Inclusive Banking, Financial Regulation and Bank Performance: Cross-Country Evidence*

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ABSTRACT

Using an international sample, this paper contributes to the ongoing policy debate on whether greater financial inclusion can help improve bank performance, even in the presence of financial regulation. We, first, document a strong positive association between financial inclusion and bank efficiency, and then show that this association is stronger in countries with limited restrictions on banking activities and more capital regulation stringency. Exploring plausible channels, we find that greater financial inclusion helps banks reduce the volatility of their deposit-funding share, providing more stable long-term funds for banks while also mitigating the negative effects of their return volatility. Exploiting cross-country and temporal variation in the timing of inclusive financial agenda with hand-collected data on membership of an inclusive policy network of countries to actively promote inclusiveness, we also show, using a difference-in-differences estimator, that an enabling inclusive financial environment has positive impact on bank performance. Thus the significant benefits of inclusive banking have ramifications for enabling regulatory incentives to promote inclusive financial intermediation.

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1. Introduction

The seminal paper by King and Levine (1993) and the subsequent literature underscore the important link between financial development and economic growth – a link that has spurred further exploration into various aspects of financial development, and documents not only positive correlations but also causal effect of finance on growth in cross-country regressions.[1] More recent literature, however, has revealed that finance has a non-linear relationship with growth which is stronger among emerging market economies (Aghion et al., 2005, Law and Singh, 2014, Arcand et al., 2015). In the aftermath of the recent global financial crisis in 2007-08, the developing country governments and policymakers including G20 and many central banks have endorsed an objective of financial inclusion for economic prosperity and growth. In particular, the G20 committed to advancing financial inclusion globally and created the Global Partnership for Financial Inclusion in 2010 at the Seoul Summit with this objective[2]. Since then almost every G20 communique has alluded to the need to pursue financial inclusion. In an inclusive financial sector, all economic agents have unfettered access to basic financial services and are able to use them effectively. Despite the optimism about inclusive finance, it is yet to be explored how it impacts the arbiters of financial service providers, especially whether greater financial inclusion is complementary to bank performance.[3]

The global financial crisis has also underscored the importance of appropriate regulatory intervention in promoting bank resiliency. A well-functioning, better performing, and efficient financial system can affect real growth by increasing savings rate (e.g., Jappelli and Pagano, 1994) and by channelling funds efficiently (Fries and Taci, 2005, Levine, 2005).

[1] See, for example: Levine (1999); Wurgler (2000); Beck et al. (2000); and Bekaert et al. (2005). Most of the studies show that various aspects of financial development causally impact economic growth. For a detailed review of the literature see Levine (2005) and Pasalı (2013).

[2] https://www.gpfi.org/about-gpfi

[3] Throughout this paper, we use the term "inclusive finance" to refer to "financial inclusion" and "inclusive banking".

Therefore, taking bank regulation and supervision surveys data of Barth et al. (2013), we examine whether the relationship between financial inclusion and bank performance differs across countries with varied regulatory and supervisory practices, such as restrictions on banking activities, severe limitations on foreign bank entry/ownership to stifle competition, and capital regulation stringency.

In this paper, unlike many existing studies that use a conventional measure of financial development namely the ratio of private credit to GDP (see Beck et al., 2014, Sahay et al., 2015), we use a composite measure of financial development, that is, financial inclusion. This indicator is constructed based on both demographic and geographic financial sector outreach as well as number of bank accounts, which is then used to investigate how it impacts bank-level performance – bank efficiency. Bank-level productive efficiency scores are obtained from non-parametric Data Envelopment Analysis (DEA). This technique is used to gauge the extent to which the performance of individual banks moves away from that of optimal standard ("best practice") banks (Assaf et al., 2011, Chortareas et al., 2011, Chortareas et al., 2012, Barth et al., 2013, Chortareas et al., 2013, Halkos and Tzeremes, 2013, Ayadi et al., 2016, Halkos et al., 2016).

Existing literature, on the one hand, argues that inclusive finance with more extensive financial sector outreach and access to financial instruments could reduce information asymmetries and agency problems between lenders and borrowers (Beck et al., 2014), reduce volatility of funding as banks are able to extract deposits from a large customer base (Han and Melecky, 2013), and also reduce return volatility as banks rely less on risky and costly money market funds (Kacperczyk and Schnabl, 2013). On the other hand, inclusive finance could also increase agency problems due to large product mix and organisational structure and reduce operating efficiency of banks as monitoring a distant bank branch by headquarters becomes more problematic (see Brickley et al., 2003). These competing effects imply that inclusive

finance could increase or decrease operating efficiency of banks. However, if the benefits associated with inclusive finance outweigh the costs, one would expect to see an overall positive relation between inclusive finance and bank efficiency.

By linking country-level supply-side data of Financial Access Survey (FAS) with bank-level data of 1,740 banks for the period 2004-2015, we investigate the association between financial inclusion and bank efficiency. Our results indicate that there is a strong positive association between these variables. In particular, the higher the degree of financial inclusion, the better the bank efficiency. We show that this association is stronger in countries with limited restriction on banking activities and more capital regulation stringency. Exploring plausible channels, we find that greater financial inclusion helps banks reduce return volatility and volatility of customer deposits funding share. We also show that banks operating in less developed financial markets benefit more from inclusive financial development compared to banks in developed economies. We subject our findings to an array of sensitivity checks. Our findings are robust to (i) using 'fractional logit' quasi-likelihood estimator proposed by Papke and Wooldridge (1996); (ii) using instrumental variable approach; (iii) running regressions only for the sample of developing and emerging market economies; and finally (iv) controlling for the levels of economic development, inflation, and institutional development.

This paper aims at contributing to the existing empirical analyses in two important ways. First, we fill an important gap in the literature by providing new evidence on the impact of financial inclusion on bank efficiency using an international sample. We contribute to the literature that explores the determinants of bank efficiency (e.g., Berger et al., 1999, Rossi et al., 2009, Barth et al., 2013, Chortareas et al., 2013, Ayadi et al., 2016). Despite the extensive literature on bank efficiency (see Berger, 2007, for reviews of the literature), a systematic study on whether financial inclusion increases or decreases efficient operation of banks does not yet exist. This is mainly due to limited data availability for a long period of time across countries

and lack of development of reliable quantitative index of financial inclusion. Furthermore, with the recent technological advancement, a new frontier of financial intermediation emerges (e.g., mobile banking, agent banking) which allows banks to reduce transaction costs, acquire effective information, and enforce loan repayment (Bruhn and Love, 2014). The process of structural change and accompanying drive for new banking business have therefore manifested a desire for bank managers to concentrate on improving operating efficiency, particularly considering low-cost technology-driven financial products and services that reach to unbanked/underbanked adult population effectively and efficiently.

The emergence of new frontier of financial intermediation has discernible impact on bank performance, and therefore on their operating efficiency.[4] If banks extend their outreach, they are likely to access more deposits which would allow them to have lower volatility in their funding and increase their efficiency. Because banks that provide greater outreach are expected to attract more retail deposits, they could reduce their reliance on wholesale funds and, consequently, reduce the volatility of their returns and increase their efficiency. Over the last decade, more financial institutions are increasingly focusing on microfinance style of operation realising the implications of access to finance on their performances as well as on the society in general.[5] Reviewing a body of recent studies, Cull et al. (2014) conclude that including unbanked people into the formal financial system is an important component for economic and social progress. Therefore, identifying policy areas that have a first-order effect on increasing

[4] See Cull and Spreng (2011) for a study on the privatisation of the National Bank of Commerce (NBC) of Tanzania which was split into two banks namely New NBC and the National Microfinance Bank (NMB). While the former had only 35 bank branches and had business lines targeted to commercial enterprises and individuals, mostly located in urban centres, the latter had 95 bank branches and had the objectives of fostering financial access of the disadvantaged groups in the rural and urban centres. Both breakaway banks were able to improve their profitability and the share of performing loans eventually. However, the initial growth of credit of New NBC was slow whereas NMB had decent growth. This is an example that shows how broadening access of the poor people to financial services does not reduce efficiency of banks.

[5] For example: Grameen Bank of Bangladesh, Bank Rakyat Indonesia, Khushhali Bank in Pakistan, BancoSol in Bolivia, Banco Solidario in Ecuador, MiBanco in Peru, Banco Azteca in Mexico, and K-Rep Bank in Kenya are most of the recent success stories that show how commercially-oriented microfinance banks can achieve high operating efficiency and become profitable while serving the poor. For more on commercially-minded microfinance bank see Harper and Arora (2005) and Bruhn and Love (2014).

efficiency of financial institutions is critical for policymakers to spur inclusive economic growth, as efficiency gains increase availability of more productive loans and overall economic development (Fries and Taci, 2005).

Second, we contribute to the literature on finance and growth by exploring the role of regulatory and supervisory practices across countries on the link between inclusive financial development and performance of banks. Literature suggests that a well-functioning and efficient financial system exerts a first-order impact on economic growth and development (see e.g., Levine, 2005). Therefore, by identifying regulations that are important for expediting inclusive financial development, we aim to contribute to an ongoing policy debate, which would be useful to researchers and policymakers alike for making informed decisions on access policies; a well-designed regulatory framework would be important for ushering efficient intermediation of banking sector.

Finally, we exploit the timing variations of the developing countries that made measurable commitments for advancing inclusive financial development through innovative policies, identify the causal effects of enabling inclusive financial environment on bank performance using difference-in-differences (DID) estimator. The DID result shows that bank performance has improved significantly for those banks that operate in the countries that had taken steps to have inclusive financial sectors. We also confirm our results using a number of matching estimators while eliminating any sample selection bias and confounding in the treatment effects.

The remaining part of the paper is organized as follows: Section 2 discusses the related literature and hypothesis. Section 3 describes the data and methodology. Section 4 discusses the empirical results. Section 5 discusses the sensitivity analyses. Section 6 provides evidence on the mechanisms through which inclusive finance may enhance banks' operating efficiency.

Section 7 shows the effect of pro-access policy on bank efficiency, and Section 8 concludes with some policy implications.

2. Literature review and hypothesis development

This section discusses the associated literature and formulate the hypothesis on the relation between inclusive finance and bank efficiency.

Levine (2005), reviewing a large body of literature, shows that supply of financial services exerts a first-order impact on real economic growth. Financial intermediaries are vital to economic prosperity and growth as they mobilise savings, facilitate information sharing, help growing small and medium-sized firms in allocating funds efficiently. In an inclusive financial sector with more extensive bank branches/ATMs and with more people having access to financial services, banks are able to reduce information asymmetry and agency problems between borrowers (see Beck et al., 2014). Beck et al. (2007) find that greater banking sector outreach reduces firms' financial obstacles.

Existing literature suggests several channels through which an inclusive financial sector might influence efficient intermediation of the financial institutions. First, higher financial inclusion increases the opportunity for banks to reduce volatility of their funds as they are able to extract deposits from a large number of people, which is often the principal source of funds for banks (Calomiris and Kahn, 1991). It is often dubbed that retail deposits are sluggish, insensitive to risk and provide stable cheaper source of long-term funding compared to wholesale funding that are sophisticated, relatively risky and expensive as wholesale funders possess critical information about the prospects of bank projects (see Song and Thakor, 2007, Huang and Ratnovski, 2011).[6] Rajan (1992) compares informed and arm's length debt and shows that former debt holders (i.e., wholesale funders) could ask for higher compensation for

[6] See for example Shin (2009) and Goldsmith-Pinkham and Yorulmazer (2010).

further funding if they sense any negative prospects of bank projects. Using a sample of European Union countries, Poghosyan and Čihak (2011) also confirm that banks depending extensively on wholesale funding are more exposed to distress than those banks that are mostly depending on retail deposits. Overall, greater financial inclusion would imply opportunities for banks to access more customer deposits, ensuring a stable source of funding, which then result in more operating efficiency for banks.[7]

Second, as inclusive financial sector allows banks to reduce funding volatility, it has also implications on reducing return volatility. Investigating risk-taking incentives of money market funds, Kacperczyk and Schnabl (2013) show that money market funds have strong incentives to take more risk as they chase for higher yields. Due to reduction of market discipline on financial institutions, it makes them more susceptible to financial shocks. A plethora of empirical evidence shows that banks that relied substantially more on non-deposit sources of funds during global financial crisis (GFC) have experienced significantly large negative effect on their stock returns, exacerbating their risk-taking attitudes (Demirgüç-Kunt and Huizinga, 2010, Raddatz, 2010). On the contrary, banks with stable funding sources, particularly U.S. banks, continued lending relative to other banks (Cornett et al., 2011), and had lower probability of failure (Bologna, 2011). Demirgüç-Kunt and Huizinga (2010), using a sample of listed banks in 101 countries for the period 1995-2007, show that higher level of non-deposit/wholesale funding shares lowers the rate of return on assets and/or bank soundness.[8] As inclusive financial sector provides ample opportunities for retail deposits funding, it therefore should reduce return volatility of banks operating in such markets.

[7] Most of the emerging economies are continuously adopting pro-access policies to broaden financial inclusion. For instance: to get rid of financial untouchability, Indian government launched a scheme called the '*Pradhan Mantri Jan Dhan Yojana*' (Prime Minister's People Money Scheme) on 28 August 2014. Within two weeks of launch of this scheme, banks were able to accumulate *retail deposits* of INR 15 Billion (US$ 240 million), with around 30.2 million new accounts. Over the last 4 years, over 320 million unbanked adults have now access to banking services, and banks have been able to mobilize over INR 820 billion (US$ 12 Billion).

[8] Beltratti and Stulz (2012) analyse overall performance of large banks around the World over the recent financial crisis period (i.e., July 2007 to December 2008). They find that banks financed with less (more) short-terms funds in the money markets (deposits) performed better.

However, there may be countervailing effect due to higher distance-related agency problems and organisational structure in financially more inclusive economies. First, in an inclusive financial sector, banks expand branches to unbanked remote areas. As distance increases between headquarters and distant branches, monitoring of the latter by senior managers becomes more difficult (see Brickley et al., 2003). In this case, the farther away a branch is from the headquarters due to broadening access of the unbanked people to finance, the more difficult it gets to transmit efficiencies and aptitude of the senior managers to branches for enhancing overall operating efficiency.[9] Second, another offsetting effect may stem from complex organisational and product structure associated with financial inclusion. Broadening access of the scattered and all income groups to financial services requires banks to maintain a large branch network and diverse product lines targeted to all customers. Inefficiency may arise due to lack of managerial and technical expertise, agency problems related to complex organisational and product structure. Therefore, in the end, whether inclusive financial sector is associated with bank performance becomes an empirical question.

Hypothesis *1*: *Financial Inclusion is positively associated with bank performance.*

Financial regulation is considered to be key to well-functioning banking sector. An appropriate regulatory and supervisory framework can help mitigate excessive risk taking and bring about efficient financial intermediation. Since regulators around the world are still grappling with identifying financial regulations that are supportive to inclusive finance agenda, it is important to assess how differing regulatory and supervisory framework across countries can play a role in the relation between financial inclusion and bank efficiency.

[9] Berger and DeYoung (2001) find that the extent of parent's control over the efficiency of affiliates decline as their distance increases.

According to Barth et al. (2008), regulatory restrictions on bank activities may have different effects on bank performance. On the one hand, stringent activity restrictions may hinder banks' ability to exploit the economies of scale and scope in collecting and processing information about customers (Laeven and Levine, 2009). It may also hinder banks to provide various types of financial instruments to customers, especially to those who are in the lowest rung of the society. High bank activity restrictions means lower diversification opportunity for banks, and thus lower income streams and franchise value, which leads to inefficient financial intermediation (Barth et al., 2013). On the other hand, unfettered financial activities may intensify moral hazard problems and encourage banks to take excessive risk (Boyd et al., 1998). Broad bank activities may create a 'too-big-to-discipline' problem as banks would be unable to efficiently manage large and complex portfolios (Laeven and Levine, 2009). Therefore, we explore the role of bank activity restrictions on the relation between financial inclusion and bank efficiency. Given the overall effects of activity restrictions, we assume that for banks operating in an environment with high restrictions on bank activities, financial inclusion would negatively impact bank efficiency.

Capital regulation has a direct bearings on bank performance. There are two contrasting views on the effects of regulatory capital requirement. The proponents of the positive relation between bank capital and performance argue that due to bank owners' limited liability, a reduced capital requirement ratio enhances excessive risk taking as depositors' funds are implicitly/explicitly guaranteed by government (Mehran and Thakor, 2011). In other words, when banks are required to have more capital, it decreases risk-shifting and incentivise owners to control risk efficiently. Relying on agency theory, on the other hand, some scholars argue for a negative relation between bank capital and performance. They argue that higher capital

regulation increases agency costs between shareholders and managers as the latter's behaviour is disciplined by higher debt repayment requirements (Calomiris and Kahn, 1991). Empirical evidence is also conflicting: using US sample, Berger and Di Patti (2006) find a positive effect, but using European sample, Fiordelisi and Marques-Ibanez (2013) find a negative effect on bank efficiency. Therefore, the role of regulatory capital requirement on the relation between financial inclusion and bank efficiency is an empirical question that we explore in this paper. We assume that higher capital requirements will align the objectives of bank managers with depositors and other creditors, which in turn could result in an efficient allocation of loans, and thus higher bank performance.

As greater inclusive banking and enabling regulatory intervention can jointly help banks perform better, it is thus important to examine whether inclusive banking is effective even in the presence of high regulatory capital requirement and other restrictions on banking activities across the efficiency distribution. Since inclusive banking can be perceived as risky, banks might require a more enabling regulatory environment to embrace financial inclusion as a policy strategy. We provide a modified spatial model incorporating bank heterogeneity and financial outreach in order to motivate this empirical analysis (see the theoretical analysis in the online appendix).

Hypothesis 2a: Financial Inclusion is negatively associated with bank performance in the presence of stringent bank activity restrictions.

Hypothesis 2b: Financial Inclusion is positively associated with bank performance in the presence of stringent capital regulation.

3. Data and Methodology

This section discusses data sources, variables, and methodology that we use in this paper.

3.1. Data sources

We compile data from a number of sources: (a) the bank level dataset is compiled from BankScope database provided by Bureau van Dijk and Fitch Ratings; (b) the country-level data is compiled from the World Bank World Development Indicators (WDI); (c) the country-year level data on bank regulation and supervision is compiled from Barth et al. (2004), Barth et al. (2008); and Barth et al. (2013); (d) the instruments for IV regressions are collected from the Mix Market database (mixmarket.org) and Medina and Schneider (2018); (e) the indicators used to measure financial inclusion index are collected from the International Monetary Fund's (IMF) Financial Access Survey (FAS) database.

Given the trade-off between data availability (e.g., availability of required dimensions of financial inclusion) and cross-country sample coverage, we managed to measure financial inclusion index for 86 countries over the period 2004 to 2015, and matched the country-year of FAS data with that of bank-level data. Our dataset comprises of 1,740 commercial banks, cooperative banks and Islamic banks (11,576 bank-year observations) operating in 86 countries over the time period 2004-15, which represent, respectively 36%, 63%, and 1% of the sample.[10] Considering the objective of this paper, we exclude countries for which we have no information on different dimensions of FII.[11] We deflate all monetary values to 2015 (2015 = 100) prices using the GDP deflator of U.S. obtained from the Federal Reserve Economic Data. The deflated series are reported in millions of U.S. dollar ($).

3.2 Measuring bank performance: bank efficiency scores

To examine the impact of financial inclusion on bank performance, we use two-stage approach. In the first-stage, we employ the widely used input-oriented non-parametric Data Envelopment Analysis (DEA) to measure the efficient frontier and estimate efficiency scores.

[10] Bank-level data are sourced from unconsolidated reports of banks. However, we discard unconsolidated reports of banks whenever consolidated one of the same group is available in order to avoid any double counting of institutions.

[11] In particular, as FAS does not have information for Australia, Germany and USA, these countries are not included in the analysis.

Then in the second-stage, we use these efficiency scores as a measure of bank performance and regress them on financial inclusion indicators while controlling for bank- and country-specific characteristics.[12]

The advantages of using non-parametric linear programming (LP) framework like DEA compared to parametric technique, such as the Stochastic Frontier Analysis (SFA) are: (i) as frontier analysis requires to assume a particular functional form, failure to choose accurate functional form yields biased efficiency scores, which is not the case for DEA methods because of its non-parametric nature and they do not require any functional form assumption (Drake et al., 2006); (ii) frontier approach is based on the central-tendency properties with strong semi-structural assumptions and they do nothing on how to measure the efficient frontier, whereas DEA evaluates bank performance to the revealed best-practice frontier (Barth et al., 2013).

Let's assume the sample size is n and there are p inputs and q outputs for each bank i.[13] Denote $x_i = (x_{1i}, x_{2i}, ..., x_{pi})$ as a $p \times 1$ vector of inputs for bank i, $X = (x_1, x_2, ..., x_n)$ as a $p \times n$ matrix of inputs, $y_i = (\mathrm{y}_{1i}, \mathrm{y}_{2i}, ..., \mathrm{y}_{qi})$ as a $q \times 1$ vector of outputs for bank i, and $Y = (\mathrm{y}_1, \mathrm{y}_2, ..., \mathrm{y}_n)$ as a $q \times n$ matrix of outputs, respectively. The variable returns to scale (VRS) DEA model for each bank i $(i = 1, 2, ..., n)$ can be expressed with the following linear programming problem:

$$\mathrm{Max}(\varphi_i \geq 1 \,|\, x_i, y_i, XY) = \mathrm{Max}(\varphi_i \geq 1 \,|\, \varphi_i y_i \leq Y\lambda_i, X\lambda_i \leq x_i, \lambda_i \geq 0, \mathrm{I}_1' \ \lambda_i = 1), \tag{4}$$

where I_1 represents a $n \times 1$ vector of ones, φ_i represents a scalar parameter, and λ_i $(\lambda_{1i}, \lambda_{2i}, ..., \lambda_{ni})'$ represents a $n \times 1$ non-negative vector of parameters.

[12] Since the seminal work of Leibenstein (1966) introducing the concept of x-inefficiency (the gap between ideal and actual efficiency), the analysis of firm performance using frontier approach has been employed in numerous recent studies as it helps summarising performance in a single statistic (for more, see Ayadi et al., 2016).
[13] See Barth et al. (2013).

The interpretation of DEA model is intuitive. For each bank i, a simulated output $(Y\lambda_i)$ is created as a weighted output of all banks by taking some non-negative weights $\lambda_i \geq 0, \mathrm{I}_1' \lambda_i = 1$. The simulated outputs $(Y\lambda_i)$ are maximized as much as possible, subject to the inputs constraint of bank i $(\mathrm{X}\lambda_i \leq x_i)$, which is then evaluated with the real outputs (y_i) of bank i. Bank i is considered inefficient if the expanded simulated outputs $(Y\lambda_i)$ are above the real outputs (y_i) of bank i by a scalar factor of $\varphi_i > 1$ or else the bank is considered to be situated at the efficient frontier as $\varphi_i = 1$. An input-oriented efficiency score of bank i is defined as $e_i = 1/\varphi_i$ $(0 \leq e_i \leq 1)$. With DEA method, an efficiency score of one means that the bank is situated at the efficient frontier and is unable to produce further outputs without increasing its inputs, whereas an efficiency score of less than one means that the bank is comparatively inefficient, and should produce the current level of outputs with fewer inputs.

Banks' efficiencies are calculated relative to a common frontier separately for each year by pooling data across countries. The advantage of this approach is that it allows us to estimate efficiency differentials not only between banks within countries but across countries as well due to same benchmark (see Chortareas et al., 2013). Intermediation approach of Sealey and Lindley (1977) is followed where financial institutions use deposits, labour, and physical capital as inputs to produce interest-earning assets, that is, loans and investments. We use an intermediation model that has three inputs (i.e., *total deposits, money market and other funds; personnel expenses;* and *total fixed assets)* and three outputs *(total loans; total other earning assets,* and *total non-interest income*). Appendix Table A1 shows the descriptive statistics of the inputs and outputs used in the measurement of DEA efficiency score.

3.3 Constructing financial inclusion index

Policymakers identified financial outreach and usage as the main indicators for financial inclusion. Following Ahamed and Mallick (2017), we use these two dimensions to

construct our financial inclusion index (FII).[14] Financial outreach dimension is used to account for the pervasiveness of outreach of the financial sector in terms of banks' physical outlets, as physical distance to physical point of financial services deems to be an important impediment to financial inclusion (see Allen et al., 2014). Following Beck et al. (2007), we use two classes of penetration of banking services, i.e., demographic and geographic penetration of bank branch and ATM, and create four sub-indices. For the demographic penetration, we use the number of bank branches and number of ATMs per 100,000 people, and for the geographic penetration we use the number of bank branches and number of ATMs per 1,000 square kilometres. For the usage dimension, we use the number of bank accounts per 1,000 populations in order to integrate the depth of the financial access.[15] Since financial inclusion is a multidimensional concept, using standalone indicators of financial inclusion would provide incomprehensive picture of inclusiveness of the financial sectors, and hence implications on bank efficiency. We therefore build upon Beck et al. (2007) to construct a composite weighted index of financial inclusion using principal component analysis (PCA) as follows:[16]

$$FII = \sum_{i=1}^{n} w_{ij} X_i \tag{5}$$

where w_{ij} are the component's loadings or weights; and X_i are the original variables. First, we apply PCA to estimate the financial outreach dimension from a group of four sub-indices related to outreach mentioned above. Second, we apply again PCA to estimate the

[14] Adding more dimensions such as the affordability that may reflect the "transaction costs" and "ease of transaction" would make financial inclusion index more comprehensive. However, we could not incorporate affordability dimension due to the limitations of comparable macro data across economies. Certainly, incorporating information, that is, the annual fees charged to customers for ATM cards and/or accounts (i.e., transaction costs) and the minimum amount and/or document requires opening savings or checking accounts (i.e., ease of transaction), would have improved the quality of financial inclusion index.

[15] Measuring penetration dimension, the number of accounts per capita is used, as data on the number of people having bank accounts is limited. In the former case there is a possibility of double counting same person having multiple accounts (for more, see Beck et al., 2007).

[16] For details on principal component analysis (see also e.g., Tetlock, 2007).

overall FII by using financial outreach and usage as causal variables.[17] In PCA, the first principal component is the single linear combination of the financial inclusion indicators that explains the most of the variation.

In case of financial outreach dimension, the first principal component (PC) explains about 68% variations with the eigenvalue of more than one, that is, 2.88. This dimension is calculated using weights (i.e., 0.52, 0.52, 0.48, and 0.47) assigned to the first PC. Constructing FII, we find two PCs with eigenvalues of 1.80 and 0.20. Again, the first PC explains about 90% of the corresponding sample variance (see Internet Appendix Table IA1). Since only the first PC has eigenvalue that is more than one, according to the Kaiser rule, we assume that it sufficiently explains the common variation among these dimensions.[18] The parametric methods that we have applied for constructing FII assigns factor loadings (weights) on each dimension. We use these weights to construct FII as in equation (5). It is noted that usage dimension has relatively much lower weights than the financial outreach dimension.[19] We normalise FII and assign each country along a 0-1 scale for ease of interpretation in the subsequent analyses, where zero indicates financial exclusion and one indicates financial inclusion.[20]

[17] Before using PCA, first, we winsorise each indicator at the 95th percentile levels to reduce the influence at the upper tail. Second, we normalise each indicator to have values between zero and one to ascertain the scale in which they are measured is immaterial.

[18] Dropping some PCs may help reducing a portion of noise components from our data, and ensures reliability of the subsequent analyses in this paper.

[19] In the spirit of Tetlock (2007), we check the stability and robustness of our financial inclusion index. In this effort, we use PCA on a year-by-year basis in which loadings are determined annually instead of over the entire sample period. The correlation between these two indices (one where the loadings are derived over the entire sample period and the other derived annually) is very high (i.e. 0.99), indicating the robustness of our index irrespective of how loadings are determined.

[20] Our primary objective in this paper is to explore the effects of inclusive financial sector on bank efficiency for the period 2004-15, therefore, FII is constructed across countries and period considering the evolution of financial inclusiveness.

3.4 Bank-specific and macro control variables

Following banking literature, we use a number of bank- and country-characteristics that can be correlated with the bank efficiency. Specifically, we use logarithm of total asset (*LogTA*) to account for scale economies of individual banks. To account for liquidity risk, capital risk, and loan portfolio risk, the ratio of total loans to deposits (*LIQ*), the ratio of shareholder's equity to total assets (*EQA*), and the ratio of loan loss provision to total loans (*LLP*) are used respectively. Next, there are two macroeconomic control variables. First, real GDP growth rate (*GDP*) is used to control for economic growth. Second, population growth (*Pop_gr*) is used to account for the demand of financial services. We also check the sensitivity of baseline results using an array of additional country-level variables related to the levels of economic development, inflation, and institutional development. The latter is compiled from Kaufmann et al. (2010) Governance Index database.

3.5 Bank regulatory and supervisory indicators

Though the primary objective of this study is to investigate whether financial inclusion impedes or improves bank performance, it is also important to see how different regulatory and supervisory practices across countries play a role in this relationship. We have used two key indicators related to banking regulation and supervision surveys of Barth et al. (2004), Barth et al. (2008), and Barth et al. (2013) for the period 2004-2007, 2008-2011, and 2012-2015, respectively. These variables have been defined in Barth et al. (2004). AR (activity restrictions) measures the degree of restrictions imposed on a bank's activity. CS (capital stringency) measures the degree of capital risk management restrictions that incorporates certain risk elements and also deducts market losses in setting up capital adequacy.

3.6 Descriptive statistics

Table 1 reports descriptive statistics of all variables, while the Appendix Table A3 presents the correlations between the different variables. The average technical efficiency is 0.35 with a standard deviation of 0.20. The higher standard deviation suggests that there is substantial variation in the levels of efficiency scores. The average *LogTA* is 6.87 with standard deviation of 1.55, indicating heterogeneous sizes of banks. The averages of *LIQ* and *EQA* are 0.72 and 0.10 respectively. *LLP* has a standard deviation of 0.02 with an average of just 0.01. The average of the volatility of customer deposits (σ_{CDEP}) is 0.03 with a standard deviation of 0.06, indicating that there is substantial variation in the volatility of deposit funding among banks.

The average of return volatility (σ_{roa}) is 0.004 with a standard deviation of also 0.006. The average of financial inclusion index is 0.29 with standard deviation of 0.24, indicating a considerable heterogeneity in the inclusiveness of financial sectors across countries. The variation in financial outreach and usage dimensions is also considerably high. Table 2 reports the average values of technical efficiency and financial inclusion indicators. While Japan, Malta, and Portugal have the most inclusive financial sector, South Sudan, Chad, and Democratic Republic of Congo have the least inclusive financial sector. Figure 1 shows the evolution of financial inclusion and its associated dimensions, indicating a clear uptrend for the sample period.

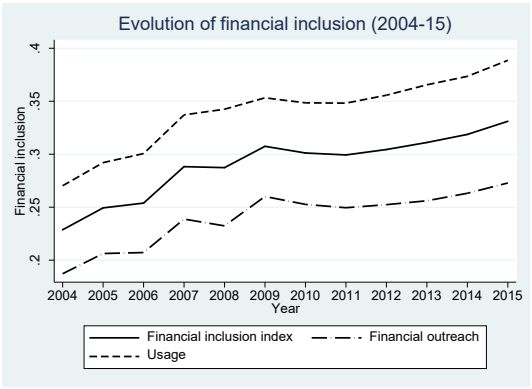

Figure 1: Evolution of financial inclusion indicators

3.7 Methodology

In the second-stage, to examine the impact of financial inclusion on bank performance, we run several regressions using the following baseline model:

$$Eff_{ijt} = \beta_0 + \beta_1 Financial\ Inclusion_{jt} + \beta_2 BC_{ijt} + \beta_3 KC_{jt} + Year_t + \varepsilon_{ijt} \quad (6)$$

Where the *i, j* and *t* subscripts indicate bank, country and year, respectively. *Eff* is bank-level technical efficiency, measured considering an efficient frontier, as a performance indicator. *BC* and *KC* are bank- and country-specific control variables, respectively. Our main explanatory variable of interest is *financial inclusion* and its associated dimensions, measured at the country level. *Year* is a yearly dummy variable controlling inter alia for other macroeconomic and time varying global business cycle effects. Equation (6) is estimated employing the Simar and Wilson (2007) parametric regression bootstrap, which incorporates

the parametric structure and distributional assumptions of the equations, to estimate bootstrap confidence intervals for the parameter estimates $\hat{\beta}_1 - \hat{\beta}_3$. This is achieved by using 2,000 bootstrap replications. As a sensitivity analysis, we also estimate Equation (6) using fractional logit estimator proposed by Papke and Wooldridge (1996). Given the possibility that our results might suffer from endogeneity and omitted variable biases, we also estimate instrumental variable (IV) and random effects Tobit regressions, discussed in great length later.

4. Empirical results: Financial inclusion and bank performance

In this section, combining both bank- and country-level variables, we test whether greater financial inclusion enhances or impedes bank-level efficiency using truncated regression model proposed by Simar and Wilson (2007), in which confidence intervals are estimated employing 2,000 bootstrap replications.

Table 3 reports the estimated parameters.[21] Column 1 shows the relation between financial inclusion index and bank efficiency, whereas columns 2 (3) show the association between financial outreach (usage) dimension and bank efficiency. *Financial inclusion* coefficient is positive at the 1% level of statistical significance, suggesting that inclusive financial sector can have significant role in enhancing bank efficiency scores. The effect is also economically significant. A one standard deviation (0.24) increase in *FII* increases bank efficiency scores by 1.8%.[22] It is obvious that when financial intermediaries operate in a more inclusive environment, they are more likely to attract stable customer deposits, reducing return volatility, which help them to operate more efficiently. Taking the individual constituents of *FII*, we also find that *financial outreach* and *usage* are positive and significant at 1% level.

[21] We confirm our results using ordinary least square regressions that include year dummies while using heteroskedasticity-robust standard errors clustered at the country level to calculate *t*-statistics. The results are quantitatively similar, and available from the authors.

[22] As a robustness test, we also find that the results are similar when we clustered the standard errors at the country level using OLS regression.

These results are also supported by the recent empirical evidence which showed that by expanding bank branches and/or reaching out to customers banks can improve operating efficiency (e.g., Grabowski et al., 1993, Berger and DeYoung, 2001, Bos and Kolari, 2005, Deng and Elyasiani, 2008, Rossi et al., 2009) and bank stability (e.g., Ahamed and Mallick, 2017).

Turning to the control variables, we find larger banks, more liquid and capitalised banks are more efficient, whereas banks that have higher loan portfolio risks are less efficient. Regarding country-level macro controls, the results suggest that banks' operating efficiency is positively associated with economic growth and population growth.

5. Sensitivity analyses

In this section, we discuss various robustness tests of our study. We use alternative estimators including instrumental variable (IV) regression and exploited bank-specific heterogeneity. We re-run regressions splitting the sample into groups based on development status of the sample countries, while adding additional macro controls along with institutional indicators.[23]

5.1 Alternative estimators, exploiting bank-specific heterogeneity

So far, we have estimated Equation (6) using truncated regression model as suggested by Simar and Wilson (2007) that efficiency scores in DEA are generated by a truncated data generating process. However, McDonald (2009) argues that the efficiency scores are not the result of a truncated process but rather the result of a fractional logit process, and thus it is not a latent variable. Therefore, when efficiency scores are generated by a fractional logit process,

[23] Using two alternative demand-side measures of financial inclusion from Global Findex database, we also find that countries with higher percentage of adults with bank accounts/savings with financial institutions tend to have banks with greater efficiency. The results are reported in online appendix Table IA3.

to check the robustness of our results, we re-estimate Equation (6) using a 'fractional logit' quasi-likelihood estimator proposed by Papke and Wooldridge (1996). Table 3 columns 4-6 report the results from a fractional logit quasi-likelihood estimator. The results corroborate our earlier findings. In particular, we find a positive and significant association between financial inclusion indicators and banks' operating efficiency. Similarly, greater financial inclusion and/or banking sector outreach and/or depth of financial services increase bank efficiency.

Until now, we have estimated pooled cross-sectional truncated regression model assuming that there is no bank-specific heterogeneity. To control for bank unobserved heterogeneity, we use random effects Tobit model as we are not aware of any truncated regression model that can accommodate bank-specific heterogeneity in the estimation.[24] Random effects Tobit model is employed, as panel Tobit estimates with fixed effects tend to be biased (Greene, 2004). The consistency of the random effects Tobit model requires the strict exogeneity assumption, that is, the error term has to be uncorrelated with the covariates across all time periods, and the unobserved bank-level heterogeneity should be uncorrelated with all covariates (Czarnitzki and Toole, 2011). However, the unreported likelihood-ratio test indicates that unobserved heterogeneity plays an important role in depicting the relationship between the variables of interest. Table 4 reports the results. The estimation results of random effect model also corroborate the pooled estimations that *FII* and *usage* dimension are positively associated with banks' operating efficiency.

5.2 Instrumental variable (IV) regression

It is plausible that the relation between financial inclusion and bank efficiency may suffer from endogeneity issue. Endogeneity can arise if banks engage in less efficient activities

[24] We use Random effects Tobit model as we could not use truncated regression model to account for bank-specific heterogeneity due to large number of bank dummies. Furthermore, by collapsing our data at the bank-level, we re-run pooled cross-sectional truncated regression. The results are also consistent with the earlier findings (available from the authors upon request).

in the current set-up and venture into unbanked areas and/or if they self-select into inclusive financial activities because these reward them with greater access to customer deposits and/or allow them to reduce income volatility. In addition, despite controlling for an array of bank- and country-specific variables, as our regressions link country-level financial inclusion to bank-level efficiency, omitted variable bias could still be of concern. It may be the case that the composite index that we construct to proxy for financial inclusion may be subject to measurement error. Therefore, to alleviate any endogeneity and omitted variable biases, and measurement errors, we employ the Tobit model with instrumental variables, using Newey's minimum chi-squared two step estimator.

To run IV regression, we searched extensively for relevant instrumental variables. Financial inclusion is a broader concept that focuses on all economic agents in an economy. However, in many developing countries, the journey of microfinance started with the idea of delivering financial services to the poorest of the poor who are often overlooked by the traditional banking sector. Therefore, MFIs have become an important alternative mechanism that provide access to financial services (low-interest loans, deposit accounts etc.) to the unbanked people (Chakrabarty and Bass, 2013). The basic tenet of MFIs is that MFIs collect small deposits from a group of individuals (the group acts as the collateral), and then lend that out to individuals even if they are less creditworthy. We, therefore, collect country-level MFIs data from the mixmarket.org. We could successfully merge MFIs data of 45 developing countries with our sample.

In the paper, we have used the average deposit balance per depositor/gross national income per capita (henceforth *average-deposit-balance-mfi*) as one of the instruments in the IV regression. We assume that *average-deposit-balance-mfi* would have a strong association with financial inclusion, but not necessarily with the bank-level efficiency. We expect that the higher the *average-deposit-balance-mfi,* the lower the level of financial inclusion. We choose

the share of shadow economy as percent of GDP (*size of informal economy*) as the second instrument, which is collected from Medina and Schneider (2018). Likewise, we expect that the higher the share of informal economy, the lower the level of financial inclusion.

Table 5 shows the results of the IV regressions. While Panel A shows the results of the First-stage regressions of financial inclusion indicators on instruments, Panel 2 shows the Second-stage regressions on bank efficiency. We find that all instruments have statistically significant effects on financial inclusion. In particular, as expected, the share of informal economy has negative and significant impact on financial inclusion indicators. Similarly, *average-deposit-balance-mfi* is also negative and significantly associated with financial inclusion. It indicates that the higher the per capita deposit balance in MFIs, the lower the level of financial inclusion provided by the formal banking sector.

Note that we test the relevance and validity of our IVs used in this study. The Anderson-Rubin test of under-identification shows that the null hypothesis of weak instruments is rejected at 1% significance level. The over-identification test proxied by Amemiya–Lee–Newey minimum χ^2 test shows that the selected group of instruments is valid as the null hypothesis cannot be rejected at 5% significance level. The second-stage result is consistent and further shows the evidence of a strong relationship between financial inclusion and bank operating efficiency.

5.4 Developing vs. Advanced economies: Who benefits more from financial inclusion?

Our dataset comprises 57 developing market economies, 20 emerging market economies, and 9 advanced economies. As financial inclusion is a phenomenon in developing and emerging market economies, to delineate differing effects of financial inclusion on bank efficiency, we run separate truncated regression model for these three groups of countries. Table 6 presents the results of fifteen different regressions. While Panel A (B) shows the results

of developing (emerging) market economies, Panel C shows the results from advanced economies. Though we have included all controls, for the sake of brevity, we just report the effects of financial inclusion indicators. The results of the sub-sample of developing and emerging market economies are in line with our earlier findings. Regarding advanced economies, though we find an insignificant positive effect of financial outreach dimension, we find significant negative effect of financial inclusion index and usage dimension on banks' operating efficiency.

To examine why financial inclusion and usage might have negative effect on bank efficiency, we divided our sample into two groups based on *private credit to GDP*: (i) High financial deepening – a sample of countries who have a ratio of *private credit to GDP* that is more than the sample average; (ii) Low financial deepening – a sample of countries with a ratio of *private credit to GDP* that is less than or equal to sample average. The estimated results of these two groups are reported in Panel D and Panel E, respectively. This approach should delineate whether financial inclusion indicators indeed influence productive efficiency of banks that operate in those countries that have lower financial deepening in the same way as with those that have greater financial deepening. As the literature shows that greater financial deepening is not necessarily a reflective of an inclusive financial sector, we should see a differential effect of financial inclusion indicators for these two groups of countries. According to Beck et al. (2014), though *private credit to GDP* has been used as one of the indicators of financial development, it fails to measure the breadth of the financial system properly, that is, it does not show the extent to which financial intermediaries cater services to smaller and geographically more dispersed customers. Though the results of Panel E are consistent with our earlier findings, Panel D coincides with the results of advanced economies, suggesting a contrasting effect of financial inclusion indicators for two groups of countries in terms of the degree of financial deepening. In other words, though greater financial inclusion enhances

banks' operating efficiency in countries that have less-deepened financial system, it reduces banks' operating efficiency in countries that have greater financial deepening, which may be due to an exhaustive level of financial development that has already been materialized in these countries.

5.5 Quantile regression estimates and additional macro controls

Using truncated regression, we find a positive association between financial inclusion and bank efficiency, which is also consistent with the results of OLS regression. As we have a large number of banks from different countries, heterogeneity might be an issue. Therefore, we use quantile regression (QR), as proposed by Koenker and Bassett (1978), to assess whether financial inclusion has homogeneous effect on bank efficiency while illustrating the relation at different points in the conditional distribution of the dependent variable. Table 7 presents the results. As bank efficiency changes across quantiles, the estimate of the financial inclusion varies in sign and magnitude, and significance. While the estimates of the financial inclusion coefficients are positive and increasing in magnitude as well as statistically significant at the 1% level for bank efficiency at quantiles from 0.20 and above (up to 0.6 quantiles), it becomes negative and insignificant for those 0.70 and above – it suggests that financial inclusion increases efficiency of more efficient banks up to a certain point.

So far, we have used real GDP growth rate and population growth rate as macro controls. It may be the case that our results are also influenced by the level of economic development, price stability, and institutional development of a country in which banks operate. Therefore, in addition to our usual macro control, we check the robustness of our results using logarithm of per capita GDP, GDP deflator, and six governance indicators from Kaufmann et al. (2010) as a proxy for institutional development. As governance indicators are highly correlated with each other, we use them one at a time with the additional macro controls to re-

run six truncated regression models. For brevity, we do not report the estimated results, but they are available on request. The results show that even after controlling for all these macro variables, our main results remain unchanged, that is, greater financial inclusion increases banks' efficiency score. In particular, we find that higher level of economic development and inflation are positive and significantly associated with bank efficiency. Though all governance indicators have positive association with bank efficiency, five of them (*Voice and accountability, Government effectiveness, Rule of law, Regulatory quality, Control of corruption*, except *Political stability*) are significant at 1% level, suggesting stronger institutional development is necessary for enhancing banks' efficiency.

6. Exploring channels

6.1. Volatility of retail deposits and bank return

Saving instruments are heavily used by poor households, and it provides an extensive ease to households for making payments and savings (Collins et al., 2009, Allen et al., 2016). Naturally, in an inclusive financial sector banks will have greater access to a large pool of customer deposits, which tends to be a less volatile source of funding for banks. In general, greater volatility of customer deposit funding should have negative effect on banks' operating efficiency. However, as banks have enormous opportunity to attract more customer deposits in an inclusive financial sector, one would expect banks' operating efficiency increasing in such a market. To delineate this effect, we measure standard deviation of customer deposit funding share (σ_{CDEP}) and create three interaction terms between financial inclusion indicators and σ_{CDEP}. We re-run our augmented truncated regression model by adding interaction term and σ_{CDEP} as an additional independent variable.

Table 8 Panel A reports the results. In column 1, though the direct effect of σ_{CDEP} is negative and significant, their interaction term enters positively and significant at 1% level,

indicating that banks operating in an inclusive financial sector are able to wither away negative effects of σ_{CDEP} and can improve productive efficiency. These results are somewhat in tandem with the arguments made elsewhere that retail deposits are sluggish, insensitive to risks and provide a stable cheaper source of long term funding (e.g., see Calomiris and Kahn, 1991, Song and Thakor, 2007, Ahamed and Mallick, 2017), compared to wholesale funding which is extremely volatile and often costly (e.g., see Demirgüç-Kunt and Huizinga, 2010, Huang and Ratnovski, 2011, Poghosyan and Čihak, 2011).

Similarly, if banks operating in an inclusive financial sector are able to reduce reliance on costly wholesale funding as they have access to cheaper retail deposits, one would expect that in such set ups banks are also able to reduce their return volatility (σ_{roa}), and operate more efficiently. Using the similar procedures as above, we create three interaction terms between financial inclusion indicators and σ_{roa} and re-run the augmented truncated regression model while using σ_{roa} as an additional independent variable. Panel B presents the results. Though the direct effect of σ_{roa} is negative and significant, their interaction term is positive and significant at 5% level, suggesting that banks operating in an inclusive financial sector are able to reduce return volatility and become more efficient.

6.2. The role of bank regulation, supervision, and monitoring

We augment our baseline regression by adding interaction terms of financial inclusion index and each of the three regulatory and supervisory indicators that are discussed earlier. All control variables are analogous. For the sake of comparability and for economic significance, the regulatory variables involved in the interaction terms are normalized to have a zero mean and unit variance. We present the results in Table 9. In general, even after introducing interactions terms, the relationship between financial inclusion and bank efficiency remains

positive and significant. In column 1, the interaction term of financial inclusion and activities restrictions is negative and statistically significant at the 1% level, implying that an inclusive financial sector enhances bank efficiency in countries with less stringent bank activity restrictions. In other words, a one standard deviation decrease in activities restrictions enhances the positive impact of financial inclusion on bank efficiency by 4.2%.[25] Taking column 2, the positive and significant interaction term of financial inclusion and overall capital stringency suggests that the relationship between financial inclusion and bank efficiency is stronger in countries where there is stringent capital regulation. Barth et al. (2013) also find that capital stringency enhances bank efficiency. Taking the interaction term, a one standard deviation increase in overall capital stringency leads to a 5.7% increase in bank efficiency in an inclusive financial sector.

7. Disentangling the role of inclusive financial policy in bank performance

In this section, we exploit the timing variations of the countries that become member of the network of policymakers engaged in financial inclusion, that is, the Alliance for Financial Inclusion (henceforth AFI), and identify the causal effects of inclusive financial policy on bank efficiency. We use a 'Quasi-natural experiment' type difference-in-differences (DID) approach. To eliminate any sample selection bias and confounding in the treatment effects, we deploy a number of matching estimators.

In response to the global financial crisis that took place in 2008, the G20 leaders committed to reduce unbanked adult population in the world through improving access of the

[25] The unreported marginal effect graph suggests that with more than average levels of activities restrictions, the impact of financial inclusion is not significant, but in the case of a lower activities restrictions regime the impact can be negative and significant.

low income groups to formal financial services at the Pittsburgh Summit in 2009. At the summit, the G20 principles for innovative financial inclusion (henceforth GPIFI) were drafted by the three Financial Inclusion Experts Group including the Alliance for Financial Inclusion (henceforth AFI), the Consultative Group to Assist the Poor (CGAP), and the World Bank's International Finance Corporation (IFC) (Soederberg, 2013). To invigorate GPIFI, the Maya Declaration was signed by many countries at the third Global Policy Forum of the AFI held in Riviera Maya, Mexico in 2011 (see Internet Appendix IA2 for detail on the GPIFI and the Maya Declaration). However, 37 countries had acknowledged the benefit of embracing low income groups with formal financial services and become signatory to the Maya Declaration commitments over the sample period (see Table A3 for membership timing across countries).

The signatory countries not only made specific commitments to create an enabling environment for inclusive financial development, but also they could share knowledge with each other via AFI membership network. Since then creating inclusive financial policy has become an important policy priority, which ushered many supportive laws and regulations for inclusive financial sectors in these countries.[26]

We assume that the pro-access policies that have been developed and implemented in the Maya Declaration Signatory countries had an obvious effect on the efficient functioning of banks.[27] With the changing environment, banks have designed and adopted innovative, affordable and low-cost financial delivery models for providing services to low income groups. Therefore, we apply a difference-in-differences approach and explore whether efficiency of

[26] The signatory countries that took various supportive laws and regulations to broaden financial inclusion over time are summarised in the AFI's Working Groups Annual Report 2014, and can be accessed through the link below: bit.ly/30GtW8F; Recent updates can be found in: bit.ly/347JnJ3

[27] The signatory countries are committed to lower the unit cost of financial services through introducing policies and appropriate innovative technology. For details on Maya Declaration, see bit.ly/2MHRSFf

banks that operate in those countries has increased or decreased due to enabling inclusive financial policies as follows:

$$\text{Eff}_{ijt} = \alpha_0 + \alpha_j + \gamma(\text{Pro-access-policy})_{jt-1} + \beta_1 \text{BC}_{ijt} + \beta_2 \text{KC}_{jt} + \varepsilon_{ijt} \quad (1)$$

Where i indexes bank and j indexes countries. Eff_{ijt} is operating efficiency. The analogous bank- and country-level controls are used as in Eq. (4) denoted by BC_{ijt} and KC_{jt}, respectively. Pro-access-policy is an indicator variable that takes a value equal to one if a bank operates in any signatory countries listed in Table A3 in 2011 and thereafter or else zero. The variable of interest is γ, and it captures the sensitivity of the dependent variable to the changes in the Pro-access policies.[28] The advantage of DID approach is that we are able to identify the causal effects of an event (in our case, the commitment to Maya Declaration) on groups that are affected by the institutional settings (henceforth treated) with those that are not affected (henceforth control).[29] Since we are controlling both groups before and after the event and same group is acting as control and treated in this methodology, we are able to control for both observables and unobservable factors that may have changed over time as well. With this approach, we can capture the treatment effect by eliminating the effects of the other changes that could have affected the treated group (Imbens and Wooldridge, 2009). The studies that apply similar approach are by Koetter et al. (2012) on cross-state setup for US banking sector and by Haselmann et al. (2010) on East European countries.

[28] For details on this methodology see Haselmann et al. (2010).

[29] To consider DID approach as meaningful, there are two aspects that should be accounted for namely homogeneous comparison groups and the changes in the efforts of improving financial inclusion as exogenous. The first issue has minimal effect on our analysis as most of the members are from developing countries (propensity score matching is employed for having valid counterfactuals in the latter analysis). Regarding the second issue, whether changes of efforts of improving financial inclusion is exogenous or endogenous, is an important concern. Since policy initiatives and innovative principles of financial inclusion were thrust upon by G20, and expert groups on financial inclusion e.g., AFI and the World Bank, it shows the exogenous nature and randomness in embracing innovative policy suggestions.

Table 10, Panel A, reports the results of DID estimation. It shows that bank efficiency has increased following the Maya Declaration commitment. Particularly, while we control for country fixed effects in column 1-2, we consider bank fixed effects in column 3-4. In all specifications, we use the analogous bank- and country-specific controls. In columns 1-2, the coefficient of Pro-access-policy is positive and significant at 1% significance level. Even controlling for bank fixed effects in columns 3-4, the results remain unchanged. The reason for positive coefficient is due to innovative pro-access policies that signatory countries developed and implemented over the years, which played an important role in the observed bank efficiency improvement. It also indicates that increasing financial inclusion reduces average costs of intermediation by increasing the levels of operating efficiency of banks. This result is also consistent with the existing evidence suggesting that with favourable institutional settings banks are better able to exploit economies of scale and operate efficiently (see Jayaratne and Strahan, 1996).

So far, we use bank/country fixed effects to control for bank- and country-level unobservables. It does not guarantee that our comparison group is appropriately handled for our analysis. This limitation can be alleviated effectively using matching estimators where treated and control groups will be selected based on their observable characteristics (Rosenbaum and Rubin, 1983). In that vein, we use the non-parametric difference-in-differences propensity score matching approach to identify the effect of the Pro-access-policy on bank efficiency. Combining matching estimators with difference-in-differences technique is arguably the most appropriate approach making a causal claim while alleviating any selection bias that ascertains a valid control group as counterfactual (Blundell and Costa Dias, 2000).

In the first stage of propensity score matching (PSM), we estimate the likelihood of countries being treated (become a signatory of the Maya Declaration) by using a logit model employing country- and industry-specific characteristics: total assets of the banking sector and per capita GDP. In the second stage, we match signatory countries with non-signatory countries with a similar propensity score.[30] For this procedure, we consider two matching techniques, nearest-neighbor and kernel marching, to calculate the average treatment effect for the treated (ATT).[31]

The results are reported in Panel B of Table 10 and are consistent with the earlier findings. In both matching estimators, we impose common support condition to restrict control groups to fall within the support of the propensity score distribution of the treated groups. Taking nearest neighbour matching result, we find that the average treatment effect of Pro-access-policy on bank efficiency is 0.06. The result on kernel matching is also positive. These results once again reaffirm the positive relationship between financial inclusion and bank efficiency.

8. Conclusions

This paper investigates the impact of financial inclusion on bank performance using an international sample of 1,740 banks across 86 countries for the period 2004-15. We find strong evidence that banks in countries with greater inclusive banking sector tend to have higher levels of operating efficiency. This effect is particularly strong for banks operating in the developing and emerging market economies, and for the banks where financial sector is less developed in terms of private credit to GDP ratio. We also find that banking regulation

[30] The balancing tests are satisfied and available from the authors.
[31] The kernel matching estimator matches the treated units with weighted average of all control units, with weights that are inversely proportional to the distance in terms of their propensity score. We use exact matches with no replacement in nearest neighbour matching. For details on the matching methods see Lin and Ye (2007) and De Mendonça and e Souza (2012).

plays an important role in the relationship between financial inclusion and bank performance as the association is stronger in countries with less restrictions on banking activities and stringent capital regulation. Furthermore, we also exploit the exogenous timing variations of the developing countries that made measurable commitments for advancing inclusive financial development through innovative policies, and find a positive effect of pro-access-policy on bank efficiency.

As banks operating in an inclusive financial sector have enormous opportunities to attract cheaper and less volatile customer deposits compared with wholesale funding, we find that operating efficiency of such banks increases as they are able to reduce volatility of retail deposits funding and also return volatility. This underscores the importance of conducive inclusive environment in broadening access to finance and its complementary effects on the efficient intermediation of financial institutions.

The results are robust: using the sample of developing and emerging market economies, employing IV analysis, controlling for bank unobserved heterogeneity, and finally, controlling for the levels of economic development, price stability, and institutional development. For all of these alternative setups, we find that greater financial inclusion increases the levels of banks' operating efficiency. Our findings suggest a financial system that provides easier access to finance increases efficiency in the financial intermediation of the banks, and hence makes them more operationally efficient. They also show that financial inclusion is an important policy lever to bring more people into the formal economy, and concurrently set an environment for efficient financial operation.

These results are novel in the literature. While previous papers show the effect of financial inclusion on various socio-economic indicators (e.g., Butler and Cornaggia, 2011, Allen et al., 2013, Demirgüç-Kunt et al., 2013), this paper is the first to show the explicit link

between a key ingredient of financial development strategy and cross-bank and cross-country variation in the levels of bank efficiency, a topic that deserves more theoretical and empirical attention for establishing a robust link between these variables. While previous studies focus on the relationship between bank branch penetration and firm's tax avoidance (see Beck et al., 2014, Ahamed, 2016), firm's financing obstacle (see Beck et al., 2007), this is the first paper to relate cross-country variation in inclusive banking sector and operating efficiency of the financial institutions, and simultaneously contribute to the bank efficiency literature.

The policy implications of our results are many folds. Since the greater is the banked population, the higher is the bank efficiency, and policymakers should introduce more policies that are conducive for access to finance aiming at ensuring efficient financial intermediation. They should continuously make efforts to provide a regulatory environment that is conducive for increasing financial inclusion and bank performance.

We see this paper as a first attempt finding the link between financial inclusion and bank efficiency. As more data covering both supply and demand-side become available, other dimensions of the financial inclusion can be incorporated in the construction of the composite index and explore the relationship between inclusive financial sector and bank efficiency in a systematic manner.

Appendix A

See Table A1, A2, A3.

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Table A1
Bank inputs and outputs (US$ million)

	2004			2015		
	Mean	Median	Std.dev.	Mean	Median	Std.dev.
Inputs						
Total deposits, money market and other funds	636.14	128.94	1869.81	1603.62	202.25	6219.07
Personnel expenses	8.31	2.28	21.02	18.44	3.57	58.58
Total fixed assets	10.56	2.48	29.40	17.04	3.30	57.23
Outputs						
Total loans	422.25	92.35	1229.46	1107.32	145.02	4181.70
Total other earning assets	170.02	29.08	544.80	374.00	44.19	1530.86
Total non-interest income	7.45	0.97	28.45	20.02	1.40	80.19

Table A2
Variable Definitions and Sources

Variables	Definition	Source
Bank-specific variables		
EFF	Data Envelopment Analysis (DEA) efficiency scores	Own
LogTA	Logarithm of total assets	BankScopre
LIQ	Total loans/total deposits	BankScopre
EQA	Shareholder's equity/total assets	BankScopre
LLP	Total loan loss provision divided by total loans	BankScopre
σ_{CDEP}	Standard deviation of Share of customer deposits of total deposits and short-term funding (calculated using a rolling window)	BankScopre
σ_{roa}	Sum of return-on-assets (ROA), defined as net profit over assets, and equity ratio (EQA), defined as equity over assets, divided by standard deviation of (ROA) of each bank over past three years (calculated using a rolling window)	BankScopre
Country-specific variables		
Financial inclusion index	Financial inclusion index is constructed using PCA from the financial outreach and usage dimensions.	IMF FAS
Financial outreach	The outreach dimension constructed using principal component analysis (PCA) from the variables related to geographic and demographic availability of branches and ATMs	IMF FAS
Usage	The number of deposit and loan accounts per 1000 adults	IMF FAS
GDP	The growth rate of GDP	WDI
Pop_gr	Population growth (Annual %)	WDI
Activities restrictions	The score for this variable is determined on the basis of the level of regulatory restrictiveness for bank participation in: (1) securities activities, (2) insurance activities, (3) real estate activities, and (4) bank ownership of non-financial firms. These activities can be unrestricted, permitted, restricted or prohibited and are assigned the values of 1, 2, 3 or 4, respectively. This index takes a value from 0 to 16, with larger values denoting more stringent activity restrictions.	Barth et al. (2004; 2008; 2013a)
Overall capital stringency	Whether the capital requirement reflects certain risk elements and deducts certain market value losses from capital adequacy is determined. Specifically, it is an indicator developed based on the following questions (Yes = 1, No = 0): 1. Is the minimum capital-asset ratio requirement risk weighted in line with the Basle guidelines? 2. Does the minimum ratio vary as a function of an individual bank's credit risk? 3. Does the minimum ratio vary as a function of market risk? 4. Before minimum capital adequacy is determined, which of the following are deducted from the book value of capital: (a) market value of loan losses not realized in accounting books; (b) unrealized losses in securities portfolios? (c) Unrealized foreign exchange losses? Higher values indicating greater stringency	Barth et al. (2004; 2008; 2013a)
Instrumental variables		
Share of informal economy	Share of informal economy as percentage of GDP	Medina and Schneider (2018)
Average-deposit-balance-mfi	The average deposit balance per depositor of MFIs/ GNI per capita (%)	mixmarket.org

Note: IMF FAS = IMF Financial Access Survey; WDI = World Development Indicators; MFI = Microfinance Institution.

Table A3
The timing of the countries that signed Maya Declaration

Country	Year	Country	Year	Country	Year	Country	Year
Armenia	2012	Ghana	2012	Mongolia	2012	Philippines	2011
Bangladesh	2012	Guatemala	2012	Morocco	2013	Rwanda	2011
Brazil	2011	Guinea	2011	Mozambique	2012	Samoa	2013
Burundi	2011	Indonesia	2012	Namibia	2012	Trinidad And Tobago	2013
Chile	2012	Kenya	2011	Nepal	2013	Uganda	2011
Colombia	2012	Liberia	2013	Pakistan	2011	United Republic Of Tanzania	2011
Congo	2012	Madagascar	2013	Panama	2013	Zambia	2011
Ecuador	2012	Malawi	2011	Papua New Guinea	2013		
El Salvador	2013	Malaysia	2012	Paraguay	2011		
Fiji	2011	Mexico	2011	Peru	2011		

Source: http://www.afi-global.org/afi-network/members

Note: the years indicate when a country made the commitment to Maya Declaration to take measurable steps towards having inclusive financial system. 37 developing countries made explicit commitments to Maya Declaration in our sample period.

Table 1
Summary Statistics

This table shows the total sample summary statistics for the bank-specific variables, macroeconomic variables and the variables that are used as instruments in the instrumental variable regressions throughout the paper. Detailed definitions and the sources of the variables are provided in Appendix Table A2. The full sample contains 11,576 bank-year observations. This table consists of three parts. The descriptive statistics of the dependent variable, that is, EFF, is used to proxy for technical efficiency of individual banks is in the first part along with all bank-specific controls. Country-specific variables are in the second part following by the instrumental variables in the final part.

Variables	Mean	Median	Std.dev.	Min.	Max.	# of countries	# of obs
Bank-specific variables							
EFF	0.35	0.31	0.20	0.01	1.00	86	11576
LogTA	6.87	6.85	1.55	3.07	10.76	86	11576
LIQ	0.72	0.63	0.37	0.11	2.50	86	11576
EQA	0.10	0.08	0.07	0.02	0.49	86	11576
LLP	0.01	0.01	0.02	-0.01	0.12	86	11576
σ_{CDEP}	0.03	0.01	0.06	0.00	0.55	86	11101
σ_{roa}	0.00	0.00	0.01	0.00	0.04	86	11169
Country-specific variables							
Financial Inclusion Index	0.29	0.23	0.24	0.01	0.99	86	86
Financial outreach	0.24	0.18	0.24	0.00	0.95	86	86
Usage	0.34	0.28	0.27	0.01	1.00	86	86
GDP	0.04	0.04	0.02	-0.04	0.09	86	86
Pop_gr	1.42	1.35	1.21	-1.31	4.33	86	86
Activities restrictions	7.87	8.07	1.74	3.00	11.83	77	77
Overall capital stringency	4.14	4.00	1.53	1.00	7.00	76	76
Instrumental variables							
Share of informal economy	31.11	30.74	11.13	8.70	65.08	75	75
Average-deposit-balance-mfi	0.54	0.12	6.71	0.01	298.79	45	45

Table 2
The estimation results for the bank efficiency and financial inclusion

This table reports the mean of technical efficiency, financial inclusion index and its dimensions across countries. The number in parenthesis refers to ranking of the country in terms of inclusive financial development. It also reports the number of banks in each countries.

Country	Technical efficiency	Financial inclusion index	Financial outreach	Usage	# of banks	Country	Technical efficiency	Financial inclusion index	Financial outreach	Usage	# of banks
Afghanistan	0.183	0.027 (78)	0.012	0.043	1	Kenya	0.233	0.134 (58)	0.049	0.228	20
Algeria	0.228	0.097 (66)	0.036	0.165	7	Lao People'S Democratic Republic	0.213	0.104 (62)	0.065	0.147	2
Angola	0.294	0.134 (57)	0.101	0.170	10	Latvia	0.348	0.558 (13)	0.312	0.824	2
Argentina	0.362	0.293 (36)	0.169	0.428	25	Lebanon	0.314	0.551 (15)	0.612	0.466	27
Armenia	0.212	0.308 (34)	0.288	0.322	13	Lesotho	0.134	0.078 (67)	0.044	0.116	3
Bahamas	0.570	0.540 (17)	0.395	0.691	6	Liberia	0.154	0.049 (74)	0.022	0.079	1
Bangladesh	0.275	0.254 (40)	0.295	0.199	12	Macedonia (Fyrom)	0.219	0.496 (20)	0.308	0.697	11
Bolivia	0.350	0.160 (53)	0.116	0.206	12	Madagascar	0.336	0.009 (81)	0.007	0.013	4
Bosnia And Herzegovina	0.227	0.351 (31)	0.300	0.398	16	Malawi	0.213	0.054 (71)	0.034	0.076	2
Botswana	0.286	0.197 (50)	0.098	0.304	3	Malaysia	0.528	0.510 (19)	0.218	0.829	21
Brazil	0.532	0.437 (23)	0.363	0.510	68	Maldives	0.213	0.558 (14)	0.641	0.448	2
Bulgaria	0.333	0.660 (9)	0.639	0.664	8	Malta	0.396	0.935 (2)	0.853	1.000	2
Burundi	0.177	0.022 (79)	0.031	0.012	1	Mauritania	0.245	0.049 (75)	0.048	0.049	1
Cambodia	0.380	0.058 (69)	0.055	0.060	10	Mauritius	0.332	0.719 (5)	0.694	0.725	10
Cameroon	0.174	0.016 (80)	0.012	0.022	5	Mongolia	0.178	0.344 (32)	0.340	0.340	3
Central African Republic	0.231	0.008 (83)	0.004	0.013	2	Montenegro	0.213	0.514 (18)	0.416	0.610	5
Chad	0.235	0.007 (85)	0.004	0.010	2	Namibia	0.249	0.209 (49)	0.147	0.275	2
Chile	0.566	0.460 (21)	0.216	0.727	3	Nepal	0.324	0.121 (61)	0.097	0.146	26
Colombia	0.324	0.578 (12)	0.573	0.566	13	Netherlands	0.721	0.712 (7)	0.725	0.675	5
Costa Rica	0.433	0.409 (25)	0.289	0.536	34	Nicaragua	0.195	0.098 (65)	0.069	0.130	4
Democratic Republic Of Congo	0.146	0.007 (84)	0.004	0.011	4	Pakistan	0.377	0.101 (63)	0.105	0.094	15
Djibouti	0.223	0.051 (73)	0.043	0.059	2	Panama	0.349	0.360 (29)	0.261	0.463	23
Dominican Republic	0.211	0.257 (39)	0.223	0.290	12	Paraguay	0.263	0.133 (59)	0.117	0.148	14
Ecuador	0.221	0.289 (37)	0.322	0.242	13	Peru	0.138	0.156 (54)	0.083	0.237	12
Egypt	0.528	0.099 (64)	0.060	0.142	17	Poland	0.493	0.611 (10)	0.450	0.778	9
El Salvador	0.296	0.309 (33)	0.256	0.362	9	Portugal	0.339	0.883 (3)	0.872	0.868	13
Estonia	0.285	0.551 (16)	0.274	0.851	3	Republic Of Moldova	0.292	0.305 (35)	0.183	0.436	9
Federated States Of Micronesia	0.165	0.138 (56)	0.119	0.157	1	Rwanda	0.133	0.062 (68)	0.067	0.056	5
Fiji	0.029	0.192 (51)	0.118	0.271	1	Samoa	0.176	0.212 (48)	0.180	0.242	1
Gabon	0.175	0.122 (60)	0.077	0.171	2	Saudi Arabia	0.828	0.245 (41)	0.183	0.310	12
Georgia	0.349	0.397 (26)	0.302	0.495	9	Seychelles	0.212	0.597 (11)	0.600	0.576	2
Greece	0.286	0.713 (6)	0.444	1.000	1	South Africa	0.406	0.358 (30)	0.214	0.513	8
Guatemala	0.176	0.361 (28)	0.300	0.420	2	South Sudan	0.205	0.006 (86)	0.005	0.008	2
Guinea	0.097	0.009 (82)	0.006	0.013	2	Spain	0.466	0.813 (4)	0.819	0.782	40
Guyana	0.275	0.176 (52)	0.069	0.293	3	Swaziland	0.186	0.148 (55)	0.109	0.191	3
Honduras	0.187	0.234 (44)	0.175	0.296	15	Thailand	0.629	0.441 (22)	0.394	0.482	7
Hungary	0.507	0.392 (27)	0.301	0.484	3	Tonga	0.183	0.231 (45)	0.251	0.203	1
India	0.502	0.245 (42)	0.187	0.305	54	Trinidad And Tobago	0.299	0.435 (24)	0.293	0.584	2
Indonesia	0.269	0.238 (43)	0.216	0.256	72	Uganda	0.200	0.045 (77)	0.032	0.059	13
Italy	0.343	0.682 (8)	0.931	0.376	430	United Republic Of Tanzania	0.235	0.045 (76)	0.022	0.071	24
Jamaica	0.338	0.264 (38)	0.179	0.354	3	Vanuatu	0.282	0.224 (46)	0.191	0.256	1
Japan	0.352	0.988 (1)	0.952	1.000	452	Zambia	0.209	0.053 (72)	0.040	0.068	8
Jordan	0.385	0.212 (47)	0.183	0.241	7	Zimbabwe	0.111	0.055 (70)	0.063	0.046	8

Source: Author's calculation.

Table 3
The effect of financial inclusion on bank efficiency

While in columns 1-3 we use truncated regression based on Simar and Wilson (2007), Algorithm 1, using 2,000 bootstrap replications for the confidence intervals of the estimated coefficients, the results in columns 4-6 are based on Quasi-Likelihood estimation methods proposed by Papke and Wooldridge (1996) . In all columns, dependent variable is EFF, which is the efficiency scores of banks measured using Data Envelopment Analysis (DEA). Our variables of interest are financial inclusion indicators: *Financial Inclusion index* is a composite index, constructed based on two dimensions, namely *financial outreach* and *usage* dimensions. An array of bank-specific controls is used: *LogTA* is the logarithm of total assets; *LIQ* is the total loans over total deposits; *EQA* is shareholder's equity over total assets; and *LLP* is Loan loss provision, measured as a percentage of total loans. All bank-specific controls are from BankScope. The macro controls used in this study are: *GDP* is the real growth rate of gross domestic products e and *Pop_gr* is the population growth rate (%). Macroeconomic data are obtained from World Development Indicators of the World Bank. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: BankScope and WDI. Coverage: 2004-15.

	Simar and Wilson (2007)			Papke and Wooldridge (1996)		
Variables	Financial inclusion index	Financial outreach	Usage	Financial inclusion index	Financial outreach	Usage
	1	2	3	4	5	6
Financial inclusion	0.077***	0.075***	0.037***	0.448***	0.293***	0.329***
	[0.009]	[0.008]	[0.007]	[0.047]	[0.043]	[0.037]
LogTA	0.073***	0.074***	0.073***	0.274***	0.280***	0.273***
	[0.001]	[0.001]	[0.001]	[0.006]	[0.006]	[0.006]
LIQ	0.009*	0.0002	0.009*	0.065***	0.017	0.088***
	[0.005]	[0.005]	[0.005]	[0.024]	[0.024]	[0.025]
EQA	0.702***	0.718***	0.669***	3.784***	3.762***	3.642***
	[0.027]	[0.029]	[0.028]	[0.138]	[0.141]	[0.135]
LLP	-0.351***	-0.348***	-0.424***	-1.131**	-1.347***	-1.316***
	[0.103]	[0.101]	[0.100]	[0.478]	[0.482]	[0.472]
GDP	0.114	0.286***	-0.169***	1.836***	1.931***	0.315
	[0.072]	[0.085]	[0.063]	[0.380]	[0.436]	[0.323]
Pop_gr	0.006***	0.004**	0.002	0.029**	-0.003	0.021*
	[0.002]	[0.002]	[0.002]	[0.012]	[0.011]	[0.011]
Constant	-0.322***	-0.327***	-0.279***	-3.360***	-3.218***	-3.210***
	[0.015]	[0.016]	[0.014]	[0.077]	[0.077]	[0.069]
Observations	11,576	11,576	11,576	11,576	11,576	11,576
# of countries	86	86	86	86	86	86
Year	Yes	Yes	Yes	Yes	Yes	Yes

Table 4
Exploiting bank unobserved heterogeneity

The results in this table are based on Random-effects Panel Tobit regressions. In all columns, dependent variable is *EFF*. Our variables of interest are financial inclusion indicators: *Financial Inclusion index* is a composite index, constructed based on two dimensions, namely *Financial outreach* and *Usage* dimensions. The bank-specific controls are: *LogTA* is the logarithm of total assets; *LIQ* is the total loans over total deposits; *EQA* is shareholder's equity over total assets; and *LLP* is Loan loss provision, measured as a percentage of total loans. All bank-specific controls are from BankScope. The macro controls are: *GDP* is the real growth rate of gross domestic products e and *Pop_gr* is the population growth rate (%). Macroeconomic data are obtained from World Development Indicators of the World Bank. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: BankScope and WDI. Coverage: 2004-15.

Variables	Financial inclusion index	Financial outreach	Usage
	1	2	3
Financial inclusion	0.028**	0.001	0.043***
	[0.014]	[0.012]	[0.012]
LogTA	0.053***	0.055***	0.052***
	[0.002]	[0.002]	[0.002]
LIQ	-0.017***	-0.016***	-0.015***
	[0.005]	[0.005]	[0.005]
EQA	0.453***	0.444***	0.453***
	[0.033]	[0.033]	[0.033]
LLP	0.206***	0.195***	0.203***
	[0.069]	[0.069]	[0.069]
GDP	-0.042	-0.073	-0.041
	[0.054]	[0.054]	[0.052]
Pop_gr	0.006**	0.004*	0.006***
	[0.002]	[0.002]	[0.002]
Constant	-0.054***	-0.044**	-0.053***
	[0.019]	[0.019]	[0.018]
Observations	11,576	11,576	11,576
# of countries	86	86	86
Bank fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes

Table 5
The effect of financial inclusion on bank efficiency using ivtobit

This table reports the results of instrumental variables regressions of IV-Tobit regression using Newey's minimum chi-squared two step estimator. The results of the second-stage regression is reported in Panel B, while the First-stage regression is presented in Panel A. The under-identification and over-identification results of the Anderson-Rubin test and the Amemiya–Lee–Newey minimum χ^2 test are reported at the bottom of the table, respectively. The bank-specific controls are: *LogTA* is the logarithm of total assets; *LIQ* is the total loans over total deposits; *EQA* is shareholder's equity over total assets; and *LLP* is Loan loss provision, measured as a percentage of total loans. All bank-specific controls are from BankScope. The macro controls are: *GDP* is the real growth rate of gross domestic products e and *Pop_gr* is the population growth rate (%). Macroeconomic data are obtained from World Development Indicators of the World Bank. Financial inclusion indicators are treated as endogenous variable, and it is instrumented via the share of the shadow economy as percentage of GDP and the average deposit balance per depositor/GNI per capita, of MFIs. While the former is collected from (Medina and Schneider, 2018), the latter is from the mixmarket.org. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively.

Panel A: First stage regression - dependent variables ⇒	Financial inclusion index	Financial outreach	Usage
Variables	1	2	3
Share of informal economy	-0.003***	-0.004***	-0.003***
	[0.000]	[0.000]	[0.000]
Average-deposit-balance-mfi	-0.005***	-0.003***	-0.008***
	[0.001]	[0.001]	[0.001]
Constant	0.329***	0.330***	0.319***
	[0.021]	[0.019]	[0.028]
Observations	2,580	2,580	2,580
Bank and Macro controls	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
# of countries	45	45	45
Adjusted R^2	0.64	0.61	0.56
Panel B: Dependent variable - **EFF**	Financial inclusion index	Financial outreach	Usage
Variables	1	2	3
Financial inclusion	0.853***	0.846***	0.857***
	[0.125]	[0.125]	[0.133]
LogTA	0.080***	0.086***	0.073***
	[0.003]	[0.003]	[0.004]
LIQ	0.0004	0.019	-0.019
	[0.013]	[0.012]	[0.016]
EQA	0.686***	0.725***	0.643***
	[0.055]	[0.055]	[0.060]
LLP	-0.367**	-0.198	-0.542***
	[0.182]	[0.173]	[0.206]
GDP	1.569***	1.446***	1.686***
	[0.224]	[0.218]	[0.245]
Pop_gr	0.072***	0.065***	0.077***
	[0.013]	[0.012]	[0.014]
Constant	-0.607***	-0.605***	-0.606***
	[0.042]	[0.042]	[0.044]
Observations	2580	2580	2580
Wald χ^2 test: exogeneity	13.86***	15.65***	22.38***
Anderson canonical correlation LM statistic	47.7***	45.7***	47.8***
Anderson canonical correlation LM statistic (*p* -value)	0.00	0.00	0.00
Amemiya-Lee-Newey test	0.01	0.73	1.19
Amemiya-Lee-Newey test (*p* -value)	0.98	0.39	0.28

Table 6
The effect of financial inclusion in the developing and emerging market economies

We use truncated regression based on Simar and Wilson (2007), Algorithm 1, using bootstrap replications for the confidence intervals of the estimated coefficients. In all columns, dependent variable is EFF, which is the efficiency scores of banks measured using Data Envelopment Analysis (DEA). Our variables of interest are financial inclusion indicators: *Financial Inclusion index* is a composite index, constructed based on two dimensions, namely *financial outreach* and *usage* dimensions. The unreported bank-specific controls are: *LogTA* is the logarithm of total assets; *LIQ* is the total loans over total deposits; *EQA* is shareholder's equity over total assets; and *LLP* is Loan loss provision, measured as a percentage of total loans. The unreported macro controls are: *GDP* is the real growth rate of gross domestic products e and *Pop_gr* is the population growth rate (%). While Panel A reports the estimated results of 70 developing market economies, Panel B reports the estimated results of 30 emerging market economies. Panel C presents the estimated results of 20 advanced economies. In Panel D, we report the results of those countries that have a ratio of *private credit to GDP* that is more than the sample average. In Panel E, we report the estimated results of those countries that have a ratio of *private credit to GDP* that is less than or equal to the sample average. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: BankScope and WDI. Coverage: 2004-15.

Variables	Financial inclusion index	Financial outreach	Usage
Panel A: Developing market economies	1	2	3
Financial inclusion	0.449***	0.385***	0.423***
	[0.024]	[0.031]	[0.025]
Observations	2,127	2,127	2,127
# of countries	57	57	57
All bank and macro controls	Yes	Yes	Yes
Year	Yes	Yes	Yes
Panel B: Emerging market economies			
Financial inclusion	0.207***	0.085*	0.171***
	[0.048]	[0.051]	[0.026]
Observations	1,948	1,948	1,948
# of countries	20	20	20
All bank and macro controls	Yes	Yes	Yes
Year	Yes	Yes	Yes
Panel C: Advanced economies			
Financial inclusion	-0.115***	0.023	-0.053***
	[0.029]	[0.029]	[0.013]
Observations	7,501	7,501	7,501
# of countries	9	9	9
All bank and macro controls	Yes	Yes	Yes
Year	Yes	Yes	Yes
Panel D: Countries those have a ratio of private credit to GDP that is more than the sample average			
Financial inclusion	-0.265***	-0.187***	-0.241***
	[0.037]	[0.040]	[0.036]
Observations	5,000	5,000	5,000
# of countries	11	11	11
All bank and macro controls	Yes	Yes	Yes
Year	Yes	Yes	Yes
Panel E: Countries those have a ratio of private credit to GDP that is less than or equal to sample average			
Financial inclusion	0.255***	0.132***	0.225***
	[0.015]	[0.011]	[0.015]
Observations	6,576	6,576	6,576
# of countries	81	81	81
All bank and macro controls	Yes	Yes	Yes
Year	Yes	Yes	Yes

Note: *Developing market economies:* Afghanistan, Algeria, Angola, Armenia, Bolivia, Bosnia and Herzegovina, Botswana, Burundi, Cambodia, Cameroon, Central African Republic, Chad, Costa Rica, Croatia, Democratic Republic Of Congo, Djibouti, Dominican Republic, Ecuador, El Salvador, Federated States Of Micronesia, Fiji, Gabon, Georgia, Guatemala, Guinea, Guyana, Honduras, Jamaica, Kenya, Lao People's Democratic Republic, Lebanon, Lesotho, Liberia, Macedonia (FYR), Madagascar, Malawi, Maldives, Mauritania, Mongolia, Montenegro, Namibia, Nepal, Nicaragua, Panama, Paraguay, Republic Of Moldova, Rwanda, Samoa, Seychelles, South Sudan, Swaziland, Tonga, Trinidad And Tobago, Uganda, United Republic Of Tanzania, Vanuatu, Zambia, and Zimbabwe.
Emerging market economies: Argentina, Bangladesh, Brazil, Bulgaria, Chile, Colombia, Egypt, Hungary, India, Indonesia, Jordan, Latvia, Malaysia, Mauritius, Pakistan, Peru, Poland, Saudi Arabia, South Africa, and Thailand.
Advanced economies: Bahamas, Estonia, Greece, Italy, Japan, Malta, Netherlands, Norway, Portugal, and Spain.

Table 7
Quantile regression approach

The dependent variable is EFF, which is the efficiency scores of banks measured using Data Envelopment Analysis (DEA). The results are based on quantile regression approach. We use bootstrapping to obtain consistent standard errors, which are reported in the brackets. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: BankScope and WDI.

VARIABLES	Bank performance								
Quantile →	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Financial inclusion	0.012	0.026***	0.041***	0.042***	0.038***	0.019**	-0.003	-0.014	-0.025
	[0.008]	[0.007]	[0.007]	[0.007]	[0.008]	[0.009]	[0.011]	[0.016]	[0.024]
LogTA	0.053***	0.055***	0.058***	0.060***	0.065***	0.071***	0.077***	0.085***	0.094***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.003]
LIQ	0.046***	0.037***	0.027***	0.013***	-0.001	-0.009	-0.021***	-0.034***	-0.056***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.005]	[0.006]	[0.009]	[0.013]
EQA	0.277***	0.393***	0.506***	0.601***	0.776***	0.947***	1.110***	1.381***	1.933***
	[0.025]	[0.023]	[0.023]	[0.023]	[0.026]	[0.030]	[0.035]	[0.052]	[0.077]
LLP	-0.336***	-0.338***	-0.259***	-0.177**	0.005	0.245**	0.434***	0.630***	0.432
	[0.088]	[0.080]	[0.080]	[0.080]	[0.089]	[0.104]	[0.120]	[0.179]	[0.267]
GDP	-0.538***	-0.441***	-0.340***	-0.344***	-0.326***	-0.309***	-0.202***	0.124	0.854***
	[0.051]	[0.046]	[0.046]	[0.046]	[0.052]	[0.060]	[0.070]	[0.104]	[0.154]
Pop_gr	-0.002	0.001	0.004**	0.004**	0.003	-0.001	-0.002	-0.002	-0.011*
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]	[0.003]	[0.004]	[0.006]
Constant	-0.236***	-0.228***	-0.232***	-0.220***	-0.230***	-0.234***	-0.233***	-0.250***	-0.239***
	[0.011]	[0.010]	[0.010]	[0.010]	[0.011]	[0.013]	[0.015]	[0.023]	[0.034]
Observations	11,576	11,576	11,576	11,576	11,576	11,576	11,576	11,576	11,576

Table 8
Exploring channels: volatility of retail deposits and bank return

We use truncated regression based on Simar and Wilson (2007), Algorithm 1, using bootstrap replications for the confidence intervals of the estimated coefficients. In all columns, dependent variable is EFF, which is the efficiency scores of banks measured using Data Envelopment Analysis (DEA). The variables of interest are: *Financial inclusion index, Financial outreach, and Usage.* The unreported bank-specific controls are: *LogTA* is the logarithm of total assets; *LIQ* is the total loans over total deposits; *EQA* is shareholder's equity over total assets; and *LLP* is Loan loss provision, measured as a percentage of total loans. The unreported macro controls are: *GDP* is the real growth rate of gross domestic products and *Pop_gr* is the population growth rate (%). In Panel A, we use interaction term of financial inclusion indicators and Volatility of customer deposit share (σ_{CDEP}). σ_{CDEP} is standard deviation of the share of customer deposits of total deposits and short-term funding (calculated using 3 year rolling window). In Panel B, we use interaction term of financial inclusion indicators and Return volatility (σ_{roa}). σ_{roa} is standard deviation of the return-on-assets (calculated using 3 year rolling window). ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: BankScope and WDI. Coverage: 2004-15.

Variables	Financial inclusion index	Financial outreach	Usage
Panel A: Volatility of customer deposit funds	1	2	3
Financial inclusion	0.086***	0.070***	0.037***
	[0.010]	[0.010]	[0.009]
σ_{CDEP}	-0.272***	0.039	-0.259***
	[0.084]	[0.064]	[0.066]
Financial inclusion X σ_{CDEP}	1.022***	0.300***	1.340***
	[0.124]	[0.082]	[0.154]
Constant	-0.344***	-0.332***	-0.278***
	[0.016]	[0.017]	[0.016]
Observations	11,101	11,101	11,101
# of countries	84	84	84
All bank and macro controls	Yes	Yes	Yes
Year	Yes	Yes	Yes
Panel B: Return volatility (σ_{roa})			
Financial inclusion	0.060***	0.063***	0.019***
	[0.009]	[0.011]	[0.006]
σ_{roa}	-3.005***	-2.135***	-3.499***
	[0.304]	[0.505]	[0.362]
Financial inclusion X σ_{roa}	3.813***	2.589***	4.360***
	[0.739]	[0.839]	[0.530]
Constant	-0.307***	-0.316***	-0.262***
	[0.010]	[0.014]	[0.012]
Observations	11,169	11,169	11,169
# of countries	84	84	84
All bank and macro controls	Yes	Yes	Yes
Year	Yes	Yes	Yes

Table 9
The role of bank regulation and supervision on financial inclusion and bank performance

We use truncated regression based on Simar and Wilson (2007), Algorithm 1, using bootstrap replications for the confidence intervals of the estimated coefficients. In all columns, dependent variable is EFF, which is the efficiency scores of banks measured using Data Envelopment Analysis (DEA). The variables of interest are interaction term of *financial inclusion* and *regulatory and supervisory indicators.* The bank-specific controls are: *LogTA* is the logarithm of total assets; *LIQ* is the total loans over total deposits; *EQA* is shareholder's equity over total assets; and *LLP* is Loan loss provision, measured as a percentage of total loans. The macro controls are: *GDP* is the real growth rate of gross domestic products and *Pop_gr* is the population growth rate (%). ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: BankScope and WDI. Coverage: 2004-15.

	Bank performance	
Financial inclusion	0.086***	0.098***
	[0.009]	[0.010]
Activities restrictions	0.019***	
	[0.003]	
Financial inclusion x Activities restrictions	-0.042***	
	[0.006]	
Overall capital stringency		-0.016***
		[0.003]
Financial inclusion x Overall capital stringency		0.057***
		[0.007]
LogTA	0.073***	0.073***
	[0.001]	[0.001]
LIQ	0.012***	0.008*
	[0.005]	[0.005]
EQA	0.697***	0.694***
	[0.031]	[0.026]
LLP	-0.363***	-0.440***
	[0.089]	[0.093]
GDP	0.165**	0.276***
	[0.073]	[0.072]
Pop_gr	0.007***	0.005**
	[0.002]	[0.002]
Constant	-0.330***	-0.327***
	[0.015]	[0.014]
Observations	11,501	11,476
All bank- and country-level controls	Yes	Yes
Year	Yes	Yes
Number of countries	77	76

Table 10
The impact of pro-financial-inclusion policy on bank performance

This table presents difference-in-differences (Panel A) and Matching (Panel B) estimations relating to pro-access policy and bank efficiency. The variable of interest is Pro-access-policy, that takes one if a country signs Maya Declaration and commit to take measurable steps to develop and implement more effective policies designed to expand access to financial services in year *t* and thereafter or else zero. The analogous bank- and country-specific controls are used. Heteroskedasticity robust standard errors (t-statistics) are reported in the brackets (parentheses). The first two columns use country fixed effects, and the last two columns use bank fixed effects. In Panel B, we use two different matching methods, Nearest Neighbour and Kernel matching. We are interested in the average treatment effect for the treated. The number of observation differs due to the difference in the underlying matching approaches. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively.
Source: BankScope and AFI. Coverage: 2004-2015.

Variables	Bank efficiency			
Panel A: Difference-in-differences	1	2	3	4
Pro-access-policy	0.057***	0.030**	0.066***	0.027**
	[0.012]	[0.012]	[0.013]	[0.011]
LogTA		0.068***		0.069***
		[0.021]		[0.011]
LIQ		0.044*		0.023
		[0.025]		[0.019]
EQA		0.677***		0.377***
		[0.105]		[0.096]
LLP		-0.024		-0.164
		[0.279]		[0.177]
GDP		-0.319**		-0.350***
		[0.157]		[0.112]
Pop_gr		0.001		-0.001
		[0.004]		[0.005]
Constant	0.340***	-0.221	0.338***	-0.165**
	[0.002]	[0.149]	[0.003]	[0.080]
Observations	6,065	6,065	6,065	6,065
Adjusted R^2	0.363	0.466	0.804	0.821
Country Fixed Effects	Yes	Yes	No	No
Bank Fixed Effects	No	No	Yes	Yes
Panel B: Matching estimators	**Nearest Neighbour**		**Kernel**	
Variables	1		2	
Average treatment effect	0.055***		0.023***	
S.E.	[0.012]		[0.008]	
t-stat	[4.961]		[2.682]	
No. of treated & control obs.	1,211 & 871		1,211 & 4,463	
Common support condition	Yes		Yes	