel A***

| Variable | | Obs | Mean | Std. Dev. |
|---|---|---|---|---|
| Growth of real GDP per-capita | G | 966 | 2.81 | 13.11 |
| Inflation | INF | 966 | 0.05 | 0.06 |
| Growth of bank credit to the private sector to GDP | B | 966 | 0.04 | 0.12 |
| Equity to asset ratio | EA | 966 | 9.10 | 3.91 |
| Regulatory capital to risk-weighted assets (Basel II) | EAR | 966 | 15.18 | 4.87 |
| Return on Assets | ROA | 966 | 1.14 | 1.25 |
| Squared ROA | ROAvol | 966 | 2.85 | 4.99 |
| Stock market total value traded to GDP (%) | FM | 966 | 59.28 | 66.47 |

***Panel B***

| Income Group | % of total observations |
|---|---|
| High-income OECD members | 32.2 |
| High-income nonOECD members | 8.5 |
| Low-income economies | 6.3 |
| Lower-middle-income economies | 19.6 |
| Upper-middle-income economies | 33.5 |

**Table 6.** ***Country-level panel IV regressions of growth of bank private credit/GDP (B) and real per-capita GDP growth (G)***

$$B_{it} = a_i + b \ln EAR_{it} + c_1 ROA_{it} + c_2 ROAV_{it} + c_3 \ln FM_{it} + d \ln BC_{it-1} + e_{it} \quad (8)$$

$$G_{it} = \alpha_i + \beta B_{it} + \gamma Y_{it} + \delta \ln RGDPPC_{it-1} + \varepsilon_{it} \quad (9)$$

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| VARIABLES | **B** | **G** | **B** | **G** | **B** | **G** |
| **LnEAR** | **-0.159*** | | **-0.156*** | | **-0.173** | |
| | [0.00] | | [0.00] | | [0.0223] | |
| ROA | 0.00204 | | 0.00178 | | -0.00266 | |
| | [0.637] | | [0.789] | | [0.500] | |
| ROAvol | -0.000465 | | -0.00146*** | | -8.25e-05 | |
| | [0.171] | | [0.00] | | [0.756] | |
| LnFM | 0.0314*** | | 0.0187 | | 0.0401*** | |
| | [0.00] | | [0.107] | | [0.00] | |
| BC(-1) | -0.131*** | | -0.0879*** | | -0.163*** | |
| | [0.00] | | [0.00] | | [0.00] | |
| **B** | | **27.56*** | | **35.12*** | | **21.37** |
| | | [0.00] | | [0.00] | | [0.0157] |
| RGDPPC(-1) | | -0.0568*** | | -0.0469*** | | -0.0725** |
| | | [0.00] | | [0.00] | | [0.0141] |
| INF | | -115.0*** | | -55.88** | | -117.7*** |
| | | [0.00] | | [0.0171] | | [0.00] |
| Constant | 0.901*** | 4.931*** | 0.774*** | 5.615** | 1.027*** | 1.638 |
| | [0.00] | [0.00] | [0.00] | [0.0493] | [0.00] | [0.520] |
| Observations | 966 | 966 | 465 | 465 | 501 | 501 |
| Number of countries | 89 | 89 | 39 | 39 | 50 | 50 |
| R-squared (Within) | 0.296 | 0.470 | 0.376 | 0.405 | 0.306 | 0.533 |

Robust pval in brackets
*** p<0.01, ** p<0.05, * p<0.1

**Table 7.** ***Statistics of the short-term and long-term declines***

*in per-capita GDP growth due to a 2% increase in regulatory capital*

| ***Country groups*** | | | **SHORT TERM** | | |
|---|---|---|---|---|---|
| ***High Income*** | **mean** | **sd** | **min** | **max** | **median** |
| High-income OECD members | 0.88 | 0.15 | 0.46 | 1.66 | 0.88 |
| High-income nonOECD members | 0.65 | 0.10 | 0.46 | 1.00 | 0.64 |
| ***Medium to Low Income*** | | | | | |
| Low-income economies | 0.50 | 0.37 | 0.17 | 2.55 | 0.41 |
| Lower-middle-income economies | 0.48 | 0.15 | 0.15 | 1.06 | 0.48 |
| Upper-middle-income economies | 0.48 | 0.17 | 0.18 | 2.96 | 0.47 |
| ***High Income*** | | | **LONG-TERM** | | |
| High-income OECD members | 1.00 | 0.11 | 0.80 | 1.24 | 0.97 |
| High-income nonOECD members | 0.73 | 0.08 | 0.64 | 1.04 | 0.74 |
| ***Medium to Low Income Group*** | | | | | |
| Low-income economies | 0.59 | 0.33 | 0.29 | 1.85 | 0.54 |
| Lower-middle-income economies | 0.60 | 0.15 | 0.29 | 0.81 | 0.62 |
| Upper-middle-income economies | 0.60 | 0.12 | 0.35 | 0.99 | 0.58 |

**Table 8.** ***Country-level panel regressions: Net Interest Margin***

$$\Delta NIM_{it} = a_{NIMi} + \gamma_{NIMt} + \beta INF_{it} + \delta \ln(L_{it} / TA_{it}) + C \ \ln EAR_{it} \ + \rho NIM_{it-1} + v_{it} \qquad (10)$$

| | All countries | High Income | Medium-to-low Income |
|---|---|---|---|
| | (1) | (2) | (3) |
| VARIABLES | dnim | dnim | dnim |
| **LnEAR** | **0.726**** | **0.507**** | **0.744**** |
| | [0.0102] | [0.0376] | [0.0358] |
| INF | 0.222 | 3.283 | -0.0211 |
| | [0.841] | [0.228] | [0.986] |
| Ln(L/TA) | 0.0435 | -0.655 | 0.355 |
| | [0.952] | [0.363] | [0.682] |
| L.nim | -0.700*** | -0.543*** | -0.720*** |
| | [0.00] | [0.00] | [0.00] |
| Constant | 0.859 | -0.448 | 1.874* |
| | [0.289] | [0.573] | [0.0928] |
| Observations | 1,086 | 439 | 647 |
| Number of countries | 106 | 39 | 67 |
| R-squared (Within) | 0.425 | 0.314 | 0.449 |

Robust pval in brackets
*** p<0.01, ** p<0.05, * p<0.1

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