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THE EFFECTS OF MACROPRUDENTIAL POLICY ON BANKS' PROFITABILITY

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Abstract

Despite the importance of profitability to banks' growth and stability, there have, to our knowledge, been no studies which assess the effect of macroprudential regulation on banks' profitability, a key aspect of the transmission of macroprudential measures. We seek to fill this lacuna with empirical estimates for a sample of 6,010 global banks. These suggest that over 2000-2013, a number of measures of macroprudential policy had a negative and significant effect on banks' profitability as measured by return of average assets and return on average equity. Furthermore, the effect of macroprudential policy on banks' profitability varies between advanced and emerging market economies, with some differences also apparent between retail and universal banks.

Assessing our results in combination with existing estimates of the impact of macroprudential policy on credit expansion, some measures such as interbank restrictions, concentration limits and taxes on financial institutions are found to affect lending negatively but not profitability; others, such as loan-to-value ratios, the debt-to-income ratio, domestic currency loan limits and the general countercyclical capital buffer affect both negatively; and some, such as reserve requirements and capital surcharges on SIFIs, affect profitability with no significant effect on lending. Since it is probably desirable for banks to make profits and build up capital from retained earnings, according to our results, the first group are more desirable than the second, and the third is the least desirable.

Keywords: Macroprudential policy, bank profitability, return of average assets, return on average equity

JEL Classifications: E44, E58, G17, G28

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1. Introduction

It has been more than ten years since the global financial crisis of 2007-2008, which contributed to the widespread introduction of macroprudential policy as an essential financial regulatory policy tool to forestall or limit the impact of banking crises. Supporting this, there have been numerous empirical studies which provide robust evidence for the effectiveness of macroprudential policy in advanced countries and emerging market economies such as Davis et al (2017), Carreras et al (2018), Cerutti et al (2017), Akinci and Olmstead-Rumsey (2018), Claessens et al (2013), Dell'Ariccia et al (2012) and Lim et al (2011)). Most of these studies have specifically focused on the effectiveness of macroprudential policy in the area of the financial sector where there is the most potential for systemic risk to develop, that is bank credit and the housing market.

In this context, banks remain central in the financial sector in virtually all countries; a sound and profitable banking sector remains important for the effective functioning of the economy. This is despite the increased trend toward disintermediation of banks with the growth of capital and securities markets, improvement in financial system technology and the transformations of banks' operating environment. A recent example is the flight to bank credit lines by companies when securities markets closed to all but the most creditworthy firms in March 2020 as the Coronavirus took hold. Furthermore, a robust and well capitalised banking sector is better able to withstand negative shocks from financial disruptions and thus contribute to financial stability. However, despite the importance of profitability to banks' growth, survival, stability and the significance of the banking sector for the real economy, and the recent growth in importance of macroprudential policy, there have, to our knowledge, been no studies which assess the effect of macroprudential regulation on banks' profitability.

Indeed, we believe there is a gap in the literature on macroprudential policy, where the focus tends to be on the overall system-wide effects of such regulation, and not on the effects on banks as measured by the impact on their profitability, structure and activities. Most of the studies cited above use macroeconomic data and there is limited research using micro banking data in analysing the use of macroprudential policy (for an exception, see Claessens et al (2013) which focused on individual banks' asset growth as a dependent variable). Whereas there is extensive research on bank profitability determinants at a micro level, this does not include assessment of the impact of most macroprudential measures (although such studies do often include a measure of capital adequacy).

In support of the relevance of the question, Van den Heuvel (2008) and Tchana (2012) suggested that although capital requirements limit moral hazard on the part of banks and hence are beneficial for financial stability, they are costly since they reduce the ability of banks to lend, and thus can hamper long term economic growth, which is an unintended side effect of regulations that limit banking activities. We contend further that although the premise of macroprudential policy is to prevent or limit financial instability across the broad financial system, extant macroprudential tools and related new regulations target the banking sector narrowly. As such, macroprudential action can be seen as an added cost to banks which in turn can affect banks' profitability. This impacts their net income, the cost of credit and their ability both to lend and to build up capital via retained earnings. It could hence be counterproductive to financial stability in the longer term as well as impacting on economic performance.

In this overall context, the purpose of this article is to present empirical research showing effects of macroprudential policies on banks' profitability. The literature on costs of regulations (microprudential policy) to the banking sector focuses on the effect on lending (Van den Heuvel (2008) and Tchana (2012)); similarly, macroprudential policy looks that limiting excessive financial sector imbalances (credit build-up). We extend this field of research to look at the effects of macroprudential policy on bank profitability (ROAA and ROAE) in the process of restricting credit. Our empirical results cover data from over 6,000 banks over the period 2000-2013. Besides filling the gaps in the literature highlighted above, this also advances understanding of how banks react to macroprudential regulations and hence the transmission process from policy to credit issuance. Cerutti et al (2017), for example, suggested there is a weaker effect of macroprudential policy on asset prices and credit in more developed and more financially open economies, suggesting some avoidance and/or disintermediation of the policy, which should find parallels in profitability.

In sum, we find that a number of macroprudential policies affect profitability significantly, across a range of such policies. These include asset-focused measures such as loan-to-value ratios measures and debt-to-income ratios; a liquidity-based measure - domestic currency loans limits as well as a capital measure – the general countercyclical capital buffer. We find that all of these had a negative and significant effect on banks' profitability as measured by return of average assets (ROAA) and return on average equity (ROAE). Similar results, albeit also some interesting contrasts, are found for two breakdowns of the sample, between advanced countries and emerging market economies and between retail and universal banks. Finally, our results, in combination with the existing literature which focuses on the impact of macroprudential policy on lending, suggest some policies have a comparative advantage over others. This is because some measures are found to affect lending negatively but not profitability, others affect both negatively and some affect profitability with no significant effect on lending. Since it is desirable for banks to make profits and thus be able to build up capital from retained earnings (see Lee 2015), then according to our results, the first group are more desirable than the second, and the third is the least desirable.

The rest of paper is structured as follows, in section 2 we set out the hypothesis of the article. Section 3 discusses the factors found in the empirical literature to affect banks' profitability (ROAA and ROAE). In Section 4 we discuss the datasets used, in Section 5 we introduce the baseline model and methodology and then Section 6 shows the principal results for 2000-13 across the whole sample of banks. In Sections 7 and 8 we look at the breakdown of the sample between advanced and emerging market economies and bank types. In Section 9 we outline two robustness checks and Section 10 concludes.

2 The cost of regulation and the effect on bank activities

Whereas there has been extensive research on determinants of bank profitability, on capital regulations' effect on lending and the impact of macroprudential policy on aggregate lending and asset prices, there remains a need to understand the effect of such macroprudential policies on profitability and activities of individual banks. This is important since banks remain central in the financing of economic activity, and macroprudential policy operates largely through the banking system.

To begin our work, in this section, we briefly survey the literature on the costs of regulation, while noting that it focuses mainly on lending and not necessarily profitability, and that the main regulatory

aspect considered is capital adequacy. This is important background, since we see the effect of macroprudential policy on profitability as another form of regulatory cost.

Van den Heuvel (2008) suggested that although capital requirements limit moral hazard on the part of banks and hence are beneficial for financial stability, they are costly since they reduce the ability of banks to lend, thus can hamper economic growth, which is an unintended side effect of regulations that limit banking activities. Using data for the US from 1993-2004, it was found that the welfare cost of then-current Basel capital adequacy minima of 8% was to reduce consumption by up to one per cent, because it reduces the ability of US banks to create liquidity. Similarly, Tchana (2012) using an overlapping-generations model, found that higher capital adequacy requirements hamper economic growth by shifting banks' portfolios from more productive, risky investment projects toward less productive and safer investment projects. On the other hand, Kim and Sohn (2017) suggested that bank capital requirements have a significant positive effect on lending once banks retain sufficient liquid assets, using quarterly data for US banks over the period 1993 to 2010.

In the UK, Noss and Toffano (2015) looked at the impact of changes in aggregate bank capital requirements on lending and growth during an economic upswing. Their definition of capital (capital-to-assets where assets are not risk weighted) is closer to the leverage ratio than the Basel risk-weighted regulatory capital ratio, as they suggested using a non-risk weighted data provide a better representation of banks' true leverage. Most countries have only focused on the leverage ratio since the recent advent of Basel III. The authors found that an increased capital requirement during an economic upswing is associated with a reduction in lending. The impact on GDP growth is however statistically insignificant as firms substitute from banks' credit towards the bond markets or shadow banking entities (as was indeed the case in the period up to 2020). Similarly, Aiyar et al (2014) indicated that regulated banks (UK-owned banks and resident foreign subsidiaries) reduce lending in response to tighter capital requirement but unregulated banks (resident foreign branches) increase lending in response to tighter capital requirements, suggesting competitive advantages.

Naceur et al (2018), using data on bank holding companies for 23 countries in Europe[1] and the US following the financial crisis for the period 2008-2015, looked at the effects of capital and liquidity regulations (Basel III) on bank lending. They found that capital ratios have significant and negative impacts on large European banks' retail and other lending growth in the context of deleveraging and the "credit crunch" since 2008. More stringent capital adequacy regulations encourage substitution from retail and other loan assets (lending) into less risky and liquid assets such as government bonds because capital is more expensive to hold for assets that are assigned higher risk weights (Basel Accord risk ratings). On the other hand, capital ratios were not found to be statistically significant in the determination of European banks' commercial lending growth.

However, in the US, Naceur et al (ibid) saw that small US banks strengthen their financial soundness and loss absorption capacities when expanding both commercial and retail lending activities, although large U.S. banks only strengthen their leverage ratios when granting riskier, illiquid commercial loans. As such, capital and leverage ratios have significant and positive impacts on US bank-lending growth. They suggested that capitalization plays a major role in US bank lending growth over the period 2008-2015 and also explains the cautious approach of US banks when facing higher risk exposure. Meanwhile, liquidity indicators have a positive and perverse effect on bank-lending growth. Liquidity

[1] Roulet (2017) undertook a similar analysis on EU commercial banks.

ratios (non-required amount of stable funding/ total assets) had a significant and positive impact on commercial lending growth on US banks, regardless of size but only on large European banks.

Pasiouras et al (2009), using a stochastic frontier approach, looked at the effect of the regulatory and supervisory framework (Basel II), official supervisory power and market discipline mechanisms on bank efficiency, cost, activities, and profit. Data came from 615 publicly quoted commercial banks operating in 74 countries during the period 2000–2004. They found that banking regulations that enhance market discipline and empower supervisory authorities increase both cost and profit efficiency of banks. In addition, they suggested that stricter capital requirements improve cost efficiency but lower profit efficiency by restricting bank activities.

A criticism of the above studies is that they do not take into account the benefit of regulation in reducing the probability of a financial crisis. This may more than offset the cost in terms of the net present value of benefits of regulation. Barrell et al (2009) calculated that the cost of tighter regulation is small in the long run, and since the costs of crises are potentially high, then tighter regulation would be appropriate, as the cost of the crisis (appropriately weighted by the effect of the measure on crisis probability) outweighs the cost of the loss of economic output. Davis et al (2019) looking at the UK, Germany and Italy in a similar manner using the NiGEM global econometric model, suggested that the hypothetical introduction of macroprudential measures such as countercyclical capital buffers prior to the subprime crisis would have the reduced the incidence of the crisis and improved macroeconomic performance.

Turning to the literature on effects of macroprudential policy, there is empirical evidence which suggest that macroprudential policy is effective in reducing the build-up of financial system imbalances. However, there tends to be a focus on the housing and credit market measures such as credit growth, house prices and the credit-to-GDP gap as shown for example in Davis et al (2017), Carreras et al (2018), Cerutti et al (2017), and Akinci and Olmstead-Rumsey (2015). Davis et al (2020) show that macroprudential policy (regulation) has a stronger effect on credit originating in the domestic financial system rather than cross-border lending from international banking firms.

The studies above used macro data. In one of the few micro studies of the effects of macroprudential policy, Claessens et al (2013) looked at the effectiveness of macroprudential policy in reducing banking system vulnerabilities as measured by individual bank asset growth. Estimation was for 48 countries, including 1650 banks in 23 advanced countries and 1,170 banks in 25 emerging markets. Using panel GMM regressions and relating these policies to changes in individual banks' assets, they found that policies aimed at borrowers are effective in (indirectly) reducing the build-up of banking system vulnerability. Measures aimed at banks' assets and liabilities are very effective, but countercyclical buffers as a group show less promise. The group of miscellaneous policies is also very effective.

Generally the above mentioned empirical analyses on the effectiveness of macroprudential policy typically find that asset measures such as debt-to-income ratio (DTI), loans-to-value ratios (LTV and LTVCAP), concentration limits (CONC) and liquidity measures such as limits on foreign and domestic currency loans, are the most effective macroprudential instruments. Table 1 summarises the results of these papers.

Table 1: Summary table of the sign and significance of the effects of macroprudential policy in recent research

Paper	Davis et al (2017)	Carreras et al (2018)	Cerutti et al (2017)	Claessens et al (2013)
Dependent variable	Credit-GDP gap	Growth in real lending to households	Growth in real non-financial private sector domestic bank credit	Individual bank asset growth
Sample date	2000-13	2000-13	2000-13	2000-10
Country/sector coverage	Global	Advanced	Global	Global
Loan-to-Value Ratio	(-)***	(-)***		(-)***
Debt-to-Income Ratio	(-)***		(-)**	
Capital Surcharges on SIFIs				Na
General Countercyclical Capital Buffer/Requirement				(-)***
Time-Varying/Dynamic Loan-Loss Provisioning	(-)**		(-)***	
Leverage Ratio				Na
Limits on Interbank Exposures		(-)***	(-)**	Na
Concentration Limits	(-)***			Na
Limits on Domestic Currency Loans				(-)**
Levy/Tax on Financial Institutions		(-)***		Na
Reserve Requirement Ratios				
Limits on Foreign Currency Loans			(-)*	
Loan-to-value ratio caps	(-)***		(-)*	Na
FX and/or Countercyclical Reserve Requirements				Na
All variables aggregated in total	(-)***	(-)***	(-)***	Na
Borrower-targeted instruments(LTV_CAP plus DTI)	(-)***		(-)**	(-)***
Financial-Institution targeted instruments	(-)***	(-)***	(-)***	(-)***(a)

Notes: Instruments were entered one at a time. *** Significant at 1%, ** significant at 5%, * significant at 10%. (a) applies to asset-related tools only not buffers. Each study used the same GMPI database of macroprudential instruments as the current study (see Section 4 below). The credit-to-GDP gap is the difference in percentage points between the total non-financial private sector credit-to-GDP ratio and its trend (see BIS 2016).

In this context, we contend that, if macroprudential policy reduces the ability of banks to lend, then there should be a significant and negative effect on bank profitability as it will reduce net interest income, unless it can be offset by increases in non-interest income, reductions in non interest costs or provisions. This in turn reduces banks' ability to accumulate capital, as well as to distribute dividends.

Our Hypothesis 1 is therefore as follows: If macroprudential policy is effective in reducing financial system imbalances as measured by the credit-to-GDP gap, general credit growth or house prices growth, there should also be a significant and negative effect on banks' profitability. An alternative Hypothesis 2 is that banks' profitability may not be affected as banks may be able to shift their activities from net interest income to non-traditional activities and increase fee-based income when lending is constrained by macroprudential measures.

3. Empirical research on the factors affecting banks' profitability

The background to our modelling in terms of choice of empirical framework and choice of control variables is the extensive literature on the determinants of bank profitability, with key papers cited below including Goddard et al (2004, 2013), Pasiouras and Kosmidou (2007), Athanasoglou et al (2006), Petria et al (2015), Chronopoulos et al (2015), Saona (2016) and Korytowski (2018). We note that many of these studies are regional or national in focus, and accordingly our paper breaks relatively new ground by using global data.

The empirical literature most commonly measures banks' profitability by the returns on average assets (ROAA) and equity (ROAE). ROAA reflects how a bank is using its assets to generate profits while ROAE measures the performance of a bank based on its average shareholders' equity, the return to shareholders on their equity. The returns figure can be divided into a number of subcomponents, namely net interest income, non-interest income, non-interest costs and provisioning. Some articles in this field focus more specifically on one or more of these subcomponents, notably net interest income and the related net interest margin.

The factors that influence banks' profitability in the literature are typically split in two groups, internal and external determinants. The internal determinants include bank-specific factors which are based on financial statements information such as bank size, financial structure (capital/ leverage ratios), risks incurred and management efficiency. The external determinants relate to industry and macroeconomic factors, which include market concentration, competition, economic growth and inflation as well as monetary policy. Macroprudential measures such as loan-to value or debt-to-income measures would tend to fall in the latter category, although the outcome of capital adequacy regulations in terms of bank leverage per se is an internal measure. We now go on to outline these influences in more detail, as revealed by the extant empirical literature.

3.1 Internal factors

Empirical research suggests that *bank size* tends to have a positive and significant effect on bank profitability, at least up to a certain point. Goddard et al (2004), using data from 665 banks in six European countries (Denmark, France, Germany, Italy, Spain and the UK) over the period 1992-1998, found that larger banks can benefit from economies of scale but these become exhausted as size increase. However, they found that the bank size-profitability relationships in their estimations are problematic since the cross-sectional estimations between the countries produced different results. For example, in Germany the small banks appeared to perform better than the larger ones, while in the UK larger banks seen to benefit from their size. In France, Denmark, Italy and Spain the results the size-profit relationship appears to be neutral.

Similarly, Pasiouras and Kosmidou (2007), who analysed the determinants of ROAA using banking data from 15 EU countries over the period 1995-2001, found that larger banks are likely to have a higher degree of product and loan diversification than smaller banks and they should benefit from economies of scale. Yet, they found that bank size has a negative effect on profitability. Similarly, Korytowski (2018), using data from 4,179 European commercial banks in the post crisis period from 2011 to 2015 found that bank size had a negative and significant effect on ROAA while it is insignificant for ROAE.

The extant work on the effects of *regulation* on bank profitability is generally limited to the effect of capital structure, which will be partly driven by capital adequacy regulation. Results of empirical estimates of the effect of financial structure on bank profitability are mixed. Rather than using risk-adjusted measures as in the original Basel agreement, this variable is most commonly computed as a reciprocal measure of leverage, namely capital/assets (see Saona (2016)). This is a measure of solvency unadjusted for risk that has only recently become a regulatory measure for most countries under Basel III.

Goddard et al (2004) found a positive effect, suggesting that higher capital ratios allow banks greater flexibility in taking advantage of new business opportunities, which in turn allow for improved profitability. Petria et al (2013), using banking data from 27 European Union countries over the period 2004-2011 did not find a significant impact of capital adequacy ratio on ROAE and a positive but weakly significant effect on ROAA. Athanasoglou et al (2006) examined the profitability (ROA and ROE) of banks using an unbalanced panel dataset in South Eastern European (SEE)[2] credit institutions over the period 1998-2002. They noted that a higher solvency ratio may have a positive effect on performance as it reduces the solvency risks taken by the bank for a given balance sheet. This may also reduce funding costs.

On the other hand, some of the literature such as Hoffmann (2011), who estimated for US banks over 1995-2007, supports a negative relationship between capital adequacy and bank profitability. This was seen to support the notion that highly capitalised banks are over-cautious and ignore potentially profitable trading opportunities. Similarly, Topak and Talu (2017), who looked at the determinants of bank profitability (ROAA and ROAE) in Turkey between 2005 and 2015, found that capital adequacy (equity/ total assets) has a negative and significant effect on bank profitability.

[2] The countries are Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Former Yugoslav Republic of Macedonia Romania, and Serbia-Montenegro.

The measurement and *management of risks* is an integral part of banking, as well as being important for the stability of the financial system. Poor asset quality and low levels of liquidity are the two major causes of bank failures. In respect to the determinants of traditional bank profitability, risks can be divided into credit and liquidity risks (market risk can be included as well) and these risks have been covered extensively in the research literature and in banking regulations such as the Basel Accords.

Athanasoglou et al (2006) found that higher exposure to *credit risk*, measured as average loan loss provisions to total loans ratio is associated with lower bank profitability. Miller and Noulas (1997), using US banking data for the period 1984-1990, also found a negative and significant relationship between credit risk (loan loss provisions to total loans ratio) and profitability (ROA) as banks with high risk loans tend to have a higher accumulation of unpaid loans. However, Korytowski (2018) found European commercial banks' risk appetite (ratio of loan loss reserves to gross loans) to be insignificant in the determinants of banks' profitability (ROAA and ROAE) during the post crisis period.

Petria et al (2013), measured *liquidity risk* as the ratio of loans to customer deposits. When this ratio increases, implying that banks use less deposits to grant loans or grant more loans without increasing deposits, then bank performance deteriorates. With a higher loan/deposit ratio banks are more dependent on costly and volatile wholesale funds. They saw a negative and significant relationship between liquidity and profitability (ROAA and ROAE). On the other hand, Korytowski (2018) found that liquidity has a positive and significant effect on bank profitability (ROAA) but the result is insignificant for ROAE. He again measured liquidity as the ratio of net loans to total deposits.

Athanasoglou et al (2008) using a sample of Greek commercial banks spanning the period 1985-2001 noted that *management cost decisions* benefit bank profitability, suggesting that higher management efficiency generates higher income and profit (both ROA and ROE). They defined management cost as operating expenses divided by assets. Similarly, Goddard et al (2013), noted the cost-to-income ratio, defined as the ratio of total operating cost to total income, is an important determinant of profitability measured by the ROE. They found that cost-to-income ratio has a negative and significant effect on bank profitability using data from banks in eight EU countries between 1992 and 2007, using a dynamic panel model. Korytowski (2018) and Petria et al (2013) found that the cost to income has a negative and significant effect on both ROAA and ROAE.

In addition, *diversification (business mix)* has been noted as having a significant effect on bank profitability. Goddard et al (2013), who proxied diversification by the ratio of non-interest income to total operating income, suggested that banks that focused more on non-traditional lines of business were more profitable on average. They suggested that synergies between core and related activities allow diversified banks to gain and maintain a competitive advantage over less diversified banks. Similarly, Petria et al (2013) found a positive and significant effect of diversification on banks profitability. However, Saona (2016), using commercial bank data from 7 Latin American countries from 1995 to 2012, suggested that there is a negative relationship between revenue diversification and profitability (NIM). As noted, NIM is a subset of profits from interest only, thus these revenue diversification results may not be surprising.

3.2. External factors

Besides the above mentioned internal factors, most empirical studies of bank profitability include external determinants i.e., industry and macroeconomic factors such as interest rates, inflation, GDP growth, taxation, market characteristics (e.g. market concentration and competition) and banking/ financial crisis. We examine these in two sections, industry factors and macroeconomic factors.

3.2.1 Industry factors

Market *concentration and competition*, measures of the effect of bank-specific factors in profitability studies are normally proxied by the Herfindhal-Hirschman Index (HHI), a measure of market concentration or the Lerner Index, which is a measure of the price-cost margin (competition).

Demirguç-Kunt and Huizinga (1999) using bank-level data for 80 countries over 1988-95, reported a positive and statistically significant relationship between bank concentration and bank profits and larger banks tend to have higher profit margins. Also, Goddard et al (2013) and Petria et al (2013) found that concentration had a positive and significant effect on bank profitability. On the other hand, Korytowski (2018) found that concentration (HHI) had a negative and significant effect on both ROAA and ROAE, using European commercial banks data for the post crisis period (2011-2015). Mirzaei et al (2013) assessed the effects of market structure on profitability and stability for 1929 banks in 40 emerging and advanced economies over 1999–2008 by incorporating the traditional structure-conduct-performance (SCP) and relative-market-power (RMP) hypotheses using concentration and market share as the relevant independent variables (see also Berger 1995). They found market share to be more relevant than concentration as a determinant of profitability for advanced countries but neither hypothesis is supported for emerging economies.

Concentration can, moreover, be criticised as a measure of competition since it does not allow for the impact on margins of potential competition from outside the sector (e.g. from cross border lending, securities markets or non-bank lending), and thus the possibility of contestability, which depends in turn on whether there are barriers to entry and exit in the market. Advances in such contestability may explain the differing results of Korytowski (2018) from the earlier literature.

A potentially superior measure to concentration as a measure of market power is the Lerner Index, derived from a translog cost function, and which is a measure of the price-cost margin. It can be seen as a proxy for current and future profits stemming from pricing power, and it varies at the level of the individual bank. Under perfect competition the index is zero as the output price (marginal revenue) equals marginal cost, and "normal" economic profits are zero. Accordingly, in our baseline model, only the Lerner Index is included. Lerner indices were used in bank-profitability studies such as Maudos and Solis (2009) with data for Mexican banks over 1993-2005, and Kasman et al (2010) looking at old and new EU members over 1995-2006. Both studies found that the Lerner Index had a positive and significant effect on bank profitability, implying lower competition raises profitability. This is also consistent with the traditional structure-conduct-performance paradigm (as Dietrich and Wanzenried (2011) found for Swiss banks over 1999-2009). It is indicated that banks are able to increase profitability by exploiting market domination, whereas increased competition tends to have a negative effect on profitability.

There are relatively few studies of the effect of *financial/ banking crises* on bank profitability.[3] One exception is Bouzgarrou et al (2018) who examined the profitability of domestic and foreign banks before, during and after the financial crisis using 170 banks operating in France over the period 2000-2012. They found that the financial crisis had a major impact on the French financial system and financial stability, with a negative effect on profitability for domestic banks and positive effect on foreign banks operating in France. They show also that foreign banks were more profitable than domestic banks especially during the financial crisis.

Xioa (2009) looked at the performance of French banks during 2006-2008 and the impact of the financial support measures taken by the French government. She concluded that French banks were not immune to the turbulence but proved relatively resilient to the financial crisis reflecting their business and supervision features and government policies. Adelopo et al (2017) examined the determinants of bank profitability (ROA and NIM) before (1999-2006), during (2007-2009) and after (2009-2009) the 2007-2008 financial crisis in West African State's bank. They saw that the financial crisis seemed to have no effect on banks profitability.

3.2.2 Macroeconomic factors

Studies that include macroeconomic factors typically find a positive relationship between *inflation, interest rates, GDP growth* on the one hand and bank profitability on the other. Such studies include Athanasoglou et al (2008) and Chronopoulos et al (2015). Saona (2016) suggested that if inflation is fully anticipated by bank managers, this will have a positive effect on profitability as it leads earnings to increase faster than costs. It also enhances the endowment benefit of zero interest deposits as against assets whose return varies with inflation. Yet, he argued that GDP growth impacts negatively on bank profitability, since it appears that in periods of substantial economic growth, banks adjust by reducing their profit margins. However, Korytowski (2018) found that the rate of inflation had negative and significant effect on both ROAA and ROAE in the period after the 2007-2008 financial crisis.

In the research literature, only a few studies have included a monetary policy or an interest rate variable in the study of the determinants of bank profitability, with tests typically finding it insignificant. Those that do include a significant interest rate (such as Alessandri and Nelson (2015) typically focus on the net interest margin and not the ROAA/ROAE as in our work and the bulk of the literature. Effects of interest rates on the net interest margin may be offset in terms of profitability by shifts in other components of total returns.

4. Datasets employed

Our key data stem on the one hand from the Fitch-Connect database, which provides annual financial information for banks, and on the other, the IMF GMPI survey data on macroprudential instruments (Cerutti et al 2015, 2017).

Our sample includes banks from 92 countries, 34 advanced countries and 58 emerging market economies, 6,010 banks (3,095 banks from advanced countries and 2,915 banks from emerging market economies) and 84,140 observations.[4] The types of banks included are universal commercial banks, retail and consumer banks, banks, wholesale banks, and Islamic banks. Investment banks and

[3] There are studies of the impact of crisis on bank failures (such as Cariboni et al (2016) and Yang (2016)).

[4] In contrast, Claessens et al (2013) dataset was for 2,800 banks in 48 countries.

private banks are excluded due to different balance sheet and income structure as are bank holding companies, to avoid double counting. As in Claessens et al (2013) the number of banks for each country covers at least the top 100 banks based on total assets, or less if fewer banks exist on the itch-Connect database.[5] The banking data collected are unconsolidated, which also allows for the reporting of foreign bank subsidiaries in each country. All financial statement data are annual and in US dollars. The period of coverage for the banking data is 2000 to 2013 in line with the GMPI database introduced below. See Appendix 1 for the list of countries and number of banks for each country, as well as a regional breakdown.

Meanwhile, the IMF GMPI dataset on macroprudential instruments covers 119 countries annually over 2000 to 2013 and this constrains the length of our overall dataset. There are 12 survey instruments and 2 additional derived instruments as well as three summary instruments in the publicly available dataset. The database of individual tools includes only categorical as opposed to numerical values for the macroprudential policies (i.e. they show simply whether the policy is applied with one for "on" and zero for "off", not the severity of application). We are showing the effectiveness of tools as applied in practice across the countries concerned, given the typical intervention undertaken.

We used this data set since it covers all the countries that are included in the empirical analysis and it is based on survey data collected from official reporting agencies to the IMF such as central banks and financial sector regulatory authorities.[6] It has been extensively used in earlier studies of the effectiveness of macroprudential policy such as Cerrutti et al (2017), Carreras et al (2018) and Davis et al (2017). The frequency in the dataset is yearly. Table 2 shows the list of instruments in the IMF dataset with a description of its effect.

[5] For most countries with more than 100 banks, at the tail end, the top 100 banks changes from year to year due to mergers and acquisitions and the closure of some banks. These banks are included in the data for the years they existed in order to capture the top 100 banks each year as far as possible and to avoid the loss of data points.

[6] In contrast, the later 2016 database (Cerrutti et al 2016) only covers 64 countries and omits a number of key macroprudential policies such as the debt-to-income ratio and taxes on financial institutions.

Table 2: Instruments in the IMF Dataset of Macroprudential Tools (2015)

Instrument	Abbreviation	Effect
Survey Instruments		
Loan-to-Value Ratio	LTV	Constrains highly levered mortgage down payments by enforcing or encouraging a limit or by determining regulatory risk weights.
Debt-to-Income Ratio	DTI	Constrains household indebtedness by enforcing or encouraging a limit.
Time-Varying/Dynamic Loan-Loss Provisioning	DP	Requires banks to hold more loan-loss provisions during upturns.
General Countercyclical Capital Buffer/Requirement	CTC	Requires banks to hold more capital during upturns.
Leverage Ratio	LEV	Limits banks from exceeding a fixed minimum leverage ratio.
Capital Surcharges on SIFIs	SIFI	Requires Systemically Important Financial Institutions to hold a higher capital level than other financial institutions.
Limits on Interbank Exposures	INTER	Limits the fraction of liabilities held by the banking sector or by individual banks.
Concentration Limits	CONC	Limits the fraction of assets held by a limited number of borrowers.
Limits on Foreign Currency Loans	FC	Reduces vulnerability to foreign-currency risks.
Reserve Requirement Ratios	RR	Limits credit growth; can also be targeted to limit foreign-currency credit growth.
Limits on Domestic Currency Loans	CG	Limits credit growth directly.
Levy/Tax on Financial Institutions	TAX	Tax on revenues of financial institutions.
Derived and summary Instruments		
Loan-to-value ratio caps	LTVCAP	Restricts to LTV used as a strictly enforced cap on new loans, as opposed to a supervisory guideline or merely a determinant of risk weights.
FX and/or Countercyclical Reserve Requirements	RRREV	Restricts to RR which i) imposes a wedge of on foreign currency deposits or ii) is adjusted countercyclically
All variables aggregated in total	MPI	Sum of MPIF and MPIB
Borrower-targeted instruments(LTV_CAP plus DTI)	MPIF	Sum of LTV_CAP and DTI

Financial-Institution targeted instruments	MPIB	Sum of other instruments, including RR_REV rather than RR and excluding LTV

Source: Cerutti et al (2015). Version February 24th, 2015. Notes: each survey instrument and derived variable is a dummy that takes on two values: 0 for no policy and 1 for policy in effect. The summary variables may exceed 1 depending on the number of policies in effect. The database covers a sample from 2000 to 2013 with annual data.

5. Baseline model

We use insights from the above-mentioned research literature on the determinants of banks' profitability model, as summarised in Section 3, to guide the study of macroprudential policy effects on banks' profitability. We constructed a baseline model which seeks to include all relevant control variables so the effect of policy is correctly measured, before adding the macroprudential policy variables one by one.

In line with the bulk of the literature, we measure our dependent variable, bank profitability by the returns on average assets (ROAA) and equity (ROAE). ROAA reflects how a bank is using its assets to generate profits while ROAE measures the performance of a bank based on its average shareholders' equity, the return to shareholders on their equity. The returns figure is based on a number of subcomponents, namely net interest income, non-interest income, noninterest costs and provisioning and banks are likely to trade-off changes in these subcomponents to stabilise overall profitability.

Then for independent control variables, we have selected the standard and common bank-specific, industry and macroeconomic variables noted in Section 3 to explain the determinants of banks' profitability (see Table 3 below). As shown in the fourth column, for many of these variables the results in the research literature (Section 3) show mixed results, we show in the final column our own a priori expectation.

Table 3: Determinants of Banks' Profitability description

Variables	Symbol	Proxy	Literature relation (+/-)	Our expected relation (+/-)
Dependent variables				
Return on Average Assets	ROAA	Net Income/ Average Total Assets		
Return on Average Equity	ROAE	Net Income/ Average Total Equity		
Independent variables				
Bank specific factors (internal)				
Bank Size	LNSIZE	Logarithm of Total Assets	+/-	+
Leverage	LEV	Equity/ Total Assets	+/-	-
Credit Risk	CRISK	Non-performing loans/ Gross Loans	-	-
Liquidity Risk	LRISK	Gross Loans/ Deposits	+/-	-
Management Efficiency	COSTINC	Total Operating Expenses/ Total Income	+/-	-
Diversification	DIVSIF	Non-Interest Income/ Gross Revenue	+/-	+
Industry specific factor (external)				
Competition	LINDEX	Lerner Index	+	+
Banking Crisis	BCRISIS	Laeven and Valencia (2018)	+/-	-
Macroeconomic factors (external)				
Economic growth	RGDPGWR	Real GDP growth rate (annual %)	+/-	+
Inflation	INFLAT	Inflation rate (annual %)	+/-	+

Data sources (columns 1 and 2): Fitch Connect, IMF, World Bank, Laeven and Valencia (2018) and authors' calculations. Column 4 is based on the literature survey in Section 3.

Using the information above, we formulated the following baseline ordinary least squares (OLS) model of the determinants of banks' profitability for ROAA and ROAE.

$$Y_{it} = \alpha_{it} + ßInternal_{it-1} + ÞMacro_{ijt-1} + \theta Industry_{ijt-1} + \varepsilon_{it} \quad (1)$$

where i denotes the individual bank, j refers to the country in which bank i operates t indicates time period. The dependent variable, Y_{it} denotes the measure of banks' profitability (ROAA or ROAE). The

independent variables are lagged by one year to avoid the potential issues of endogeneity (see Davis et al (2019), de-Ramon et al (2018), Beck et al (2013)). These come in three groups denoted *internal*, *macro* and *industry*.

The set of variables denoted by *Internal* is the vector of bank internal factors. As shown in Table 3 above, these are respectively; bank size (LNSIZE), which is the logarithm of total assets; leverage (LEV) the ratio equity/total assets; credit risk (CRISK) measured by non-performing loans/gross loans; liquidity risk (LRISK) shown by gross loans/deposits; management efficiency (COSTINC) as shown by cost-income ratio of total operating expenses/total income; and diversification (DIVSIF) which is the ratio non-interest income/gross revenue.

Industry refers to banking industry wide variables, which are twofold. The BCRISIS variable is a vector capturing the presence of a banking crisis during the period a country experienced a banking crisis, as defined by Laeven and Valencia (2018). It is a dummy variable and it is coded one in the year the crisis starts until the year it was over and is otherwise zero. LINDEX is the chosen competition variable, the Lerner Index, which varies bank by bank.[7] Note that we do not employ the Panzar-Rosse H statistic unlike Schaeck and Cihák (2012), Davis and Karim (2019) and others, owing to some technical issues arising with this measure.[8]

The *Macro* variable is the vector of macroeconomic variables. These comprise Economic growth (RGDPGWR) the Real GDP growth rate (annual %); Inflation (INFLAT) the CPI Inflation rate (annual %).

Please see Appendix 2 for the summary statistics across the sample, which are in line with those in other studies such as Davis and Karim (2019). Appendix 2 also shows the correlation matrix for the variables across the sample. We find that none of the variables are highly correlated except for the correlation between management efficiency (COSTINC) and Lerner Index (LINDEX) at -0.749, which is moderately negatively correlated (Pearson's correlation coefficient) (see Hindkle et al (2003)). None of the other correlations exceed 0.5.

We estimated the baseline model by panel OLS with lagged independent variables, as in papers such as Mirzaei et al (2013), Petria et al (2015) and Davis and Karim (2019). As noted, lagging the variables by a year as shown in equation (1) is to avoid the potential issues of endogeneity (see Davis et al (2017), de-Ramon et al (2018), Beck et al (2013)).[9] As is common in the literature, all variables are

[7] The Lerner index is a measure of the price-cost margin; it can be seen as a proxy for current and future profits stemming from pricing power, and it varies at the level of the individual bank. Under perfect competition the index is zero as the output price (marginal revenue) equals marginal cost, and "normal" economic profits are zero. The Lerner index is positive as a firm's market power increase and price rises above marginal cost in a quantity-setting oligopoly model, with the limiting case being monopoly. We derived the Lerner Index following Anginer et al. (2014), Beck et al. (2013), Weill (2013) and Davis and Karim (2018) using a restricted translog cost function.

[8] Notably, Shaffer and Spierdijk (2015) show that under a variety of conditions, an H Statistic exceeding zero may still be consistent with substantial market power in banking; a value over zero can arise in a variety of oligopoly settings, all consistent with a positive Lerner Index.

[9] The endogeneity problem could also be mitigated by use of Generalised Method of Moments (GMM) estimation using instrument variables. A good instrument would be a variable which is highly correlated with regressors, but not with the error terms. One and two lagged values of regressors and dependent variables are conventionally used as instrument variables. However, as also argued by Mirzaei et al (2013), the use of lagged variables implies further loss of degrees of freedom that would vitiate our results by markedly reducing the

winsorised at 99% to avoid an impact of outliers. We use bank level fixed effects in our baseline model used for the principal results. [10]

The estimated baseline OLS model (equation 1) was then evaluated using the Hausman's test to decide the appropriate model to allow for cross-section variation, that is between fixed and random effects model. The results of the Hausman test for the full sample suggested that fixed effects model is appropriate. (ROAA - Hausman test, X^2: 170.62, p-value: 0.00; ROAE - Hausman test, X^2: 103.95, p-value: 0.00).

Further, in order to examine the joint significance of potential fixed effects, the fixed effect models are tested using the Likelihood Ratio test. The results are supported by the highly statistical significance of the Likelihood Ratio test at 1%, 5% and 10%, which suggest bank fixed effects are significant in the models. Accordingly, the models were estimated with bank level fixed effects with White's cross-sectional standard errors and covariance (corrected for degrees of freedom) and we used White (1980) cross-sectional standard errors and covariance (corrected for degrees of freedom) to reduce the impact of heteroskedasticity (as in Davis and Karim (2019)).

6. Main estimation model results for the period 2000-2013 (all countries)

Table 4 reports the empirical results for banks' profitability measured by ROAA and ROAE (equation 1 above). The ROAA model is estimated using 2,471 banks with 11,308 observations whilst the ROAE model included 2,453 banks and 11,159 observations. Both models were estimated over 13 periods (years) since the independent variables were lagged by one period. The F-test indicates that the variables included in the models are statistically significant for explanatory changes in bank profitability.

size of the unbalanced panel dataset. Furthermore, GMM is commonly used in cases where there is a large lagged dependent variable, while our own estimation suggests that this is not a major issue with the lagged dependent variable estimated by OLS being around 0.2 for both ROAA and ROAE in the baseline estimates.

[10] Results of a country fixed effects model and a bank and time fixed effects model are shown in Section 9 as robustness checks.

Table 4: Regression results for return on average assets (ROAA) and return on average equity (ROAE) as dependent variable (all countries) for the period 2000-2013

		ROAA	ROAE
	Our expected relation (+/-)	**Panel OLS with bank level fixed effects**	**Panel OLS with bank level fixed effects**
Constant		3.786*** (2.9)	38.227*** (4.3)
LNSIZE(-1)	+	-0.119** (-2.1)	-1.187*** (-3.0)
LEV(-1)	-	0.261 (0.6)	-4.053* (-1.7)
CRISK(-1)	-	-1.041*** (-4.1)	-10.237*** (-6.1)
LRISK(-1)	-	0.004 (1.2)	-0.038 (-1.1)
COSTINC(-1)	-	-0.747*** (-4.2)	-6.297*** (-3.5)
DIVSIF(-1)	+	0.004*** (4.0)	0.040*** (5.4)
LINDEX(-1)	+	0.206* (1.6)	-0.433 (-0.5)
BCRISIS(-1)	-	-0.187* (-1.9)	-1.638** (-2.2)
RGDPGWR(-1)	+	0.014** (2.5)	0.123* (1.9)
INFLAT(-1)	+	0.014* (1.9)	0.102* (1.8)
R-squared		0.542	0.487
R-squared (adj.)		0.414	0.341
Standard error		1.81	13.87
F-statistic		4.222	3.350
Prob(F-statistic)		0.000	0.00
Periods included		13	13
Banks included		2,471	2,453
Observations		11,308	11,159

Note: Independent variables coefficient values are reported and the t-statistics are reported in parenthesis below each estimated coefficient. Variables are winsorised at 99%. *** Significant at 1%, ** significant at 5%, * significant at 10%. White (1980) cross-sectional standard errors and covariance (corrected for degrees of freedom) are used.

In terms of the bank-specific factors, the results confirm that bank size (LNSIZE), credit risk (CRISK), and management efficiency (COSTINC) have negative and significant effects on banks' profitability measured by ROAA and ROAE, while diversification (DIVERSIFIC) has a positive effect. Leverage (LEV) has a negative effect for the ROAE only.

As shown in Table3, the literature shows conflicting results for bank size. Part of the literature suggests that larger banks can benefit from economies of scale to a point as they are able to raise capital at lower cost and benefit from economies of scale, thus increasing profit. Yet, researchers such as Korytowski (2018), Dietrich and Wanzenried (2010), Pasiouras and Kosmidou (2007) found a significant and negative effect on banks' profitability. Consistent with their results, our empirical results suggest indeed that bank size has a significant and negative effect on profits measured by ROAA and ROAE during the period, which indicate that large banks suffered lower profitability than average over 2000-2013. We suggest that this is not solely due to a greater impact of the crisis on larger banks, as the crisis variable is also significant.

A negative sign for credit risk (CRISK), as measured by non-performing loans/gross loans, shows that our results are similar to the reported results of studies such as Petria et al (2013), Athanasoglou et al (2006). This shows that the increase in poor asset quality will have a negative and significant effect on bank profitability. Overall, managing risk, and in some aspect especially credit risk has become one of the most central issues in banking and for regulators (as reflected in the Basel Accords) as poor credit risk practises have been an underlying factor leading to many banking crises, such as the 2007-2008 subprime crisis in the US (FCIC (2011)), and the banking crises and economic slowdown in Scandinavian countries over the period 1990-1991 (Sandal 2004). On the other hand, liquidity risk (LRISK) as measured by the deposit/loan ratio has an insignificant effect on banks' profitability in our sample.

The cost/income ratio (COSTINC), defined as total operating expenses/ total income which is an indicator of management efficiency had a significant and negative relationship to banks' profitability. Our result is similar to the results reported by Goddard et al (2013), Petria et al (2013) and Hoffmann (2011).

The leverage ratio (LEV) had a negative and significant effect on ROAE at the 10% significance level but it is insignificant in the ROAA model over the period under review. Our result shows that during the period a higher leverage ratio or capital ratio leads to lower profitability, as in Hoffmann (2011) and Topak and Talu (2017). This could be due to the effect of the new Basel Accord capital requirements. It contrasts with Goddard et al (2004) who suggested that higher capital ratios allow banks greater flexibility in taking advantage of new business opportunities which allows for improved profitability.

In our estimations, diversification (DIVSIF) measured by non-interest income/gross revenue has a positive and significant effect on both ROAA and ROAE. Goddard et al (2013) in line with this suggested that banks which focused more on non-traditional lines of business were more profitable on average. Similarly, Petria et al (2013) found that business diversification had a positive and significant effect on banks' profitability.

Concerning the banking sector specific factors, the banking crisis (BCRISIS) variable is negative and significant as a determinant of banks' profitability as measured by ROAA and ROAE, which is what we

expected. As noted, the BCRISIS variable is a time dummy variable which is one during crisis periods and otherwise zero. However, our result for the BCRISIS variable is contrary to some of the results in the research literature on bank profitability, such as Bouzgarrou et al (2018) and Xioa (2009), where they indicated that the financial crisis had limited effects on banks, especially domestic banks in the specific countries concerned.

The competition measure, Lerner Index (LINDEX), as a proxy to market power, had a positive and significant effect on ROAA, yet there was an insignificant effect on ROAE. This suggests that while banks were able to increase their ROAA on account of greater market power according to the literature (see Maudos and Solis (2009), Kasman et al (2010)), this may not be the case with ROAE. Banks' new capital requirements (Basel II/ III) may have more than offset any gains from market power and negatively affected banks' profitability as measured by ROAE during the period.

In term of the macroeconomic factors, our results are in line with the literature. They show that real GDP growth (RGDPGWR) and the rate of inflation (INFLAT) had a positive and significant effect on banks' profitability over the empirical analysis period. Growth in the economy should result in an increase in banks' profitability as suggested by Korytowski (2018) and Petria et al (2013), and the inflation effect is in line with Saona (2016). The relatively low coefficient for the rate of inflation and significance only at the 10% level may suggest that banks are not fully anticipating inflation in the period under review.

Using the above model as a baseline, in the following section we move on to discuss the effects of the macroprudential instruments.

The macroprudential instruments (see Table 2 above for further information) were tested one by one using the baseline estimation model (equation 1) for the full sample period, 2000-2013 (as shown in Table 4). This is in line with the standard approach in the literature on macroprudential policy such as Cerrutti et al (2017) Carreras et al (2018) and Davis et al (2017). Similar to the independent variables in the model, the macroprudential instruments were lagged by one period. As discussed above, we expect that prudential measures which target banks assets (i.e. credit activities) to have the greatest effect on banks' profitability.

Table 5 below outlines the effect of macroprudential instruments on banks' profitability measured by ROAA and ROAE (using the baseline model shown in Table 4).

Table 5: Macroprudential instruments results using baseline regression model for the period 2000-2013 (all countries)

	ROAA	ROAE
Macroprudential instruments	**Panel OLS with bank level fixed effects**	**Panel OLS with bank level fixed effects**
Loan-to-Value Ratio (LTV(-1))	-0.129** (-2.0)	-2.441*** (-3.6)
Debt-to-Income Ratio (DTI(-1))	-0.355*** (-5.3)	-3.744*** (-4.8)
Capital Surcharges on SIFIs (SIFI(-1))	-0.150 (-0.7)	0.690 (0.6)
General Countercyclical Capital Buffer/Requirement (CTC(-1))	-2.628** (-2.3)	-15.000* (-1.6)
Time-Varying/Dynamic Loan-Loss Provisioning (DP(-1))	-0.414 (-1.4)	-0.495 (-0.3)
Leverage Ratio (LEV(-1))	-0.131 (-1.1)	-0.685 (-0.6)
Limits on Interbank Exposures (INTER(-1))	-0.130 (-1.4)	-0.762 (-0.7)
Concentration Limits (CONC(-1))	0.083 (0.7)	0.233 (0.1)
Limits on Domestic Currency Loans (CG(-1))	-0.994* (-1.8)	-9.373*** (-3.2)
Levy/Tax on Financial Institutions (TAX(-1))	-0.030 (-0.4)	0.777 (1.2)
Reserve Requirement Ratios (RR(-1))	-0.494 (-0.8)	-3.630 (-0.8)
Limits on Foreign Currency Loans (FC(-1))	-0.140 (-0.6)	-1.714 (-0.8)
Loan-to-value ratio caps (LTVCAP(-1))	-0.195** (-2.1)	-3.060** (-3.5)
FX and/or Countercyclical Reserve Requirements (RRREV(-1))	-0.220 (-0.32)	-2.538 (-0.5)
Total macroprudential instruments (MPI(-1))	-0.100** (-1.9)	-0.862* (-1.8)
Macroprudential instruments focused on the borrower (MPIB(-1))	-0.072* (-1.6)	-0.535* (-1.3)
Macroprudential instruments focused on the financial institution (MPIF(-1))	-0.100 (-1.2)	-0.644 (-0.9)

Note: The macroprudential instruments coefficient values are reported and the t-statistics are reported in parenthesis below each estimated coefficient. Each equation includes all the control variables shown in Table 4. *** significant at 1%, ** significant at 5%, * significant at 10%.

Overall in the period 2000-2013, the model results suggest that a policy limiting lending (asset measures) such as loan-to-value ratios (LTV and LTVCAP) and debt-to-income ratios (DTI); the liquidity measure, domestic currency loans limits (CG) as well as the capital measure, general countercyclical capital buffer (CTC) had the most consistent effect on banks' profitability. These instruments are statistically significant and negatively related to ROAA and ROAE. We note that leverage is already included in the specification and is also significant and negative suggesting an impact of overall capital requirements also.

Loan-to-value measures (LTV and LTVCAP) restrict the borrowing capacity of customers as they limit the amount of funds that can be lent relative to the value of the asset. DTI has a direct effect on customers' ability to borrow, as the DTI ratio is determined by income level and debt outstanding, and thus will have an effect on banks' ability to lend to highly leveraged customers. Similarly, limits on domestic currency loans (CG) affects banks' capacity to lend by reducing directly the amount of domestic currency loans that can be issued. CG is in principle more restrictive on banks than LTV or DTI, as it involves a cap on banks' total lending without regard to the debt-service ratio, loan-to-value ratio, or risk ratings of customers. It applies to both corporate and household sector borrowers.

General Countercyclical Capital Buffer/ Requirements (CTC) require banks to hold more capital during economic upturns, that is with growing credit. CTC limits banks' capacity to lend and invest, thus reducing banks' ability to increase profits. The overall macroprudential policy (MPI) and the aggregate borrowers based (MPIB) indexes which incorporate the above measures, are statistically significant and negatively affect profits. However, the overall institution-based measure (MPIF) is not significant.

These results are fully in line with our expectation as stated above. Asset measures are most effective in reducing credit activities in an economic upswing as supported by the research literature such as Davis et al (2017), Carreras et al (2018), Cerutti et al (2017), and Akinci and Olmstead-Rumsey (2018) and summarised in Table 1. In this context, since macroprudential policies (notably asset-based measures) are effective in reducing the build-up of financial system imbalances (banks' credit activities), our empirical results confirm that a number of the most effective instruments of macroprudential policy have a significant and negative effect on banks' profitability as banks' credit activities are restricted. This is to be expected since lending is the major source of banks' interest and fee income, thus their profitability. This result has not to our knowledge been tested hitherto in the empirical literature on macroprudential policy. Therefore, we accept that Hypothesis 1 is true for a number of key and commonly used macroprudential tools, that is, banks' profitability is negatively affected when macroprudential policy are effective in reducing financial system imbalances. The implication is that although macroprudential policy limits credit-driven booms and enhances short term robustness, it may in turn reduce robustness in the long term as it limits scope to accumulate capital via retained earnings. However, as discussed further in Sections 9 and 10, this is not true for all macroprudential measures with some indication that measures shown to have no significant effect on profitability may still affect credit growth.

7. Results for emerging market economies and advanced countries

To further develop the analysis, we tested the macroprudential instruments according to a country division between emerging market economies (EME) and advanced countries (ADV). There are 58 emerging market economies and 34 advanced countries in the sample (see Appendix 1 for a list of countries).

It is important to note that emerging market economies have a longer history of using macroprudential policies than advanced countries (Cerutti et al 2017). Among the findings of that paper (which also introduced the GMPI dataset we use) were that emerging markets focus on foreign exchange policies, suggesting the dual objective of stabilising the country foreign exchange market while advanced countries tend to use more borrower-based policies which specifically target consumer spending and the real estate market. Also, there is a weaker effect on credit growth and real estate prices in more developed and more financially open economies, suggesting some avoidance and/or disintermediation of the policy.

Before discussing the macroprudential instruments results separately for emerging market economies (EME) and advanced countries (ADV), we first discuss the ROAA and ROAE main estimation models. Table 6 below shows the summary results of the banks' profitability models, measured by ROAA and ROAE (with bank level fixed effects) for the period 2000-2013. We suggest that these results are themselves a contribution to the literature on bank profitability since most studies cited in Section 3 are banks from specific for regions, small groups of countries or individual countries.

Table 6: Regression results for return on average assets (ROAA) and return on average equity (ROAE) as dependent variable for emerging market economies and advanced countries for the period 2000-2013

		Emerging market economies		Advanced countries	
	Our expected relation (+/-)	**ROAA Panel OLS with bank level fixed effects**	**ROAE Panel OLS with bank level fixed effects**	**ROAA Panel OLS with bank level fixed effects**	**ROAE Panel OLS with bank level fixed effects**
Constant		3.470**	33.110***	4.540***	46.834***
		(1.9)	(3.0)	(3.8)	(5.3)
LNSIZE(-1)	+	-0.120	-0.970**	-0.140***	-1.476***
		(-1.4)	(-1.9)	(-2.7)	(-3.9)
LEV(-1)	-	0.212	-15.990***	0.270	2.546
		(0.3)	(-4.0)	(0.5)	(0.9)
CRISK(-1)	-	-1.394***	-12.960***	-0.855***	-7.661***
		(-3.1)	(-4.7)	(-2.6)	(-2.9)
LRISK(-1)	-	0.006	-0.014	0.003	-0.052
		(0.7)	(-0.2)	(0.9)	(-1.6)
COSTINC(-1)	-	-0.360*	-3.185**	-1.153***	-9.954***
		(-1.8)	(-2.5)	(-4.0)	(-3.3)
DIVSIF(-1)	+	0.008***	0.065***	0.001	0.012
		(4.2)	(3.5)	(0.1)	(0.9)
LINDEX(-1)	+	0.390**	1.087	-0.075	-2.777
		(2.1)	(1.1)	(-0.3)	(-1.5)
BCRISIS(-1)	-	-0.054	0.130	-0.240*	-2.164**
		(-0.3)	(0.1)	(-1.8)	(-2.4)
RGDPGWR(-1)	+	0.020**	0.116*	0.010	0.160
		(2.3)	(1.7)	(0.8)	(1.6)
INFLAT(-1)	+	0.012	0.082*	-0.0071	-0.115
		(1.5)	(1.2)	(-0.4)	(0.7)
R-squared		0.561	0.483	0.527	0.491
R-squared (adj.)		0.448	0.350	0.380	0.330
Standard error		1.78	13.38	1.87	14.55
F-statistic		4.955	3.605	3.572	3.060
Prob(F-statistic)		0.000	0.000	0.00	0.000
Periods included		13	13	13	13
Banks included		1,219	1,210	1,274	1,264
Observations		5,985	5,925	5,397	5,304

Note: Independent variables coefficient values are reported and the t-statistics are reported in parenthesis below each estimated coefficient. *** significant at 1%, ** significant at 5%, * significant at 10%. The variables are winsorised at 99%. White (1980) cross-sectional standard errors and covariance (corrected for degrees of freedom) are used.

Briefly, in Table 6 above, the main regression models for both emerging market economies (EME) and advanced countries find credit risk (CRISK - negative), management efficiency (COSTINC - negative) significant and negative for banks in both types of country. This is also true for bank size (negative) except for the ROAA for EMEs where it is not significant. However, diversification (DIVSIF) and GDP growth (RGDPGRW) are positive and significant only for EMEs, as is inflation (positive) and leverage (negative) for the ROAE. Also, competition is only significant for EMEs for the ROAA with the expected positive sign. Meanwhile, the variable for banking crisis (BCRISIS) is significant only for advanced countries, with a negative sign for both ROAA and ROAE. As is well known, banking crises of 2007-8 had a greater effect on the advanced countries and this is reflected in the significance of the BCRISIS term. These results are mostly in line with the results in Table 4 above for all countries.

Table 7 below shows the macroprudential instruments results for emerging market economies and advanced countries separately over the data period 2000-2013. As in the estimates above for the full sample, the macroprudential instruments were tested one by one using the main regression models and as is the case for the independent control variables in the model, the macroprudential instruments were lagged by one period.

Table 7: Macroprudential instruments results for emerging market economies and advanced countries for the period 2000-13

	Emerging market economies		Advanced countries	
Instruments	**ROAA**	**ROAE**	**ROAA**	**ROAE**
	Panel OLS with bank level fixed effects	**Panel OLS with bank level fixed effects**	**Panel OLS with bank level fixed effects**	**Panel OLS with bank level fixed effects**
LTV (-1)	-0.141 (-1.1)	-1.576 (-1.4)	-0.191** (2.0)	-3.602*** (-3.8)
DTI(-1)	-0.453*** (-6.1)	-3.774*** (-5.1)	-0.220 (-1.1)	-4.642*** (-3.2)
SIFI(-1)	-0.191 (-0.7)	1.326 (1.2)	0.012 (0.2)	-1.960*** (-2.7)
CTC(-1)	-2.670** (-2.3)	-14.674 (1.6)	Na	Na
DP(-1)	-0.420 (-1.4)	-0.222 (-0.1)	Na	Na
LEV(-1)	-0.170 (-0.8)	-1.425 (-1.3)	-0.060 (-0.2)	0.368 (0.2)
INTER(-1)	-0.005 (-0.1)	0.320 (0.3)	-0.256 (-1.5)	-1.811 (-1.2)
CONC(-1)	0.096 (0.8)	-0.515 (-0.3)	0.065 (0.4)	1.030 (0.6)
CG(-1)	-0.970* (-1.8)	-9.271*** (-3.3)	Na	Na
TAX(-1)	0.160* (1.6)	1.781*** (2.9)	-0.151 (-1.3)	0.330 (0.3)
RR(-1)	-0.491 (-0.8)	-3.467 (-0.8)	Na	Na
FC(-1)	-0.122 (-0.4)	-0.530 (-0.2)	-0.141 (-1.1)	-5.554* (-1.9)
LTVCAP(-1)	-0.096 (-0.7)	-1.811 (-1.2)	-0.418** (-2.4)	-5.057*** (-3.6)
RRREV(-1)	-0.222 (-0.3)	-2.375 (-0.5)	Na	Na
MPI(-1)	-0.097 (-1.4)	-0.694 (-1.2)	-0.115* (-1.7)	-1.257*** (-2.9)
MPIB(-1)	-0.054 (-0.9)	-0.225 (-0.4)	-0.136* (-1.8)	-1.210*** (-3.1)
MPIF(-1)	-0.010 (-0.9)	-0.620 (-0.6)	-0.083 (-1.2)	-0.557 (-1.1)

Note: The macroprudential instruments coefficient values are reported and the t-statistics are reported in parenthesis below each estimated coefficient. Each equation includes all the control variables shown in Table 4.*** significant at 1%, ** significant at 5%, * significant at 10%. NA not applicable as the instrument has not been used by many countries over the estimation period.

For EMEs, asset-based policies such as debt-to-income ratios (DTI), liquidity measure, domestic currency loans limits (CG) as well as the capital measure, general countercyclical capital buffer (CTC) had the most consistent effect on banks' profitability. These instruments are statistically significant and negatively related to ROAA and (except CTC) ROAE. These results are consistent with the results in Table 5 above for all countries. However, the results for the aggregate macroprudential instruments indexes are not statistically significant and LTV ratios are also not significant. Meanwhile, levy/tax on financial institutions (TAX) instrument had a positive and significant effect on both measures of profitability, which suggest banks are able to pass on the cost of the tax/ levy to customers.

As regards advanced countries, loan-to-value measures (LTV and LTVCAP) had the most significant effect on banks' profitability as measured by ROAA and ROAE. Other instruments such as debt-to-income (DTI), capital surcharges on SIFIs (SIFI) and limits on foreign currency loans (FC) are statistically significant and affect ROAE negatively. The corresponding aggregate macroprudential instruments indexes, total (MPI) and borrowers-based (MPIB) are significant and affect banks' profitability as measured by ROAA and ROAE. These results are consistent with the results in Table 5 above for all countries, except that CTC and CG are not significant for advanced countries, and results for SIFI and FC do not appear for all countries being specific to advanced countries.

As noted previously, loan-to-value measures (LTV and LTVCAP) and debt-to-income limits (DTI) have become one of the most common macroprudential instruments for reducing credit growth since the 2007-2008 financial crisis, as cited by studies such as Carreras et al (2018), Cerutti et al (2017), Claessens et al (2013) and Crowe et al (2011). However, Jácome and Mitra (2015) suggested that although LTVCAP is effective in reducing loan-growth, it is not always the case in curbing house prices growth. Our results for advanced countries are broadly in line with the credit effects shown in the literature in Table 1.

In summary, the results suggest that effects on bank profits in emerging markets tend to arise from limits to domestic lending, debt to income ratios (DTI) and countercyclical capital buffers (CTC). Furthermore, for EMEs, loan-to-value measures (LTV and LTVCAP) are statistically insignificant. For advanced countries, loan-to-value measures (LTV and LTVCAP) and debt-to-income (DTI) are significant, which is consistent with the existing literature shown in Table 1. Effects are also found for limits on foreign currency lending (FC) and capital surcharges on SIFIs. Overall, our hypothesis is verified, that is, if macroprudential policy reduces the ability of banks to lend, as summarised in Table 1, then there should usually be a significant and negative effect on banks' profitability.

8 Bank types – retail and consumer banks and universal banks

Using the ROAA and ROAE baseline model, we estimated ROAA and ROAE models with banks fixed effects based on the two most common type of banks in the Fitch Connect dataset. These are retail and consumer banks and universal banks. Retail and consumer banks are typical mass-market banking in which individual customers use local branches of larger commercial banks. Retail and consumer banking aims to be the one-stop shop for as many retail financial services as possible on behalf of individual retail clients such as checking accounts, savings accounts, personal loans, lines of credit, mortgages, etc. These banks are common in the US. Universal bank is a system in which banks provide a wide variety of financial services, including commercial and investment services. These banks are common in Europe.

Table 8: Regression results for return on average assets (ROAA) and return on average equity (ROAE) as dependent variable based on bank types for the period 2000-2013 (all countries)

Sector	**Retail and Consumer Banks**		**Universal Banks**	
Dependent variable	**ROAA**	**ROAE**	**ROAA**	**ROAE**
	Panel OLS with banks fixed effects	**Panel OLS with banks fixed effects**	**Panel OLS with banks fixed effects**	**Panel OLS with banks fixed effects**
Constant	6.996***	66.526***	4.534***	45.327***
	(4.7)	(5.7)	(6.6)	(8.3)
LNSIZE(-1)	-0.242***	-2.470***	-0.159***	-1.473***
	(-3.6)	(-4.6)	(-5.3)	(-6.1)
LEV(-1)	0.093	5.078	0.461	-7.001**
	(0.2)	(-1.4)	(1.3)	(-2.5)
CRISK(-1)	-1.114***	-7.652***	-1.046***	-10.752***
	(-3.9)	(-2.8)	(-4.4)	(-5.3)
LRISK(-1)	-0.016***	-0.165***	0.008**	0.004
	(-2.7)	(-3.3)	(-2.2)	(0.1)
COSTINC(-1)	-1.538***	-13.144***	-0.640***	-5.965***
	(-6.4)	(-6.7)	(-5.8)	(-6.3)
DIVSIF(-1)	-0.002	0.024	0.005*	0.039***
	(-0.7)	(1.2)	(3.9)	(3.4)
LINDEX(-1)	-0.613***	-4.473***	0.358***	-0.698
	(-2.8)	(-2.7)	(3.2)	(-0.8)
BCRISIS(-1)	-0.031	-0.463	-0.215***	-1.879***
	(-0.2)	(-0.4)	(-2.7)	(-3.1)
RGDPGWR(-1)	0.013	0.067	0.010	0.117*
	(0.9)	(0.6)	(1.2)	(1.9)
INFLAT(-1)	0.020*	0.115	0.015**	0.121**
	(1.7)	(1.2)	(2.5)	(2.6)
R-squared	0.717	0.607	0.541	0.506
R-squared (adj.)	0.584	0.419	0.412	0.367
Standard error	1.51	11.88	1.78	13.95
F-statistic	5.400	3.229	4.186	3.628
Prob(F-statistic)	0.000	0.000	0.000	0.000
Periods included	13	13	13	13
Cross sections included	770	766	1,798	1,783
Observations	2,435	2,393	8,219	8,130

Note: Independent variables coefficient values are reported and the t-statistics are reported in parenthesis below each estimated coefficient. *** significant at 1%, ** significant at 5%, * significant at 10%. The variables are winsorised at 99%. White (1980) cross-sectional standard errors and covariance (corrected for degrees of freedom) are used.

Note that the sample for the retail banks is relatively small compared with the universal banks. The ROAA and ROAE models results based on retail and consumer banks (see Table 8 above) show that banks' profitability is determined by bank size (LNSIZE, negative) credit risk (CRISK, negative), management efficiency (COSTINC, negative), which are similar to the baseline model results (see Table 4). However, a difference is that here liquidity risk (LRISK) had a negative and significant effect on ROAA and ROAE. In the research literature Petria et al (2013) found that there is negative and significant relationship between level of liquidity (loan/deposit ratio) and banks' profitability. On interest is the negative and significant effect of the Lerner Index which suggests that retail and consumer banks are unable to increase profit based on their market power. This result contrasts with the literature, where it is expected that the Lerner Index has a positive and significant effect on profits. The rate of inflation has a positive and significant effect on ROAA only.

For universal banks, the ROAA and ROAE model results are the same as for the retail and consumer banks in respect to bank size (LNSIZE, negative) credit risk (CRISK, negative) and management efficiency (COSTINC, negative). In addition, diversification (DIVSIF) and the rate of inflation had a positive and significant effect on ROAA and ROAE which is consistent with the result of the baseline model (Table 4). The banking crisis (BCRISIS) variable coefficient sign is negative and significant suggesting that the 2007-2008 financial crisis affected universal banks more than retail and consumer banks. Liquidity risk (LRISK) had a positive and significant effect on ROAA only, similar to Korytowski (2018), who found that liquidity has positive and significant effect on bank profitability (ROAA) after the 2007-2008 financial crisis. The Lerner Index has a positive and significant effect on ROAA, while GDP growth has a positive and significant effect on ROAE.

In term of the macroprudential instruments, see Table 9 below, the results show that the effect of macroprudential instruments on universal banks are most in line with the results of the baseline (Table 5 above). The results for universal banks suggest that a policy limiting borrowing (asset measures) such as debt-to-income ratios (DTI), a liquidity measure, namely domestic currency loans limits (CG) as well as the capital measure, general countercyclical capital buffer (CTC) had the most consistent effect on banks' profitability. These instruments are statistically significant and negatively related to ROAA and ROAE. These instruments also have a significant and negative on the credit/GDP gap (see Davis et al 2017). Reserve requirements are also significant and negatively related to the ROAA and ROAE. Other instruments that have a significant and negative effect on banks' profitability measured by either ROAA or ROAE are the loan-to-value measures (LTV and LTVCAP), limits on foreign currency loans (FC) and FX and/or countercyclical reserve requirements (RRREV). The aggregate indexes of total macroprudential and financial institution-based instruments are statistically significant and negatively related to ROAA and ROAE. The aggregate borrowers-based instruments index mostly affects ROAE.

The results for retail and consumer banks show that at time-varying/dynamic loan-loss provisioning (DP) had the most significant effect on both ROAA and ROAE. Other instruments that have a significant and negative effect on banks profitability measured by either ROAA or ROAE are the loan-to-value ratios (LTV and LTVCAP) and levy/tax on financial institutions (TAX). The aggregate macroprudential instruments indexes have the appropriate negative signs and are significant for ROAA.

Table 9: Macroprudential instruments results based on bank types for the period 2000-2013 (all countries)

Dependent variable: ROAA and ROAE				
	Retail and Consumer Banks		**Universal Banks**	
	ROAA Panel OLS with banks fixed effects	**ROAE Panel OLS with banks fixed effects**	**ROAA Panel OLS with banks fixed effects**	**ROAE Panel OLS with banks fixed effects**
Macroprudential instruments				
Loan-to-Value Ratio (LTV (-1))	-0.318*	-2.019	0.016	-1.670**
	(-1.8)	(-1.4)	(0.2)	(-1.9)
Debt-to-Income Ratio (DTI(-1))	-0.184	-0.007	-0.343***	-4.202***
	(-0.8)	(-0.0)	(-2.8)	(-4.3)
Capital Surcharges on SIFIs (SIFI(-1))	-0.071	-0.867	-0.260	1.168
	(-0.1)	(-0.2)	(-0.7)	(0.4)
General Countercyclical Capital Buffer/Requirement (CTC(-1))	-0.138	-1.385	-5.910***	-44.33***
	(-0.1)	(-0.2)	(-6.6)	(-4.8)
Time-Varying/Dynamic Loan-Loss Provisioning (DP(-1))	-3.073***	-14.308***	0.135	2.349
	(-5.5)	(-3.2)	(0.5)	(1.1)
Leverage Ratio (LEV(-1))	-0.113	1.398	-0.154	-2.491
	(-0.3)	(0.5)	(-0.8)	(-1.6)
Limits on Interbank Exposures (INTER(-1))	-0.185	0.534	-0.083	-2.632
	(-0.9)	(0.3)	(-0.5)	(-1.9)
Concentration Limits (CONC(-1))	-0.015	-2.370	0.158	0.631
	(-0.1)	(0.9)	(1.1)	(0.6)
Limits on Domestic Currency Loans (CG(-1))	0.308	3.710	-1.244***	-12.168***
	(0.5)	(0.7)	(-4.3)	(5.2)
Levy/Tax on Financial Institutions (TAX(-1))	-0.528**	0.135	0.017	0.276
	(-2.0)	(0.1)	(0.1)	(0.2)
Reserve Requirement Ratios (RR(-1))	-0.460	-4.184	-0.582**	-5.605***
	(-0.9)	(-1.1)	(-2.6)	(-3.1)
Limits on Foreign Currency Loans (FC(-1))	-0.313	-2.900	-0.174	-2.773**
	(-1.1)	(-1.3)	(-1.2)	(-2.3)
Loan-to-value ratio caps (LTVCAP(-1))	-0.380*	-2.242	-0.148	-2.759***
	(-1.9)	(-1.4)	(-1.2)	(-2.8)
FX and/or Countercyclical Reserve Requirements (RRREV(-1))	-0.295	-4.046	-0.296	-4.778**
	(-0.5)	(-0.9)	(-1.2)	(-2.5)
Total macroprudential instruments (MPI(-1))	-0.179***	-0.708	-0.085**	-1.156***
	(-2.7)	(-1.3)	(-2.3)	(-3.9)
Macroprudential instruments focused on the borrower (MPIB(-1))	-0.202***	-0.286	-0.034	-0.717**
	(-2.7)	(-0.5)	(-0.8)	(-2.0)

Macroprudential instruments focused on the financial institution (MPIF(-1))	-0.218** (-2.5)	-0.557 (-0.8)	-0.092* (-1.8)	-1.250*** (-3.1)

Note: The macroprudential instruments coefficient values are reported and the t-statistics are reported in parenthesis below each estimated coefficient. Each equation includes all the control variables shown in Table 4.*** significant at 1%, ** significant at 5%, * significant at 10%.

In Table 10 below, we summarise the results of the effects of macroprudential policy on banks' profitability (ROAA and ROAE) and compare the results with the research literature on the effectiveness of macroprudential policy in reducing financial system imbalances as measured by the credit-to-GDP gap and credit, using the same IMF dataset of macroprudential instruments and time period, namely Davis et al (2017), Carreras et al (2018), Cerutti et al (2017) and Claessens et al (2013). (We abstract from their results for house prices which is less closely linked to bank behaviour.) Davis et al (2017) used the credit-to-GDP gap as the target variable, Carreras et al (2018) used the growth rate of real household credit, the Cerutti et al work focused on the growth of real credit growth in the country, although they noted that effects were greater for household credit. Claessens et al (2013) looked at individual bank asset growth. Carreras et al (2018) covered advanced countries only, Cerutti et al (2017), Davis et al (2017) and Claessens et al (2013) had a much wider sample of both advanced and emerging/developing countries.

Table 10: Summary table of the results of the effects of macroprudential policy on banks' profitability

Table/ Paper	**Table 5 All countries**		**Table 7 Regional subsamples**				**Table 9 Segmented by bank type**				**Davis et al (2017)**	**Carreras et al (2018)**	**Memo: Cerutti et al (2017)**	**Claessens et al (2013)**
Sample date	2000-2013	2000-2013	2000-2013	2000-2013	2000-2013	2000-2013	2000-2013	2000-2013	2000-2013	2000-2013	2000-2013	2000-2013	2000-2013	**2000-10**
Country/ sector coverage	Global	Global	EME	EME	Advanced	Advanced	Retail banks	Retail banks	Universal banks	Universal banks	Global	Advanced	Global	Global
Dependent	**ROAA**	**ROAE**	**ROAA**	**ROAE**	**ROAA**	**ROAE**	**ROAA**	**ROAE**	**ROAA**	**ROAE**	Credit-GDP gap	Growth in real lending to households	Growth in real NFPS domestic bank credit	Individual bank asset growth
LTV	(-)**	(-)***			(-)**	(-)***	(-)*			(-)*	(-)***	(-)***		(-)***
DTI	(-)***	(-)***	(-)***	(-)***		(-)***			(-)***	(-)***	(-)***		(-)**	
SIFI						(-)***								Na
CTC	(-)**	(-)*	(-)**						(-)***	(-)***				(-)***
DP							(-)***	(-)***			(-)**		(-)***	
LEV														Na
INTER												(-)***	(-)**	Na
CONC											(-)***			Na
CG	(-)*	(-)***	(-)*	(-)***					(-)***	(-)***				(-)**
TAX			+*	+***			(-)**					(-)***		Na
RR									(-)**	(-)***				
FC						(-)*				(-)**			(-)*	
LTVCAP	(-)**	(-)**					(-)*			(-)***	(-)***		(-)*	Na
RRREV										(-)**				Na
MPI	(-)**	(-)*			(-)*	(-)***	(-)***		(-)**	(-)***	(-)***	(-)***	(-)***	Na
MPIB	(-)*	(-)*			(-)*	(-)***	(-)***			(-)**	(-)***		(-)**	(-)***
MPIF							(-)**		(-)*	(-)***	(-)***	(-)***	(-)***	(-)***(a)

Notes: For macroprudential instruments definitions see Section 5. Signs of significant variables are shown where *** significant at 1%, ** significant at 5% * significant at 10%. A blank implies the variable was tested but not significant, na that the variable was not tested. IMF WEO country classification (April 2017), ADV - advanced countries, EME - emerging market economies. NFPS is non financial private sector. Each study used the same GMPI database of macroprudential instruments as the current study (see Section 4) (a) applies to asset-related tools only not buffers

Table 10 above shows a summary of the results of the effects of macroprudential policy on banks' profitability for all countries (All), advanced countries (ADV) and emerging market economies (EME) as well as retail versus universal banks over the period 2000-2013. It also compares the results with the research literature on the effectiveness of macroprudential policy in reducing financial system imbalances at a macro level, specifically Davis et al (2017), Carreras et al (2018) and Cerutti et al (2017) as well as the sole extant paper looking at individual bank data, Claessens et al (2013).

It is noteworthy that the tools that we find have the most significant effect on banks' profitability and consistently effective in reducing the credit-to-GDP gap or credit/asset growth are the credit/ housing-market focused instruments (asset measures) such as the loan-to-value ratios (LTV and LTVCAP) and the debt-to-income ratio (DTI). There is a significant result for the limit on foreign currency loans (FC) in the full sample for advanced countries ROAE , universal banks and Cerutti et al (2017), where the effect is negative and for limits on domestic loans (CG) and the general countercyclical capital buffer/ requirement (CTC) in Claessens et al (2013). Also, dynamic provisioning applies for retail banks and two of the research papers on macro data.

We also show that there are some measures that have a significant and negative effect on banks' profitability in some samples such as reserve requirements (RR and RRREV) but no effects on credit-to-GDP gap and credit-related measures of financial imbalances.

Furthermore, we found that levy/tax on financial institutions (TAX) instrument had a positive and significant effect on profitability in EME, which suggest banks are able to pass on the cost of the tax/ levy to customers (although it is negative for retail banks). Yet, Carreras et al (2018) found that TAX has a negative and significant effect on growth rate of real household credit. The zero effects on profitability of the measures interbank restrictions (INTER) and concentration limits (CONC) are also of interest since more than one of the studies shown in Table 10 find a significant negative effect of the measures on credit or the credit gap. Again, there is an implication that the cost of the measures can be passed on to consumers and that along with TAX they are less costly to banks than LTV and DTI but with a detectable effect on credit growth.

Finally, in term of the summary indexes, total macroprudential instruments (MPI), borrowers-based index (MPIB) and financial-based index (MPIF) are statistically significant and have a negative effect on banks' profitability in most of the samples, and also on the credit-to-GDP gap and/or credit/ house prices related measures of financial imbalances.

9. Robust checks

We undertook two robustness checks on the sample, firstly with country instead of bank fixed effects and secondly with bank and time fixed effects.

9.1. Country fixed effects

First, we ran estimates on the above ROAA and ROAE models results using country fixed effects. The main model was adjusted to include country fixed effects instead of bank fixed effects. Banks are exposed to different country risks (e.g. regulations and laws) and operate in different financial system structures and institutions, at different stages of development, etc. Therefore, we assess whether controlling for country characteristics can affect the empirical results.

Table 11: Regression results for return on average assets (ROAA) and return on average equity (ROAE) as dependent variable with country fixed effects for the period 2000-2013 (all countries)

Dependent variable: ROAA and ROAE		
	ROAA	**ROAE**
	Panel OLS with country fixed effects	**Panel OLS with country fixed effects**
Constant	-	-
LNSIZE(-1)	-0.040* (-1.9)	0.066 (0.5)
LEV(-1)	2.612*** (7.1)	1.780 (0.9)
CRISK(-1)	-2.012*** (-9.6)	-16.148*** (-12.8)
LRISK(-1)	-0.005 (-1.0)	0.098*** (-2.7)
COSTINC(-1)	-1.601*** (-9.8)	-10.163*** (-6.9)
DIVSIF(-1)	0.002* (1.7)	0.001 (1.5)
LINDEX(-1)	0.204 (1.6)	-0.728 (-1.2)
BCRISIS(-1)	-0.055 (-0.7)	-0.545 (-0.8)
RGDPGWR(-1)	0.019** (2.4)	0.125** (2.0)
INFLAT(-1)	0.007 (1.3)	0.018 (0.4)
R-squared	0.120	0.095
R-squared (adj.)	0.112	0.086
Standard error	2.23	16.43
F-statistic	15.144	11.463
Prob(F-statistic)	0.000	0.000
Countries fixed effects	Yes	Yes
Periods included	13	13
Cross sections included	2,471	2,453
Observations	11,308	11,159

Note: Independent variables coefficient values are reported and the t-statistics are reported in parenthesis below each estimated coefficient. *** significant at 1%, ** significant at 5%, * significant at 10%.The variables are winsorised at 99%. White (1980) cross-sectional standard errors and covariance (corrected for degrees of freedom) are used.

The country fixed effects model results (see Table 11) show that banks' profitability (both ROAA and ROAE) are determined by credit risk (CRISK, negative), management efficiency (COSTINC, negative), and GDP growth (RGDPGWR, positive). In addition, bank size (LNSIZE) has a negative and significant effect on ROAA, while leverage (LEV) and diversification (DIVSIF) has positive and significant effect on ROAA. In some aspect these results are consistent with the baseline results in Table 4, except for the rate of inflation (INFLAT), Lerner Index (LINDEX) and banking crisis (BCRISIS), which are insignificant in the country fixed effects model. This – and the fact the dummies are mostly significant - indicate that a country's characteristics (which could include regulatory structure as discussed above) having an effect on the determinants of banks' profitability.

In term of the macroprudential instruments, Table 12 below shows that the debt-to-income ratio (DTI) has the most significant effect on bank profitability, similar to the baseline results in Table 5. DTI is also significant and negatively affects the credit-to-GDP gap (Davis et al 2017) as well as the measure of real credit growth in Cerrutti et al (2017). Time-varying/dynamic Loan-Loss Provisioning (DP) and general countercyclical capital buffer/requirement (CTC) have significant and negative effects on ROAA only which is not fully in line with the baseline Table 5, where CTC had a negative and significant effect on both ROAA and ROAE, while DP was insignificant. Loan-to-value measures (LTV and LTVCAP) have a significant and negative effect on ROAE only, unlike the results in Table 5, where both ROAA and ROAE are negatively affected and significant. Loan-to-value measures also have a significant and negative on the credit/GDP gap (Davis et al 2017). The leverage rate (LEV) has a significant and negative effect on ROAE only, unlike the results in Table 5, where it is insignificant for both ROAA and ROAE. These results suggest that, although some macroprudential instruments are significant and negatively affect banks' profitability as in line with the results in Table 5, countries characteristics can influence which macroprudential instrument have the greater impact on banks' profitability.

Table 12: Macroprudential instruments results with country fixed effects for the period 2000-2013 (all countries)

Dependent variable	**ROAA**	**ROAE**
Macroprudential instruments	**Panel OLS with country fixed effects**	**Panel OLS with country fixed effects**
Loan-to-Value Ratio (LTV (-1))	-0.042 (-0.4)	-1.940** (-2.1)
Debt-to-Income Ratio (DTI(-1))	-0.303*** (-4.8)	-3.603*** (-5.8)
Capital Surcharges on SIFIs (SIFI(-1))	-0.272 (-1.0)	-1.482 (-1.3)
General Countercyclical Capital Buffer/Requirement (CTC(-1))	-1.339* (-1.7)	-4.841 (-1.0)
Time-Varying/Dynamic Loan-Loss Provisioning (DP(-1))	-0.561** (-2.0)	-1.776 (-1.4)
Leverage Ratio (LEV(-1))	-0.120 (-0.8)	-1.649* (-1.9)
Limits on Interbank Exposures (INTER(-1))	-0.172 (-1.3)	-1.071 (-1.1)
Concentration Limits (CONC(-1))	-0.021 (-0.2)	-0.801 (-0.6)
Limits on Domestic Currency Loans (CG(-1))	-0.553 (-1.2)	-6.013 (-1.7)
Levy/Tax on Financial Institutions (TAX(-1))	0.075 (1.2)	0.629 (1.0)
Reserve Requirement Ratios (RR(-1))	-0.057 (-0.1)	-1.833 (-0.4)
Limits on Foreign Currency Loans (FC(-1))	-0.121 (-0.5)	-2.324 (-1.2)
Loan-to-value ratio caps (LTVCAP(-1))	-0.055 (-0.7)	-2.591*** (-2.9)
FX and/or Countercyclical Reserve Requirements (RRREV(-1))	0.225 (0.4)	-0.444 (-0.1)
Total macroprudential instruments (MPI(-1))	-0.061 (-1.3)	-0.862** (-2.0)
Macroprudential instruments focused on the borrower (MPIB(-1))	-0.058 (-1.2)	-0.785 (-1.9)
Macroprudential instruments focused on the financial institution (MPIF(-1))	-0.056 (-0.8)	-0.664 (-1.0)

Note: The macroprudential instruments coefficient values are reported and the t-statistics are reported in parenthesis below each estimated coefficient. Each equation includes all the control variables shown in Table 4.*** significant at 1%, ** significant at 5%, * significant at 10%.

9.2. Bank and time fixed effects

In the second robustness test, we ran estimates of the baseline ROAA and ROAE models results using both bank and time fixed effects. The main model in equation (1) was adjusted to include time fixed effects as well as bank fixed effects. The combined model controls for unobservable factors that change over time but are constant over entities and it also controls for unobservable factors that differ across entities but are constant over time. Therefore, we verify whether time fixed effects can affect the empirical results.

The bank and time fixed effects model results (see Table 13 below) show that banks' profitability (both ROAA and ROAE) is determined by bank size (LNSIZE, negative), credit risk (CRISK, negative), management efficiency (COSTINC, negative), diversification (DIVSIF, positive) and GDP growth (RGDPGWR, positive). In addition, the Lerner Index ((LINDEX) has positive and significant effect on ROAA so competition has a negative relation to profitability as would be expected. In many aspect these results are consistent with the baseline results in Table 4 except for the rate of inflation (INFLAT), leverage (LEV) and banking crisis (BCRISIS), which are insignificant in the bank and time fixed effects model. This indicates that time fixed effects factors having an effect on the determinants of banks' profitability.

Table 13: Regression results for return on average assets (ROAA) and return on average equity (ROAE) as dependent variable with banks and time fixed effects for the period 2000-2013 (all countries)

Dependent variable: ROAA and ROAE		
	ROAA	**ROAE**
	Panel OLS with bank and time fixed effects	**Panel OLS with bank and time fixed effects**
Constant	3.329** (2.5)	32.031*** (3.8)
LNSIZE(-1)	-0.100* (-1.7)	-0.913** (-2.4)
LEV(-1)	0.343 (0.8)	-3.096 (-1.3)
CRISK(-1)	-1.020*** (-3.9)	-10.304*** (-6.0)
LRISK(-1)	0.004 (1.2)	-0.040 (-1.2)
COSTINC(-1)	-0.735*** (-4.2)	-6.247*** (-3.5)
DIVSIF(-1)	0.004*** (3.6)	0.037*** (5.0)
LINDEX(-1)	0.204* (1.6)	-0.480 (-0.6)
BCRISIS(-1)	-0.125 (-1.3)	-0.887 (-1.1)
RGDPGWR(-1)	0.021** (2.3)	0.194** (2.0)
INFLAT(-1)	0.009 (1.1)	0.066 (1.0)
R-squared	0.545	0.490
R-squared (adj.)	0.416	0.344
Standard error	1.81	13.92
F-statistic	4.232	3.370
Prob(F-statistic)	0.000	0.000
Periods included	13	13
Cross sections included	2,471	2453
Observations	11,308	11,159

Note: Independent variables coefficient values are reported and the t-statistics are reported in parenthesis below each estimated coefficient. *** significant at 1%, ** significant at 5%, * significant at 10%.The variables are winsorised at 99%. White (1980) cross-sectional standard errors and covariance (corrected for degrees of freedom) are used.

In term of the macroprudential instruments, Table 14 below shows the debt-to-income ratio (DTI) has the most significant effect on bank profitability, similar to the baseline in The general countercyclical capital buffer/requirement (CTC) has significant and negative effects on ROAA only, while limits on domestic currency loans (CG) has significant and negative effects on ROAE. These results are broadly in line with Table 5, although there CTC and CG have negative and significant effect on both ROAA and ROAE.

Table 14: Macroprudential instruments results with banks and time fixed effects for the period 2000-2013 (all countries)

Dependent variable	**ROAA**	**ROAE**
Macroprudential instruments	**Panel OLS with bank and time fixed effects**	**Panel OLS with bank and time fixed effects**
Loan-to-Value Ratio (LTV (-1))	0.0230 (0.3)	-1.368 (-1.4)
Debt-to-Income Ratio (DTI(-1))	-0.235*** (-3.2)	-2.690*** (-3.4)
Capital Surcharges on SIFIs (SIFI(-1))	-0.032 (-0.1)	1.28 (0.5)
General Countercyclical Capital Buffer/Requirement (CTC(-1))	-2.605** (-2.3)	14.583 (-1.6)
Time-Varying/Dynamic Loan-Loss Provisioning (DP(-1))	-0.29 (-1.1)	0.742 (0.4)
Leverage Ratio (LEV(-1))	-0.001 (-0.0)	0.260 (0.3)
Limits on Interbank Exposures (INTER(-1))	0.034 (0.4)	0.734 (0.8)
Concentration Limits (CONC(-1))	0.183 (2.5)	1.080 (0.9)
Limits on Domestic Currency Loans (CG(-1))	-0.852 (-1.5)	-8.380*** (-2.9)
Levy/Tax on Financial Institutions (TAX(-1))	0.120 (1.7)	1.847*** (3.8)
Reserve Requirement Ratios (RR(-1))	-0.372 (-0.6)	-2.776* (-0.6)
Limits on Foreign Currency Loans (FC(-1))	0.013 (0.1)	-0.560 (-0.3)
Loan-to-value ratio caps (LTVCAP(-1))	-0.050 (-0.4)	-2.060 (-1.3)
FX and/or Countercyclical Reserve Requirements (RRREV(-1))	-0.090 (-0.1)	-1.710 (-0.3)
Total macroprudential instruments (MPI(-1))	-0.040 (-0.8)	-0.412 (-0.9)
Macroprudential instruments focused on the borrower (MPIB(-1))	0.004 (0.1)	0.127 (0.3)
Macroprudential instruments focused on the financial institution (MPIF(-1))	-0.022 (-0.3)	0.020 (0.0)

Note: The macroprudential instruments coefficient values are reported and the t-statistics are reported in parenthesis below each estimated coefficient. Each equation includes all the control variables shown in Table 4.*** significant at 1%, ** significant at 5%, * significant at 10%.

Levy/tax on financial institutions (TAX) has a positive and significant effect on ROA only, suggesting that banks are able to pass on the cost of the tax to customer. This was insignificant in the baseline in Table 5), but is consistent with the results for emerging

markets (Table 8) and retail and consumer banks (Table 10). Finally, reserve requirement ratios (RR) has a negative and significant ROAE only, unlike in Table 5, where it was insignificant but there is some consistency with Table 10, universal banks where it was significant and has a negative effect on both ROAA and ROAE. There is some difficulty in interpreting the results for reserve requirements as it is link to their dual role as an instrument of monetary policy and of macroprudential policy (Davis et al (2017), Izquierdo et al (2013)).

Despite the contrasts highlighted above, overall, we contend that the results for robustness underpin the validity of the main results of the paper.

10. Conclusions

The purpose of this article is to present estimates of effects of macroprudential policies on banks' profitability which will also help in the understanding of how banks react to macroprudential regulations. To our knowledge, this analysis has not been undertaken in the research literature to date.

The empirical results suggest that in the sample period 2000-2013, a number of measures of macroprudential policy such as the asset measures, loan-to-value ratios measures (LTV and LTVCAP) and debt-to-income ratios (DTI); a liquidity measure, domestic currency loans limits (CG) as well as a capital measure, the general countercyclical capital buffer (CTC) generally had a negative and significant effect on banks' profitability as measured by return of average assets (ROAA) and return on average equity (ROAE).

Also, we found that country and bank characteristics have an influence on the effect of macroprudential policy on banks' profitability. The results show that, although some macroprudential instruments are significant and negatively affect banks' profitability quite consistently, country and bank characteristics can influence which macroprudential instrument have the greater impact on banks' profitability and similar differences are found in papers assessing effects on credit such as Davis et al (2017) and Cerrutti et al (2017). Authorities should thus be aware that there is no "one size fits all" and careful consideration of country characteristics is needed in choice of instrument. Our overall results are broadly underpinned by two robustness checks.

Since research such as Davis et al (2017), Carreras et al (2018) and Cerutti et al (2017) has shown that macroprudential policy (notably LTV and DTI) are effective in reducing the build-up of financial system imbalances as measured by the credit-to-GDP gap or credit growth, our empirical results suggest that we accept that Hypothesis 1 is true for these measures, that is, banks' profitability is negatively affected when macroprudential policy are effective in reducing financial system imbalances. A related group of measures affects profitability negatively but is found to influence credit growth only at a micro level in the existing literature (Claessens et al 2013), namely limits of domestic lending (CG), the countercyclical buffer (CTC) and dynamic provisioning (DP).

On the other hand, we found a further subset of measures that is either effective for profitability or credit growth but not both. For example, we found that, capital surcharges on SIFIs (SIFI) and reserve requirements (RR and RRREV) affect profitability in some samples, but no study cited here shows a significant effect on credit growth. On the other hand, we find that taxes on financial institutions (TAX), interbank limits (INTER) and concentration measures (CONC) affect

credit negatively in some studies but not profitability (except for the case of retail banks for TAX).

These results are of policy relevance since they suggest there is a varying efficiency of macroprudential measures. The most efficient limit credit without hitting bank profitability, and hence they allow banks to build up capital and develop robustness while having the desired effect on credit conditions at a macro level. Our work suggests that a second group affect credit but reduce bank profits at the same time. Such an effect might risk being counterproductive if banks choose to offset lower profitability by taking higher risks in unrestricted lending markets (such as commercial property) in order to counteract the fall in profits. Even if this is not the case, lower profits will limit scope to build up capital buffers from retained earnings. Our work suggests that the third group is the least efficient since it reduces bank profits but has no detectable effect on credit at a macro level. This pattern is worthy of further research, especially at a country level before policy measures are introduced.

Further research could also be undertaken to analyse the impact macroprudential policy has on the real economy when banks' profits are restricted. The contrasting results for the country and bank type are worthy of further investigation by regions and individual countries for the benefit of regulators. Detailed country characteristics could be considered for testing. In addition, research can be undertaken to understand the monetary and macroprudential policies nexus in terms of how banks deposit and lending interest rates and hence the net interest margin react to the employment of macroprudential policy and whether there are offsetting effects in non interest income. Finally, there could be investigation whether there is a nonlinear relation of profitability to bank size.

Appendix 1: The list of countries and banks used in the empirical analysis

Table A.1.1 shows the list of countries and the number of banks in the empirical analysis. We include 92 countries, 34 advanced countries and 58 emerging market economies, 6,010 banks (3,095 banks from advanced countries and 2,915 banks from emerging market economies) and 84,140 observations. The types of banks included are universal commercial banks, retail and consumer banks, banks, wholesale banks, and Islamic banks. Investment banks and private banks are excluded due to different balance sheet and income structure as well as bank holding companies, to avoid double counting.

Table A.1.1: List of countries and number of banks

Country	ISO Code	IMF category	Region	No. of banks	
				ADV	EME
Algeria	DZA	EME	Africa		16
Angola	AGO	ADV	Africa		22
Argentina	ARG	ADV	South America		112
Australia	AUS	EME	Oceania	89	
Austria	AUT	EME	Europe	125	
Bahamas	BHS	ADV	Caribbean		41
Bahrain	BHR	EME	Middle East		40
Barbados	BRB	EME	Caribbean		9
Belgium	BEL	EME	Europe	102	
Belize	BLZ	ADV	Caribbean		2
Bolivia	BOL	ADV	South America		17
Brazil	BRA	EME	South America		100
Bulgaria	BGR	EME	Europe		20
Canada	CAN	EME	North America	73	
Chile	CHL	EME	South America		80
China	CHN	EME	Asia		100
Colombia	COL	ADV	South America		77
Costa Rica	CRI	ADV	Central America		81
Cote D'Ivoire	CIV	ADV	Africa		18
Croatia	HRV	EME	Europe		51
Cyprus	CYP	ADV	Europe	26	
Czech Republic	CZE	ADV	Europe	48	
Denmark	DNK	ADV	Europe	138	
Ecuador	ECU	ADV	South America		53
Egypt	EGY	ADV	Africa		37
El Salvador	SLV	ADV	Central America		21
Estonia	EST	EME	Europe	11	
Finland	FIN	ADV	Europe	68	
France	FRA	ADV	Europe	126	
Germany	DEU	EME	Europe	136	
Ghana	GHA	ADV	Africa		48
Greece	GRC	EME	Europe	25	
Guatemala	GTM	EME	Central America		39
Guyana	GUY	ADV	Caribbean		8

Honduras	HND	ADV	Central America		30
Hong Kong	HKG	ADV	Asia	123	
Hungary	HUN	EME	Europe		134
Iceland	ISL	ADV	Europe	42	
India	IND	ADV	Asia		105
Indonesia	IDN	ADV	Asia		103
Ireland	IRL	EME	Europe	66	
Israel	ISR	EME	Europe	20	
Italy	ITA	ADV	Europe	188	
Jamaica	JAM	EME	Caribbean		12
Japan	JPN	EME	Asia	141	
Jordan	JOR	ADV	Middle East		18
Kenya	KEN	ADV	Africa		60
Korea	KOR	ADV	Asia	105	
Kuwait	KWT	ADV	Middle East		24
Latvia	LVA	EME	Europe	25	
Lithuania	LTU	ADV	Europe		12
Luxembourg	LUX	EME	Europe	132	
Malaysia	MYS	EME	Asia		90
Malta	MLT	EME	Europe	20	
Mexico	MEX	ADV	Central America		49
Mongolia	MNG	ADV	Asia		13
Morocco	MAR	ADV	Africa		25
Mozambique	MOZ	EME	Africa		18
Netherlands	NLD	ADV	Europe	87	
New Zealand	NZL	EME	Oceania	30	
Nicaragua	NIC	EME	Central America		17
Nigeria	NGA	EME	Africa		84
Norway	NOR	ADV	Europe	135	
Oman	OMN	EME	Middle East		14
Panama	PAN	EME	Central America		114
Paraguay	PRY	EME	South America		32
Peru	PER	EME	South America		36
Philippines	PHL	EME	Asia		46
Poland	POL	EME	Europe		103
Portugal	PRT	ADV	Europe	121	
Qatar	QAT	EME	Middle East		12
Romania	ROM	EME	Europe		40
Russia	RUS	EME	Europe		148
Saudi Arabia	SAU	EME	Middle East		14
Serbia	SRB	EME	Europe		49
Singapore	SGP	ADV	Asia	38	
Slovak Republic	SVK	ADV	Europe	26	
Slovenia	SVN	ADV	Europe	27	
South Africa	ZAF	EME	Africa		53
Spain	ESP	ADV	Europe	218	
Suriname	SUR	EME	Caribbean		4

Sweden	SWE	ADV	Europe	133	
Switzerland	CHE	ADV	Europe	136	
Tanzania	TZA	EME	Africa		42
Thailand	THA	EME	Asia		32
Trinidad and Tobago	TTO	EME	Caribbean		15
Turkey	TUR	EME	Europe		103
UK	GBR	ADV	Europe	159	
Ukraine	UKR	EME	Europe		174
United Arab Emirates	ARE	EME	Middle East		38
Uruguay	URY	EME	South America		60
USA	USA	ADV	North America	156	
Total	**92**			**3,095**	**2,915**

Main data source: Fitch Connect, IMF and authors' calculation.

Appendix 2. Descriptive statistics of the ROAA and ROAE baseline model variables

Table A.2.1: ROAA and ROAE baseline model variables descriptive statistics for the period 2000-2013 (all countries)

Variables	Mean	Median	Max	Min	StdDev	Obs
Dependent variables						
ROAA (%)	1.048	0.880	12.035	-13.165	2.784	36,900
ROAE (%)	8.725	8.810	59.053	-84.690	17.665	36,306
LNSIZE (log)	21.348	21.320	27.211	15.843	2.420	45,015
LEV	0.149	0.091	1.267	0.001	0.207	41,273
CRISK	0.091	0.033	1.162	0.002	0.174	25,137
LRISK	2.370	0.890	152.950	0.010	9.090	36,555
COSTINC	0.451	0.390	3.176	0.001	0.450	39,834
DIVSIF (%)	34.270	29.500	142.620	-55.785	30.060	40,557
LINDEX	0.203	0.207	0.998	-2.311	0.501	21,541
BCRISIS						
RGDPGWR (%)	3.260	3.187	12.110	-6.600	3.450	83,892
INFLAT (%)	4.718	2.903	38.470	-1.210	5.690	83,666

Data Source: Fitch Connect, IMF and author calculations. Banking Crisis (BCRISIS) is a dummy variable and it is coded one in the year the crisis starts until the year it was over and is otherwise zero. The values are a ratio unless otherwise stated. Max – maximum, Min – minimum, StdDev - standard deviation. The variables are winsorised at 99% and in level (not lagged).

Table A.2.2: Correlation matrix for the return on average assets (ROAA) for the period 2000-2013 (all countries)

	ROAA	LNSIZE	LEV	CRISK	LRISK	COST INC	DIVSIF	LINDEX	BCRISIS	RGDP GWR	INFLAT	3MTH RATE	YD SLOPE
ROAA	1.000												
LNSIZE	-0.068	1.000											
LEV	0.089	-0.358	1.000										
CRISK	-0.099	-0.110	0.027	1.000									
LRISK	0.024	-0.028	0.068	0.028	1.000								
COST INC	-0.260	-0.376	0.490	0.086	0.004	1.000							
DIVSIF	0.029	-0.108	0.066	-0.011	0.003	0.224	1.000						
LINDEX	0.104	0.414	-0.478	0.011	0.000	-0.745	-0.314	1.000					
BCRISIS	-0.011	0.016	0.060	-0.043	0.007	0.034	-0.065	-0.003	1.000				
RGDP GWR	0.036	0.062	-0.060	0.001	0.004	-0.073	0.024	0.080	-0.454	1.000			
INFLAT	-0.011	0.127	-0.012	-0.040	0.002	-0.072	-0.048	0.103	0.046	0.293	1.000		

3MTH RATE	0.026	0.108	-0.050	0.030	-0.007	-0.071	0.011	0.089	-0.231	0.507	0.481	1.000	
YD SLOPE	-0.045	0.104	-0.006	0.008	-0.003	-0.002	-0.012	0.031	0.021	0.048	0.460	0.547	1.000

Data Source: Fitch Connect, IMF and author calculations. Banking Crisis (BCRISIS) is a dummy variable. The variables are winsorised at 99% and in level (not lagged).

Table A.2.3: Correlation matrix for the return on average equity (ROAE) the period 2000-2013 (all countries)

	ROAE	LNSIZE	LEV	CRISK	LRISK	COST INC	DIVSIF	LINDEX	BCRISIS	RGDP GWR	INFLAT	3MTH RATE	YD SLOPE
ROAE	1.000												
LNSIZE	-0.008	1.000											
LEV	-0.008	-0.362	1.000										
CRISK	-0.260	-0.256	0.106	1.000									
LRISK	-0.029	-0.020	0.069	0.066	1.000								
COST INC	-0.253	-0.364	0.513	0.229	-0.010	1.000							
DIVSIF	0.012	-0.096	0.061	0.160	0.004	0.211	1.000						
LINDEX	0.071	0.407	-0.486	-0.111	0.018	-0.749	-0.310	1.000					
BCRISIS	-0.037	0.020	0.059	-0.017	0.001	0.023	-0.074	0.009	1.000				
RGDP GWR	0.057	0.062	-0.061	-0.027	0.012	-0.062	0.027	0.069	-0.452	1.000			
INFLAT	-0.009	0.131	-0.014	-0.042	0.004	-0.076	-0.053	0.106	0.042	0.304	1.000		
3MTH RATE	0.030	0.104	-0.050	-0.020	-0.002	-0.062	0.018	0.079	-0.233	0.513	0.484	1.000	
YD SLOPE	-0.056	0.104	-0.005	-0.005	-0.005	-0.008	-0.012	0.036	0.017	0.062	0.457	0.550	1.000

Data Source: Fitch Connect, IMF and author calculations. Banking Crisis (BCRISIS) is a dummy variable. The variables are winsorised at 99% and in level (not lagged).

REFERENCES

Adelopo, I., Lloyd-King, R. and V. Tauringana (2018), "Determinants of bank profitability before, during, and after the financial crisis", International Journal of Managerial Finance, Vol. 14 Issue: 4, pp.378-398.

Aiyar, S., Calomiris, C.W. and T. Wieladek (2014), "Does Macro-Prudential Regulation Leak? Evidence from a UK Policy Experiment", Journal of Money, Credit and Banking, Supplement to Vol. 46, No. 1, February.

Akinci, O. and Olmstead-Rumsey, J. (2018) "How effective are macroprudential policies? An empirical investigation", Journal of Financial Intermediation, 33C:33-57.Alessandria, P. and B. D. Nelson (2015), "Simple Banking: Profitability and the Yield Curve", Journal of Money, Credit and Banking, Vol. 47, No. 1, pp 143-175.

Anginer, D., Demirguc-Kunt, A. and Z. Zhu (2014), "How does competition affect bank systemic risk?", Journal of Financial Intermediation 23, pp. 1-26.

Athanasoglou, P. P., Delis, M. D. and C. K. Staikouras (2006), "Determinants of bank profitability in the South Eastern European region", Bank of Greece Working Paper No. 47.

Athanasoglou, P. P., Brissimis, S. N. and M. D. Delis (2008), "Bank-specific, industry-specific and macroeconomic determinants of bank profitability", Journal of International Financial Markets, Institutions and Money 18, pp. 121-136.

Barrell R, Davis E P, Fic T, Holland D, Kirby S, Liadze I (2009), "Optimal regulation of bank capital and liquidity: how to calibrate new international standards, FSA Occasional Paper No 38

Beck, T., De Jonghe, O., and G. Schepens (2013), "Bank competition and stability: Cross-country heterogeneity", Journal of Financial Intermediation, 22, pp. 218-244.

Berger, A. N (1995), "The Profit-Structure Relationship in Banking--Tests of Market-Power and Efficient-Structure Hypotheses", Journal of Money, Credit and Banking, Vol. 27, No. 2, pp. 404-431, May.

BIS (2016), "Recent enhancements to the BIS statistics", BIS Quarterly Review, September:38-39.

Borio, C., Gambacorta, L. and B. Hofmann (2017), "The influence of monetary policy on bank profitability", International Finance, 20, pp. 48-63.

Bouzgarroua, H., Jouidaa, S. and W. Louhichib (2018), "Bank profitability during and before the financial crisis: Domestic versus foreign banks", Research in International Business and Finance 44, pp. 26-39.

Cariboni, J., Fontanai, A., Langedijki, S., Maccaferrii, S., Paganoi, A., Giudicii, M. P., Rancani, M. and S. Schich (2016), "Reducing and sharing the burden of bank failures", OECD Journal: Financial Market Trends, Vol. 2015/2, April.

Carreras O, Davis E P and Piggott R (2018), "Assessing macroprudential tools in OECD countries within a cointegration framework", Journal of Financial Stability, 37, August 2018, 112-130

Cerutti, E., Claessens, S. and Laeven, L., (2015), "The Use and Effectiveness of Macroprudential Policies: New Evidence", IMF Working Paper 15/61.

Cerutti, E., Correa, R., Fiorentino, E., Segalla, E., (2016), "Changes in Prudential Policy Instruments, a New Cross Country Database", IMF Working Paper 16/110.

Cerutti, E., Claessens, S. and Laeven, L., (2017), "The Use and Effectiveness of Macroprudential Policies: New Evidence", Journal of Financial Stability, 28, pp. 203-224.

Chronopoulos, D. K., Liu, H., McMillan, F. J. and J. O. S. Wilson (2015), "The dynamics of US bank profitability", The European Journal of Finance, 21:5, pp. 426-443.

Claessens, S., Ghosh, S. R. and R. Mihet (2013), "Macroprudential policies to mitigate financial system vulnerabilities", Journal of International Money and Finance, 39, 153-185.

Crowe, C., Dell'Ariccia, G., Igan, D. and P. Rabanal (2011), "How to deal with real estate booms: lessons from country experiences", IMF Working Paper No. WP/11/91.

Davis, E.P, Karim, D., and D. Noel (2017), "Macroprudential policy and Financial Imbalances", Brunel University London Economics and Finance Working Paper No. 17-22.

Davis E P and Karim D (2019), "Exploring short- and long-run links from bank competition to risk", European Financial Management, 25, 462-488

Davis E P, Liadze I and Piggott R (2019), "Assessing the macroeconomic impact of alternative macroprudential policies", Economic Modelling, 80, 407-428

Davis, E.P., Karim, D. and Noel, D. (2020), "Financial Stability and Macroprudential Policy: Are there cross-border effects?"", mimeo, Brunel University

Dell'Ariccia, G., Igan, D., Laeven, L., and H. Tong (2012), "Policies for Macrofinancial Stability: How to Deal with Credit Booms," IMF Staff Discussion Note No. 12/06.

Demirguc-Kunt, A. and H. Huizinga (1999), "Determinants of Commercial Bank Interest Margins and Profitability: Some International Evidence", The World Bank Economic Review, Vol. 13, No. 2, pp. 379-408, May.

de-Ramon, S., Francis, W. and M. Straughan (2018), "Bank competition and stability in the United Kingdom", Bank of England Staff Working Paper No 748.

Dietrich, A. and G. Wanzenried (2011), "Determinants of bank profitability before and during the crisis: Evidence from Switzerland", Journal of International Financial Markets, Institutions & Money 21, pp. 307-327.

Goddard, J., Liu, H., Molyneux, P. and J. O. S. Wilson (2013), "Do Bank Profits Converge?", European Financial Management, Vol. 19, No. 2, pp. 345–365.

Goddard, J., Molyneux, P. and J. O. S. Wilson (2004), "The profitability of European Banks: A cross-sectional and dynamic panel analysis", The Manchester School Vol 72, No. 3, June.

Goddard, J., Molyneux, P. and J. O. S. Wilson (2014), "Banking in the European Union: Deregulation, Crisis, and Renewal", The Oxford Handbook of Banking, Second Edition (2 ed.).

Hinkle, D. E, Wiersma, W. and S. Jurs (2003), "Applied Statistics for the Behavioral Sciences", Houghton Mifflin, 5th Edition.

Hoffmann, P. S. (2011), "Determinants of the Profitability of the US Banking Industry", International Journal of Business and Social Science, Vol. 2 No. 22, pp. 255-269.

Izquerido, A., Loo-Kung, R. and Rojas-Suarez, L. (2013), "Macroprudential Regulations in Central America", Center for Global Development, Working Paper No 318.

Jácome, L. I. and S. Mitra (2015), "LTV and DTI Limits—Going Granular", IMF Working Paper 15/154, July.

Kim, D. and W. Sohn (2017), "The effect of bank capital on lending: Does liquidity matter?", Journal of Banking and Finance 77, 95-107.

Korytowski, M. (2018), "Banks' profitability determinants in post-crisis European Union", Journal of Finance & Banking Studies 7(1), pp. 01-12.

Laeven, L. and F. Valencia (2018), "Systemic Banking Crises Revisited", IMF Working Paper 18/206, September.

Lee. S. W. (2015), "Capital Strength and Bank Profitability", Asian Social Science, Vol. 11, No. 10.

Lim, C, Columba, F., Costa, A., Kongsamut, P., A. Otani, Saiyid, M., Wezel, T., and X. Wu (2011), "Macroprudential Policy: What Instruments and How to Use Them? Lessons from Country Macroprudential Policy: What Instruments and How to Use Them? Lessons from Country Experiences", IMF Working Paper 11/238.

Maudos, J. and L Solis (2009), "The determinants of net interest income in the Mexican banking system: An integrated model", Journal of Banking & Finance 33, pp. 1920-1931.

Miller, S. M., & Noulas, A. G. (1997), "Portfolio mix and large-bank profitability in the USA", Applied Economics, 29(4), 505–512.

Mirzaei, A. Liu, G. and Moore, T. (2013), "Does market structure matter on banks' profitability and stability? Emerging vs. advanced economies", Journal of Banking and Finance, 37, 2920-37.

Naceur, S. B., Marton, K. and C. Roulet (2018), "Basel III and bank-lending: Evidence from the United States and Europe", Journal of Financial Stability 39, pp. 1–27.

Noss, J. and P. Toffano (2016), "Estimating the impact of changes in aggregate bank capital requirements on lending and growth during an upswing", Journal of Banking & Finance 62, 15-27.

Pasiouras, F. and K. Kosmidou (2007), "Factors influencing the profitability of domestic and foreign commercial banks in the European Union", Research in International Business and Finance 21, pp. 222–237.

Pasiouras, F., Tanna, S. and C. Zopounidis (2009), "The impact of banking regulations on banks' cost and profit efficiency: Cross-country evidence", International Review of Financial Analysis 18. pp. 294-302.

Petria, N., Capraru, B. and I. Ihnatov (2015), "Determinants of banks' profitability: evidence from EU 27 banking systems", Procedia Economics and Finance 20, pp. 518 – 524.

Roulet, C. (2018), "Basel III: Effects of capital and liquidity regulations on European bank lending", Journal of Economics and Business 95, pp. 26-46.

Sandal, K. (2004), "The Nordic Banking Crises in the Early 1990s – Resolution Methods and Fiscal Costs", In More, T G, Solheim, J A and Vale, B (Eds.): The Norwegian Banking Crisis, Norges Banks Skriftserie/Occasional Papers No. 33, pp. 77–115.

Saona, P. (2016), "Intra- and extra-bank determinants of Latin American Banks' profitability", International Review of Economics and Finance 45, pp. 197-214.

Schaeck, K., Cihák, M., (2012), "Banking competition and capital ratios", European Financial Management, 18, 836–866.

Shaffer, S., Spierdijk, L., (2015), "The Panzar-Rosse revenue test and market power in banking", Journal of Banking and Finance 61, 340–347.

Tchana, F.T. (2012), "The welfare cost of banking regulation", Economic Modelling, 29, pp. 217-232.

Topak, M. S. and N. H. Talu (2017), "Bank Specific and Macroeconomic Determinants of Bank Profitability: Evidence from Turkey", International Journal of Economics and Financial Issues, 7(2), pp. 574-584.

Van den Heuvel, S. (2008), "The welfare cost of bank capital requirements", Journal of Monetary Economics, 55, pp. 298-320.

Weill, L. (2013), "Bank competition in the EU: How has it evolved?", Journal of International Financial Markets, Institutions & Money, 26, pp. 100-112.

White, H. (1980), "Nonlinear regression on cross section data" Econometrica, 48, 721–746.

Xiao, Y. (2009), "French Banks Amid the Global Financial Crisis", IMF Working Paper 08/201, September.

Yang, X. (2016), "Predicting bank failures: The leverage versus the risk-weighted capital ratio", Working paper 2016-15, University of Paris-Nanterre