Journal of Banking and Finance 124 (2021) 106055

Contents lists available at ScienceDirect

Journal of Banking and Finance

journal homepage: www.elsevier.com/locate/jbf

Inclusive banking, financial regulation and bank performance: Cross-country evidence ☆

M. Mostak Ahamed [a], Shirley J. Ho [b], Sushanta K. Mallick [c,*], Roman Matousek [c]

[a] University of Sussex Business School, University of Sussex, Jubilee Building, Falmer, Brighton BN1 9SL, UK
[b] Department of Economics, National Chengchi University, Taipei 11605, Taiwan
[c] Queen Mary University of London, School of Business and Management, Mile End Road, London E1 4NS, UK

ARTICLE INFO

Article history:
Received 7 February 2019
Accepted 7 January 2021
Available online 20 January 2021

JEL Classification:
G15
G21
O16

Keywords:
Financial inclusion
Pro-access policy
Regulatory environment
Bank efficiency

ABSTRACT

This paper investigates whether inclusive banking can boost bank-level performance, using an international sample of 1,740 banks over the period 2004-2015. We find that there is a significant positive association between financial inclusion and bank efficiency. Greater financial inclusion helps banks in reducing the volatility of their deposit-funding share as it provides more stable long-term funds for banks, while also mitigating the adverse effects of their return volatility. The association is stronger in countries with limited restrictions on banking activities or more capital regulation stringency as the deposit channel enables greater flow of low-cost funds for high-return investments. The results are robust to instrumental variable analysis, multiple dimensions of financial inclusion (supply, demand, and pro-access policy), and a difference-in-differences estimator that exploits cross-country and temporal variations in actively promoting an inclusive agenda, further confirming that inclusive financial development can be beneficial for banks.

1. Introduction

The literature on the link between financial development and economic growth, starting with King and Levine (1993), documents a positive effect of finance on growth in cross-country regressions (see, Levine, 1999; Beck et al., 2000; Wurgler, 2000; Bekaert et al., 2005). More recent literature reveals that the effect of finance on growth is non-linear, with a stronger effect among emerging market economies (Aghion et al., 2005; Law and Singh, 2014; Arcand et al., 2015). Levine (2005) reviews a large body of literature and concludes that financial intermediaries help mobilise savings, facilitate information sharing, and help growing small and medium-sized firms in allocating funds efficiently. A well-functioning, better performing, and efficient financial system can affect real growth by increasing savings (e.g., Jappelli and Pagano, 1994) and by channelling funds efficiently (Fries and Taci, 2005; Levine, 2005).

Following the global financial crisis in 2007-2008, a number of developing countries have endorsed the objective of financial inclusion for economic prosperity and growth. Many multilateral organisations have made commitments to advance financial inclusion globally. For example, the G20 created the 'Global Partnership for Financial Inclusion' in 2010 at the Seoul Summit with the objective to promote inclusive financial development in developing

☆ The authors would like to thank the editor, Geert Bekaert, and the three anonymous reviewers of this journal for their very constructive comments that contributed significantly to the improvement of this paper. We are solely responsible for any error that might yet remain. Earlier versions of this paper were presented at UNU-WIDER, Helsinki, Finland (5 Feb 2020); the People's Bank of China, Ningbo, China (17 Apr 2019); Centre for Inclusive Finance, Nottingham University Business School, Ningbo, China (16 Apr 2019); the 14th International Conference on Asian Financial Markets and Economic Development, Kyoto, Japan, Dec 15-16, 2018; the International Academic Conference of Accounting and Finance in the Emerging Markets, Nanjing University of Finance and Economics, Nanjing, China, Oct 13-14, 2018; International Conference on Management and Operations Research (ICMOR), Jul 7-9, 2018, Beijing, China; Workshop on Enterprise growth and Economic Development in Western China, 24 Jun 2018, Yunnan University, Kunming, China; the 22nd Annual ICMAIF Conference at University of Crete at May 24-26, 2018; Allied Social Science Associations (ASSA) Annual Meeting, Philadelphia, USA, 4-7 Jan, 2018; European Economics and Finance Society (EEFS) 16th Annual Conference, 22–25 Jun 2017, University of Ljubljana, Ljubljana, Slovenia; and research seminars at Nanjing University of Finance and Economics, Nanjing, China (19 Dec 2018); Shanghai Lixin University, China (20 Sep 2018); Fudan Economics Forum, Fudan University, China (16 Jul 2018); Roehampton University London (28 Mar 2018), Indira Gandhi Institute of Development Research, Mumbai (2017); Indian Institute of Management Ahmedabad (2017); and Indian Institute of Technology (IIT) Madras (2017). The authors are thankful to the participants and the discussants for their insightful comments.

* Corresponding author at: Queen Mary University of London, School of Business and Management, Mile End Road, London E1 4NS, UK.

E-mail addresses: M.Ahamed@sussex.ac.uk (M.M. Ahamed), sjho@nccu.edu.tw (S.J. Ho), s.k.mallick@qmul.ac.uk (S.K. Mallick), r.matousek@qmul.ac.uk (R. Matousek).

https://doi.org/10.1016/j.jbankfin.2021.106055

countries.[1] However, it is yet to be fully explored how financial inclusion impacts the providers of financial services. In particular, the outstanding question is whether financial inclusion is complementary to bank performance.[2]

The conventional measures of financial development, used in most of the empirical studies, include the ratio of the volume of private credit or stock market capitalisation to GDP at the cross-country level (see Beck et al., 2014; Sahay et al., 2015). In this paper, we take IMF's Financial Access Survey (FAS) data to construct a composite index of inclusive financial development. In doing so, we incorporate both the depth and breadth of the financial system by using the usage and outreach dimensions of banking activities respectively. We then investigate the association between financial inclusion and bank performance in terms of efficiency improvement, and how bank regulation affects this relationship using data for 1,740 banks over the period 2004-2015. We obtain bank-level efficiency scores from the non-parametric data envelopment analysis (DEA), and evaluate the extent to which the performance of individual banks moves away from "best practice" frontier banks within a country (Assaf et al., 2011; Chortareas et al., 2013; Halkos and Tzeremes, 2013). By exploring the impact of financial inclusion on bank efficiency, we contribute to the literature that explores the determinants of bank efficiency (Chortareas et al., 2013; Ayadi et al., 2016).

The current literature suggests an ambiguous relationship between financial inclusion and bank performance. Greater financial inclusion brings unbanked firms and consumers into the formal banking system. It helps financial institutions to diversify their depositor base and loan portfolio. Increased diversification potentially enhances the resilience of financial institutions to withstand a financial crisis (Mehrotra and Yetman, 2015). 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). Low information asymmetries can reduce any type of funding volatility, as banks are able to extract deposits from a large customer base (Han and Melecky, 2013). The large accumulation of deposits then reduces return volatility, as banks rely less on risky and costly money market funds (Demirgüç-Kunt and Huizinga, 2010; Poghosyan and Čihak, 2011; Beltratti and Stulz, 2012; Kacperczyk and Schnabl, 2013). As inclusive banking provides ample opportunities for customer deposit funding, it should, therefore, reduce the return volatility of banks operating in such markets.

However, in an inclusive financial sector, banks expand branches to unbanked remote areas. As the distance increases between headquarters and distant branches, the 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 headquarter, the more difficult it becomes to transmit the efficiencies and aptitude of senior managers to different branches for enhancing overall operating efficiency (Berger and DeYoung, 2001). Moreover, broadening access to financial services for all income groups requires that banks maintain diverse product lines targeted at different categories of customers. Thus, inclusive finance could increase agency problems due to a large product mix and organisational structure. The above-mentioned competing effects imply that whether inclusive finance increases or decreases bank efficiency is an empirical issue. However, if the benefits associated with inclusive finance outweigh the costs, one would expect to see an overall positive relationship between inclusive finance and bank efficiency. Therefore, our first hypothesis is that financial inclusion is positively associated with bank performance.

Regulators around the world are still trying to identify suitable financial regulations that not only support an inclusive finance agenda but also promote bank resiliency. Therefore, it is important to assess how differing regulatory frameworks across countries can play a role in the relationship between financial inclusion and bank efficiency. We focus on the role of two important bank regulations: activities restrictions and overall capital stringency. According to Barth et al. (2008a), high regulatory restrictions on banking activities could mean fewer diversification opportunities for banks. Less diversification leads to reduced income streams and franchise value, which lead to inefficient financial intermediation (Laeven and Levine, 2009; Barth et al., 2013). On the contrary, unfettered financial activities may intensify moral hazard problems and encourage banks to take excessive risk (Boyd et al., 1998). More restrictions on activities can reduce the expected return of risky assets, while increasing the holding of safe assets. This could increase or decrease bank efficiency. However, when the deposits increase following inclusive banking, higher restrictions on banking activities would impede the usage (investment) of the additional funds, thus reducing efficiency. Therefore, given the adverse effects of activity restrictions, we hypothesise that for banks operating in an environment with high restrictions on banking activities, the net effect of financial inclusion could still be negative on bank performance.

The overall capital stringency regulation has a direct bearing on bank performance. When banks are required to have more capital, it decreases risk-shifting and incentivises owners to control risk efficiently, implying a positive impact on bank performance (Mehran and Thakor, 2011). Relying on agency theory, the argument for a negative effect of bank capital suggests 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). Therefore, the role of regulatory capital requirement in the relationship between financial inclusion and bank efficiency is an empirical question that we explore in this paper. In this context, we provide a modified spatial model incorporating bank heterogeneity and financial outreach in order to motivate this empirical analysis. Although capital regulation can lower bank efficiency, in the presence of inclusive banking the upper bound for risky investment can increase, raising expected return that can mitigate any reduction in bank efficiency due to the regulation (see the theoretical analysis in Appendix A).

Our empirical results indicate that there is a strong positive association between financial inclusion and bank efficiency. We show that this association is stronger in countries with more capital regulation stringency and limited restrictions on banking activities. Further, we find that greater financial inclusion helps banks to reduce their return volatility and the volatility of their customer-deposit funding share. We also show that banks operating in less developed financial markets benefit more from inclusive banking compared to banks in developed economies. We subject our findings to an array of sensitivity checks. Our findings are robust to (i) using the 'fractional logit' quasi-likelihood estimator proposed by Papke and Wooldridge (1996); (ii) using the instrumental variable approach; (iii) running regressions only for the sample of developing economies; (iv) using alternative measures of financial inclusion indicators; and finally (iv) controlling for the country-level economic and population growth.

Furthermore, we exploit the timing variations of pro-access policies in the developing countries that have made measurable commitments for advancing the inclusive financial development agenda. We explore the effects of enabling inclusive financial environment on bank performance using the difference-in-differences (DID) estimator. The DID results show that bank performance has

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

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

improved significantly for those banks that operate in countries that have taken steps towards having an inclusive banking sector. We also confirm these results using several matching estimators.

The remaining part of the paper is organised as follows: Section 2 describes the empirical strategy, data and methodology. Section 3 discusses the empirical results and sensitivity analyses. Section 4 provides evidence on the mechanisms through which inclusive finance can enhance banks' operating efficiency. Section 5 shows the effect of pro-access policy on bank efficiency, and Section 6 concludes with some policy implications.

2. Empirical strategy: Data and methodology

This section describes the different data sources, reports descriptive statistics and discusses our methodology.

2.1. Data sources

We compile data from the following sources: (a) the bank-level data are compiled from the BankScope database provided by Bureau van Dijk and Fitch Ratings; (b) the country-level data are compiled from the World Bank World Development Indicators (WDI); (c) the country-year level data on bank regulation and supervision are compiled from Barth et al. (2004); Barth et al. (2008b); and Barth et al. (2013); (d) the instruments for IV regressions are collected from the World Bank's Women, Business and the Law (WBL) database, and Medina and Schneider (2018); and finally (e) the indicators to measure the financial inclusion index (FII) are collected from the IMF's FAS database.

Given the trade-off between data availability (e.g., availability of required dimensions of financial inclusion) and cross-country sample coverage, we could measure FII for 86 countries over the period 2004–2015. We match the country-year of FII data with that of the bank-level data. Our dataset comprises 1,740 commercial banks, cooperative banks and Islamic banks (11,576 bank-year observations), representing 36%, 63%, and 1% of the sample, respectively. Bank-level data are sourced from unconsolidated reports of banks. However, we discard unconsolidated reports of banks whenever a consolidated one of the same group is available to avoid any double counting of institutions.

Considering the objective of this paper, we exclude countries for which we have no information on different dimensions of the FII. In particular, as FAS does not have information for Australia, Germany and the USA, these countries are not included in the analysis. We deflate all monetary values to 2015 (2015 = 100) prices using the GDP deflator of the U.S. obtained from the Federal Reserve Economic Data (FRED). The deflated series are reported in millions of US dollars ($).

2.2. Measuring bank performance: Bank efficiency scores

To examine the impact of financial inclusion on bank performance, we use a two-stage approach. In the first stage, we employ the widely used input-oriented non-parametric DEA to measure the efficient frontier and estimate efficiency scores. 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. We use DEA over the parametric technique such as stochastic frontier analysis (SFA) as the latter requires assuming a particular functional form. If we choose an inaccurate functional form, it may yield biased efficiency scores. In the case of DEA, it does not require any functional form assumption (Drake et al., 2006).

Let us assume the sample size is n and there are p inputs and q outputs for each bank i. 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, $y_i = (y_{1i}, y_{2i}, ..., y_{qi})$ as a $q \times 1$vector of outputs for bank i, and $Y = (y_1, y_2, ..., y_n)$ as a $q \times n$ matrix of outputs, respectively. The variable returns to scale DEA model for each bank $i(i = 1, 2, ..., n)$ can be expressed with the following linear programming problem:

$$\begin{aligned}\text{Max}(\varphi_i \geq 1 | x_i, y_i, XY) = \text{Max}(\varphi_i \geq 1 | \varphi_i y_i \leq Y\lambda_i, X\lambda_i \\ \leq x_i, \lambda_i \geq 0, I_1'\lambda_i = 1),\end{aligned} \quad (4)$$

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

The interpretation of the 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$\lambda_i \geq 0, I_1'\lambda_i = 1$. The simulated outputs $(Y\lambda_i)$ are maximised, subject to the inputs constraint of bank $i(X\lambda_i \leq x_i)$, which is then evaluated with the real outputs (y_i) of bank i. Bank i is considered inefficient either if the expanded simulated outputs $(Y\lambda_i)$ are more than the real outputs (y_i) of bank i by a scalar factor of $\varphi_i > 1$ or if 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 the 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. 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 for each country. The advantage of this approach is that it allows us to estimate efficiency differentials not only between banks within countries but between banks across countries due to the same benchmark (see Chortareas et al., 2013). We follow the intermediation approach of Sealey and Lindley (1977). In this approach, financial institutions use deposits, labour, and physical capital as inputs to produce interest-earning assets, that is, loans and investments. In our model, we have 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*). Table OA1 in the online appendix shows the descriptive statistics of the inputs and outputs.

2.3. Constructing a financial inclusion index

Policymakers identify financial outreach and usage of financial services as the main indicators of financial inclusion. There is lack of consistent data across countries on affordability and other informal dimensions. Therefore, following Ahamed and Mallick (2019), we use financial outreach and usage dimensions to construct FII. We use financial outreach dimension to account for the pervasiveness of outreach of the banking sector in terms of their physical outlets. Physical distance to the point of financial services is deemed 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 a sub-index of outreach. For demographic penetration, we use the number of bank branches and the number of ATMs per 100,000 people, whereas for geographic penetration, we use the number of bank branches and the number of ATMs per 1,000 square kilometres. For the usage dimension, we use the number of bank accounts per 1,000 adults to integrate the depth of financial access.

Financial inclusion is a multidimensional concept. Using a standalone indicator of financial inclusion would provide an incomprehensive picture of the inclusiveness of the financial sector and, hence, implications on bank efficiency. Therefore, we build upon

Beck et al. (2007) to construct a composite weighted index of financial inclusion using principal component analysis (PCA) as follows:

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

where w_{ij}denotes the component's loadings or weights; and $X_i$denotes the original inclusion indicators. First, we apply PCA to estimate the financial outreach dimension from a group of four correlated indicators related to the outreach mentioned above. Second, we apply PCA again to estimate the overall FII by using financial outreach sub-index and usage as variables.[3] In PCA, the first principal component is the single linear combination of the financial inclusion indicators, explaining most of the variation.

In the case of the financial outreach dimension, the first principal component (PC) explains approximately 68% of the variations with an 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. In constructing FII, we find two PCs with eigenvalues of 1.80 and 0.20. Again, the first PC explains approximately 90% of the corresponding sample variance (see the online appendix Table OA2). As only the first PC has an eigenvalue of more than one, according to the Kaiser rule, we assume that it sufficiently explains the common variation among these dimensions.[4] The parametric methods that we apply for constructing the FII assign factor loadings (weights) on each dimension. We use these weights to construct the FII as in Eq. (5). It is noted that the usage dimension has relatively much lower weights than does the financial outreach dimension. We normalise the 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.

2.4. Bank- and country-specific variables with bank regulatory indicators

Following the banking literature, we use several bank and country characteristics that can be correlated with bank efficiency. Specifically, we use the 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, the 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 country-level economic growth and population growth.

To test whether different regulatory practices across countries play a role in the relationship between financial inclusion and bank efficiency, we use two key indicators related to the banking regulation and supervision surveys of Barth et al. (2004); Barth et al. (2008b); 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) measure the degree of restrictions imposed on a bank's activity. CS (capital stringency) measures the degree of capital risk management restrictions that incorporate certain risk elements, and it also deducts market losses in setting up capital adequacy.

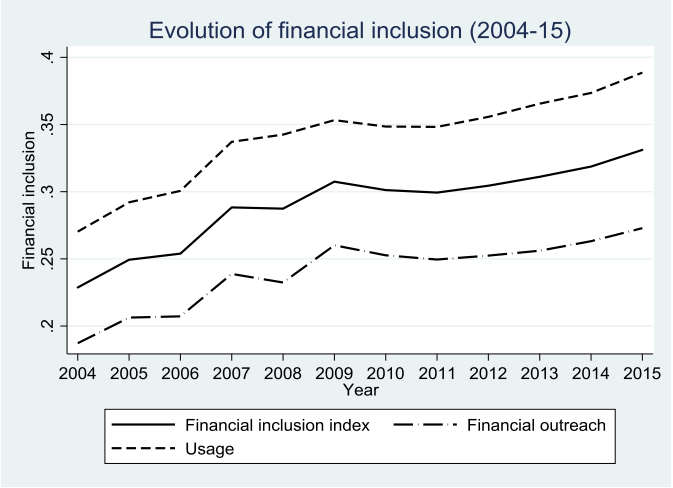

Fig. 1. Evolution of financial inclusion indicators

2.5. Descriptive statistics and methodology

Table 1 reports the descriptive statistics of all variables. While Table B1 in the appendix presents the variable definitions, the online appendix OA3 presents the correlation matrix. 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 a 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 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 return volatility (σ_{roa}) is 0.004 with a standard deviation of 0.006. The average FII is 0.29, with a standard deviation of 0.24, indicating 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 bank efficiency and financial inclusion indicators. Whereas Japan, Malta, and Portugal have the most inclusive financial sectors, South Sudan, Chad, and the Democratic Republic of Congo have the least inclusive financial sectors. Fig. 1 shows the evolution of financial inclusion and its associated dimensions, indicating a clear uptrend for the sample period.

We examine the impact of financial inclusion on bank performance by running several regressions that use the following baseline model:

$$Eff_{ijt} = \beta_0 + \beta_1 FinancialInclusion_{jt} + \beta_2 BC_{ijt} + \beta_3 KC_{jt} + Year_t + \varepsilon_{ijt} \tag{6}$$

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. Eq. (6) is

[3] Before using PCA, we, first, winsorise each indicator at the 95th percentile level to reduce the influence at the upper tail. Second, we normalise each indicator to have values between zero and one to ascertain that the scale in which they are measured is immaterial. We have also excluded economies from the sample if observations of any of the indicators are missing.

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

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 B1. 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, are in the first part along with all bank-specific controls. Country-specific variables are in the second part followed by the instrumental variables in the final part. Coverage: 2004-15.

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
Woman's-ability-to-work	0.98	1.00	0.15	0.00	1.00	75	75

estimated employing the Simar and Wilson (2007) parametric regression bootstrapping. This approach 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 Eq. (6) using the fractional logit estimator proposed by Papke and Wooldridge (1996).

3. 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. In doing so, we use the truncated regression model proposed by Simar and Wilson (2007), in which 2,000 bootstrap replications are employed to estimate confidence intervals.

Table 3 reports the estimated parameters.[5] Column 1 shows the relationship between the FII and bank efficiency, whereas columns 2 (3) show the association between the financial outreach (usage) dimension and bank efficiency. The FII coefficient is positive at the 1% level of statistical significance. It suggests that an inclusive financial sector can play a significant role in enhancing bank efficiency scores. The effect is also economically significant, as a one standard deviation (0.24) increase in the FII increases bank efficiency scores by 1.8%. 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 helps them to operate more efficiently. Taking the individual constituents of the FII, we also find that financial outreach and usage are positive and significant at the 1% level. These results are also supported by recent empirical evidence showing that expanding bank branches or reaching out to customer, 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, 2019).

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

Next, we analyse the various robustness tests of our study. We use alternative estimators, including IV regressions, and exploit bank-specific heterogeneity. We re-run regressions, splitting the sample into groups based on the development status of the sample countries while adding additional macro controls. Using two alternative demand-side measures of financial inclusion from the Global Findex database, we also find that countries with a higher percentage of adults using bank accounts/savings at financial institutions tend to have banks with greater efficiency. The results are reported in the Appendix Table B2. Furthermore, we identify some small island countries (Fiji, Jamaica, Madagascar, Maldives, Malta, Samoa, Seychelles, Tonga, Trinidad and Tobago and Vanuatu) and drop them from the sample if they have fewer than five banks during the sample period to dispel the country selection bias.[6] We re-run the regression by income group and report them in the online appendix Table OA4. For columns 1-9, we find that financial inclusion indicators are positively associated with bank efficiency except for financial outreach in low income country. For columns 10-12, we find that the coefficients of financial inclusion indicators are negative and significantly associated with bank efficiency. It suggests that higher financial inclusion might not be beneficial for banks in high income countries. We provide more evidence on this issue later in the paper.

3.1. Alternative estimators, adjusted-FII, and exploiting bank-specific heterogeneity

So far, we have estimated Eq. (6) using a truncated regression model as suggested by Simar and Wilson (2007). They claim that

[5] 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.

[6] We are thankful to an anonymous reviewer for this suggestion.

Table 2
The estimation results for 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 the ranking of the country in terms of inclusive financial development. It also reports the number of banks in each country. Coverage: 2004-15.

Country	Bank efficiency	Financial inclusion index	Financial outreach	Usage	# of banks	Country	Bank 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, the dependent variable is EFF, which is the efficiency scores of banks measured using 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 product and *Pop_gr* is the population growth rate (%). Macroeconomic data are obtained from the 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	Simar and Wilson (2007)			Papke and Wooldridge (1996)		
	Financial inclusion index 1	Financial outreach 2	Usage 3	Financial inclusion index 4	Financial outreach 5	Usage 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

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, rather that of a fractional logit process and, thus, is not a latent variable. Therefore, when efficiency scores are generated by a fractional logit process, to check the robustness of our results, we re-estimate Eq. (6) using a 'fractional logit' quasi-likelihood estimator proposed by Papke and Wooldridge (1996). Columns 4–6 in Table 3 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 bank efficiency. Similarly, greater financial inclusion and/or banking sector outreach and/or depth of financial services increase bank efficiency.

In constructing FII, we use the number of accounts per 1,000 adults, as data on the number of people having bank accounts are limited. This approach might double count the same person having multiple accounts (Beck et al., 2007). However, to reduce the influence of multiple accounts in the FII, we re-construct the usage dimension by dividing the number of accounts per 1,000 adults by 3 in the case of developing countries and 7 for developed ones.[7] The correlation between the FII and the adjusted-FII is 0.98. We also check the robustness of our results using the adjusted-FII and find no change to the main results (see the online appendix Table OA5).

Until now, we have estimated a pooled cross-sectional truncated regression model assuming that there is no bank-specific heterogeneity. To control for bank unobserved heterogeneity, we use the random effects Tobit (RET) model, as we are not aware of any other truncated regression model that can accommodate bank-specific heterogeneity in the estimation.[8] We also use the RET model because panel Tobit estimates with fixed effects tend to be biased (Greene, 2004). The consistency of the RET model requires a 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 the RET model also corroborate the pooled estimations that the FII and usage dimension are positively associated with bank efficiency.

3.2. Instrumental variable (IV) regression

It is plausible that the relationship between financial inclusion and bank efficiency may suffer from the endogeneity issue. Endogeneity can arise if banks engage in less efficient activities in the current setup and venture into unbanked areas or if they self-select into inclusive financial activities as such activities reward them with greater access to customer deposits and 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, the omitted variable bias could still be a 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 also measurement errors, we employ the Tobit model with instrumental variables, using Newey's minimum chi-squared two-step estimator.

[7] We thank the anonymous referee for suggesting this solution of how to avoid the effect of multiple accounts.

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

Table 4
Exploiting bank unobserved heterogeneity
The results in this table are based on Random-effects Panel Tobit regressions. In all columns, the 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 product and *Pop_gr* is the population growth rate (%). Macroeconomic data are obtained from the 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 1	Financial outreach 2	Usage 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

To run an IV regression, we have tried extensively to find relevant instrumental variables. In this section, we discuss the intuition behind selecting instruments to treat financial inclusion as an endogenous variable in our IV regression. Financial inclusion, as a broader concept focuses on all economic agents in an economy. About 1.1 billion women – or nearly one in every three women in the world – are excluded from the formal financial system.[9] There is a gender gap in entrepreneurship where women are underrepresented compared to men. Access to finance remains the greatest hurdle for households and enterprises in developing countries where women entrepreneurs suffer the most when running and wanting to grow a business.

There are many financial and non-financial barriers that can inhibit women from getting proper access to finance. In terms of financial barriers, in most cases, women possess a lack of credit histories, connections, and collateral, which is at the core for banks to lend to anyone. Non-financial barriers can take the form of antagonistic legal and institutional settings, and gender differences in formal economic rights in the law.

Using an international sample of developing countries and data from the World Bank's Women, Business and the Law (WBL) database, Demirgüç-Kunt et al. (2013) explore the degree to which economy-wide legal discrimination against women can explain the gender gap in access to finance. The WBL database contains 35 indicators under eight categories on the laws and regulations that restrict women's economic opportunities. It compiles data with regard to laws governing a women's ability to enter the labour force, earn an income, own property, freedom of movement, work, and run a business. The indicators in the WBL are based on codified law and regulations. Therefore, its indicators include any common laws or religious codes; but exclude any customary laws unless they are codified.

Demirgüç-Kunt et al. (2013) find that in countries where women face legal discrimination in getting a job or pursuing a trade or profession in the same way as men, women are less likely than men to have an account and to save and borrow. In other words, when women face differential treatment under the law or by custom, they tend to have less opportunities than men to own, manage, control, or inherit assets and property, which in turn affect women's access to and demand for financial services. Furthermore, using individual-level survey data for nine countries in Sub-Saharan Africa, Aterido et al. (2013) also find that the lower use of formal financial services by women in these countries can be explained by gender differences in formal employment.

As existing studies show that legal discrimination against women in getting a job or pursuing a trade or profession affects women's demand for financial services, we, therefore, use this variable as one of the instruments in the IV regressions. We collect information on "Can a woman legally get a job or pursue a trade or profession in the same way as a man?" (henceforth, *woman's-ability-to-work*) from the WBL database for the sample period 2004-2015.[10] We assume that *woman's-ability-to-work* would have a strong association with financial inclusion, but not necessarily with bank-level efficiency. We expect that the higher the *woman's-ability-to-work,* the higher the level of financial inclusion. We choose the share of the shadow economy as a percent of GDP (*share of informal economy*) as the second instrument, which is collected from Medina and Schneider (2018). Likewise, we expect that the higher the share of the informal economy, the lower the level of financial inclusion.

Table 5 shows the results of the IV regressions. Panel A shows the results of the first-stage regressions of financial inclusion indicators on instruments while using the ordinary least squares (OLS) estimation, and Panel B shows the second-stage regressions on

[9] https://www.cgap.org/blog/5-challenges-womens-financial-inclusion

[10] See WBL data at https://wbl.worldbank.org/en/resources/data

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 are 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 product and *Pop_gr* is the population growth rate (%). Macroeconomic data are obtained from the World Development Indicators of the World Bank. Financial inclusion indicators are treated as an endogenous variable, and it is instrumented via the share of informal economy as a percentage of GDP and the woman's-ability-to-work. While the former is collected from Medina and Schneider (2018), the latter is from the World Bank's Women, Business and the Law (WBL) database. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Coverage: 2004-15.

Panel A: First stage regression - dependent variables→ Variables	Financial inclusion index 1	Financial outreach 2	Usage 3
Share of informal economy	-0.014***	-0.010***	-0.017***
	[0.000]	[0.000]	[0.000]
Woman's-ability-to-work	0.100***	0.164***	0.024**
	[0.008]	[0.010]	[0.011]
Constant	1.094***	1.058***	1.101***
	[0.013]	[0.016]	[0.017]
Observations	11,351	11,351	11,351
Bank and Macro controls	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
# of countries	75	75	75
Adjusted R^2	0.85	0.81	0.77
Panel B: Dependent variable - **EFF**	Financial inclusion index	Financial outreach	Usage
Variables	1	2	3
Financial inclusion	0.186***	0.231***	0.151***
	[0.016]	[0.020]	[0.013]
LogTA	0.069***	0.071***	0.067***
	[0.001]	[0.001]	[0.001]
LIQ	0.026***	0.005	0.040***
	[0.005]	[0.005]	[0.006]
EQA	0.957***	1.032***	0.898***
	[0.030]	[0.033]	[0.029]
LLP	0.075	0.178*	-0.01
	[0.103]	[0.107]	[0.102]
GDP	0.842***	1.610***	0.243***
	[0.099]	[0.156]	[0.072]
Pop_gr	0.021***	0.021***	0.020***
	[0.003]	[0.003]	[0.003]
Constant	-0.416***	-0.479***	-0.363***
	[0.020]	[0.025]	[0.017]
Observations	11351	11351	11351
Wald χ^2 test: exogeneity	87.08***	109.45***	90.81***
Anderson canonical correlation LM statistic	141.12***	141.12***	133.06***
Anderson canonical correlation LM statistic (*p*-value)	0.00	0.00	0.00
Amemiya-Lee-Newey test	0.02	2.56	2.12
Amemiya-Lee-Newey test (*p*-value)	0.89	0.11	0.15

bank efficiency.[11] We find that all the instruments have statistically significant effects on financial inclusion. In particular, as expected, the share of the informal economy has a negative and significant impact on financial inclusion indicators. However, *woman's-ability-to-work* has a positive and significant association with financial inclusion. It indicates that in a country where women can legally get a job or pursue a trade or profession in the same way as men, there is a higher level of financial inclusion provided by the formal banking sector.

We test the relevance and validity of the IVs used in this study. IV methods depend on two assumptions: (i) the excluded instruments are distributed independently of the error process, and (ii) they are sufficiently correlated with the included endogenous regressors. In the context of the IV Tobit regression, we report over-identification tests, proxied by the Amemiya–Lee–Newey minimum $\chi 2$ test, which satisfy assumption (i). Again, assumption (ii) is satisfied by the under-identification tests, proxied by the Anderson-Rubin test. The Anderson-Rubin test of under-identification shows that the null hypothesis of weak instruments is rejected at the 1% significance level. The over-identification test proxied by the Amemiya–Lee–Newey minimum χ^2 test shows that the selected group of instruments is valid as the null hypothesis cannot be rejected at the 5% significance level. The second-stage result is consistent, further confirming the evidence of a strong association between financial inclusion and bank efficiency.

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

Our dataset comprises 77 developing economies and nine advanced economies. Financial inclusion is a phenomenon in developing economies. Therefore, to delineate differing effects of financial inclusion on bank efficiency, we run a truncated regression model for these two groups separately. Table 6 presents the results of 12 different regressions. Panel A and B show the results of developing and advanced economies, respectively. Though we have included all controls, we report only the effects of financial

[11] To check robustness, we include the logarithm of GDP per capita as one of the additional control variables in the first- and second-stage regressions. Both the first- and second-stage results remain unchanged and are available upon request. We are thankful to an anonymous reviewer for this suggestion.

Table 6
The effect of financial inclusion in the developing 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, the dependent variable is EFF, which is the efficiency scores of banks measured using 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 product and *Pop_gr* is the population growth rate (%). While Panel A reports the estimated results of 77 developing economies, Panel B reports the results of 9 advanced economies. In Panel C, 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 D, 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	0.301***	0.194***	0.307***
	[0.030]	[0.024]	[0.023]
Observations	3,890	3,890	3,890
# of countries	77	77	77
All bank and macro controls	Yes	Yes	Yes
Year	Yes	Yes	Yes
Panel B: Advanced economies			
Financial inclusion	-0.115***	0.023	-0.053***
	[0.029]	[0.027]	[0.015]
Observations	7,395	7,395	7,395
# of countries	9	9	9
All bank and macro controls	Yes	Yes	Yes
Year	Yes	Yes	Yes
Panel C: 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 D: 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 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, Zimbabwe, 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, Portugal, and Spain.

inclusion indicators for the sake of brevity. The results of the subsample of developing economies are in line with our earlier findings. Regarding advanced economies, we find either an insignificant or negative significant effect of different inclusion dimensions on bank efficiency. It suggests that there is no additional benefit from financial inclusion in advanced countries as over 90% of adults already have access to banking services in these countries.

To examine why financial inclusion and usage might have a negative effect on bank efficiency in advanced countries, we divided our sample into two groups based on the level of financial development (*private credit to GDP)*: (i) High financial deepening – a sample of countries with *private credit to GDP* ratio being more than the sample average; and (ii) Low financial deepening – a sample of countries with *private credit to GDP* ratio being less than or equal to the sample average. The estimated results of these two groups are reported in Panel C and Panel D, respectively. This approach should delineate whether financial inclusion indicators actually influence the productive efficiency of banks that operate in those countries which have lower financial deepening in the same way as with banks that operate in countries with greater financial deepening. As the literature shows that greater financial deepening is not necessarily a reflection 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 D are consistent with our earlier findings, Panel C coincides with the results of advanced economies. It suggests 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 bank efficiency in countries that have a less-deepened financial system, it reduces bank efficiency in countries that have greater financial deepening. In the

Table 7
Quantile regression approach
The dependent variable is EFF, which is the efficiency scores of banks measured using DEA. The results are based on a 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. Coverage: 2004-15.

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

case of the latter, it may be due to a mature level of financial development that has already materialised in these countries.

3.4. 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 the OLS regression. As we have a large number of banks from different countries, heterogeneity might be an issue. Therefore, we use quantile regression, as proposed by Koenker and Bassett (1978), to assess whether financial inclusion has a homogeneous effect on bank efficiency. We illustrate the relationship at different points in the conditional distribution of the dependent variable. Table 7 presents the results. As bank efficiency changes across quantiles, the estimates of financial inclusion vary in sign, magnitude, and significance. Though the estimates of the financial inclusion coefficients are positive and increasing in magnitude, in addition to being statistically significant at the 1% level for bank efficiency at quantiles from 0.2 up to 0.6, they turn insignificant for higher quantiles (those above 0.7). This suggests that financial inclusion increases the efficiency of more efficient banks up to a certain point. In other words, the middle-tier efficient banks tend to benefit more from financial inclusion, whereas the top-tier efficient banks do not engage in serving the low-end customers.

So far, we have used the real GDP growth rate and the population growth rate as macro controls. Our results may also be influenced by the level of economic development, price stability, and the institutional development of a country in which the banks operate. Therefore, in addition to our usual macro controls, we check the robustness of our results using the logarithm of per capita GDP, a 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 rerun six truncated regression models. For brevity, we do not report these estimated results, but they are available upon request. The results show that even after controlling for all these macro variables, our main findings remain unchanged, that is, greater financial inclusion increases bank efficiency. Though all governance indicators have a positive association with bank efficiency, five of them (*Voice and accountability, Government effectiveness, Rule of law, Regulatory quality, and Control of corruption*, with the exception of *Political stability*) are significant at the 1% level, suggesting that stronger institutional development is necessary for enhancing bank efficiency.

4. Exploring channels

4.1. Volatility of customer deposits and bank return

Saving instruments are commonly used by poor households, as they are of great help for households in making payments and accumulating 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 a negative effect on bank efficiency. However, as banks have enormous opportunities to attract more customer deposits in an inclusive financial sector, one would expect bank efficiency to increase in such a market. To delineate this effect, we measure the standard deviation of customer deposit funding share (σ_{CDEP}) and include interactions between financial inclusion indicators and σ_{CDEP}. We re-run our augmented truncated regression model by adding an interaction term and σ_{CDEP} as an additional independent variable.

Panel A in Table 8 reports the results. In column 1, though the direct effect of σ_{CDEP} is negative and significant, the interaction term is positive and significant at the 1% level, indicating that banks operating in an inclusive financial sector are able to withstand the negative effects of σ_{CDEP} and can improve productive efficiency. These results are somewhat in tandem with the arguments made elsewhere that customer deposits are sluggish, insensitive to risks, and provide a stable and cheaper source of long-term funding (e.g., Calomiris and Kahn, 1991; Song and Thakor, 2007; Ahamed and Mallick, 2019), 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).

If banks operating in an inclusive financial sector are able to reduce reliance on costly wholesale funding because they have access to cheaper customer deposits, one would expect that in such setups, banks are also able to reduce their return volatility (σ_{roa}), and operate more efficiently. Using similar procedures as above,

Table 8
Exploring channels: volatility of customer 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, the dependent variable is EFF, which is the efficiency scores of banks measured using 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 product 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 the standard deviation of the share of customer deposits of total deposits and short-term funding (calculated using 3-year rolling windows). In Panel B, we use an interaction term of financial inclusion indicators and Return volatility (σ_{roa}). σ_{roa} is the standard deviation of the return-on-assets (calculated using 3-year rolling windows). ***, **, 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

we introduce 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 the 5% level, suggesting that banks operating in an inclusive financial sector are able to reduce their return volatility and become more efficient.

4.2. The role of bank regulation

We augment our baseline regression by adding the interaction terms of the FII and each of the two regulatory indicators discussed earlier. All control variables are analogous. For the sake of comparability and for economic significance, the regulatory variables included in the interaction terms are normalised to have a zero mean and unit variance. We present the results in Table 9. In general, even after introducing interaction terms, the relationship between financial inclusion and bank efficiency remains positive and significant. In column 1, the interaction of financial inclusion and activities restrictions is negative and statistically significant at the 1% level. It implies 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%. In 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. For both interaction terms, we plot the marginal effects of financial inclusion on bank efficiency, at different levels of regulation (see the online appendix Fig. OA1). It is plausible that in an inclusive financial sector, the diversified deposit base allows banks to comply with higher capital requirements, while increasing their risky investments that would yield higher return on those risky assets.

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

In this section, we exploit the timing variations of the developing countries that became signatories to a global policy initiative on financial inclusion and explore its effect on bank efficiency using the DID approach and matching estimators.

In response to the global financial crisis, the G20 leaders made a commitment at the Pittsburgh Summit in 2009. They aim to reduce the number of the world's unbanked adult population through improving access (for low-income groups) to formal financial services. At the summit, the G20 principles for innovative financial inclusion (GPIFI) were drafted by three Financial Inclusion Expert Groups: the Alliance for Financial Inclusion (AFI), the Consultative Group to Assist the Poor, and the World Bank's International Finance Corporation (Soederberg, 2013). To invigorate the GPIFI, the Maya Declaration (a global policy initiative) was signed

Table 9
The role of bank regulation in 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, the dependent variable is EFF, which is the efficiency scores of banks measured using DEA. The variables of interest are interaction term of *financial inclusion* and *regulatory 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 product 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

by many countries at the third Global Policy Forum of the AFI held in Riviera Maya, Mexico in 2011 (see the online appendix Table OA6 for details on the GPIFI and the Maya Declaration). The signatory countries of the Maya Declaration are required to make a formal measurable commitment to create an enabling environment for financial inclusion. In total, 40 countries signed the Maya Declaration commitments over the sample period (see Table B3 for membership timing across countries).

The signatory countries make specific commitments to create an enabling environment for inclusive financial development. They also share knowledge with each other via the AFI membership network. Once countries become the Maya signatory, they initiate supportive laws and regulations for an inclusive financial system (see the online appendix Table OA7 for the summary of the policy targets).

We assume that the pro-access policies that the Maya signatory countries started have had an obvious effect on the efficient functioning of banks.[12] 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 DID approach and explore whether the efficiency of banks operating in those countries has either increased or decreased due to enabling inclusive financial policies, as follows:

$$\text{Eff}_{\text{ijt}} = \alpha_0 + \alpha_{\text{j}} + \gamma\,(\text{Pro-access-policy})_{\text{jt}-1} + \beta_1 \text{BC}_{\text{ijt}} + \beta_2 \text{KC}_{\text{jt}} + \varepsilon_{\text{ijt}} \quad (7)$$

where i indexes bank and j denotes countries. Eff_{ijt} is operating efficiency. The analogous bank- and country-level controls are used as in Eq. (6) and 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 country listed in Table B3 in 2011 and thereafter, or zero otherwise.[13] The coefficient of interest is γ, which captures the sensitivity of the dependent variable to the Pro-access policy intervention (for details on this methodology, see Haselmann et al. (2010)). The advantage of the DID approach is that we are able to identify the effects of an event (in our case, the commitment to the Maya Declaration) on country groups that are affected by institutional settings (henceforth treated) with those that are not affected (henceforth control).

To consider the DID approach as meaningful, two aspects should be accounted for: homogeneous comparison groups and the changes in the efforts of improving financial inclusion as exogenous. The first issue has a 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, the question of whether changes of efforts of improving financial inclusion are exogenous or endogenous is a valid concern. We assume that developing countries, as part of the AFI's peer-learning networks, were able to share best practices in policy initiatives and innovative principles of financial inclusion, and thus adopted pro-access policies randomly. Different multilateral organisations such as the G20 and expert groups on financial inclusion e.g., AFI and World Bank, help create financial inclusion strategies in developing countries. For instance, Haiti's new financial inclusion strategy was drawn up with the help of the World Bank (EIU, 2015, p. 12). The World Bank's Financial Inclusion Support Framework (FISF) helped develop the National Financial Inclusion Strategies in Ethiopia, Mozambique, and Zambia. There are many such examples where developing countries are supported by international organisations. These examples illustrate both the exogenous nature as well as the randomness in implementing financial inclusion policies in developing countries. However, we would like to stress also that endogeneity is less of a concern for us as we study a bank-level outcome variable while policy change is at the country level (see Haselmann et al., 2010). An individual bank does not have the luxury or desire to opt in or out of the market for policy changes.

We are monitoring both country groups before and after the event as control and treated in this methodology. Therefore, 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). Studies that apply a similar approach include Koetter et al. (2012) on a cross-state setup for the US banking sector, and Haselmann et al. (2010) on East European countries.

Panel A in Table 10 reports the results of the DID estimation. They show that bank efficiency has increased following the Maya Declaration commitments. Particularly, as we control for country fixed effects in columns 1 and 2, we consider bank fixed effects

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

[13] To show further robustness of our results, we have used the Economist Intelligence Unit (EIU)'s microscope score instead of the pro-access policy indicator and re-run Eq. (7). We report the results in the Online Appendix Table OA8. The results show that the coefficient of the microscope score is positive and significant, even after controlling for country- or bank-fixed effects. It suggests that banks operating in countries that have higher levels of pro-access policy perform better in terms of bank efficiency.

Table 10
The impact of pro-active 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 commits 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.

Variables	Bank efficiency			
Panel A: Difference-in-differences	1	2	3	4
Pro-access policy	0.057***	0.029**	0.064***	0.025**
	[0.011]	[0.011]	[0.013]	[0.011]
LogTA		0.068***		0.069***
		[0.021]		[0.011]
LIQ		0.045*		0.024
		[0.025]		[0.019]
EQA		0.676***		0.375***
		[0.105]		[0.096]
LLP		-0.025		-0.165
		[0.280]		[0.177]
GDP		-0.319**		-0.349***
		[0.156]		[0.112]
Pop_gr		0.001		-0.001
		[0.004]		[0.005]
Constant	0.339***	-0.22	0.338***	-0.164**
	[0.002]	[0.150]	[0.003]	[0.081]
Observations	6,065	6,065	6,065	6,065
Adjusted R^2	0.364	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 Neighbor		Kernel	
Variables	1		2	
Average treatment effect	0.061***		0.019***	
S.E.	[0.015]		[0.007]	
t-stat	[4.191]		[2.929]	
No. of treated & control obs.	1,241 & 899		1,241 & 4,404	
Common support condition	Yes		Yes	

in columns 3 and 4. In all specifications, we use the analogous bank- and country-specific controls. In columns 1 and 2, the coefficient of *pro-access-policy* is positive and significant at the 1% significance level. Even controlling for bank fixed effects in columns 3 and 4, the results remain unchanged. The reason for the positive coefficient is due to innovative pro-access policies that signatory countries developed and implemented over the years, which have played an important role in the observed improvement in bank efficiency. It also indicates that increasing financial inclusion reduces the 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 have used bank/country fixed effects to control for bank- and country-level unobservables. This does not guarantee that our comparison group is handled appropriately 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 DID propensity score matching (PSM) approach to identify the effect of *pro-access-policy* on bank efficiency. Combining matching estimators with the DID technique is arguably the most appropriate approach to make a robust claim while alleviating any selection bias that ascertains a valid control group as counterfactual (Blundell and Dias, 2000).

In the first stage of the PSM, we estimate the likelihood of countries being treated (becoming a signatory to 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.[14] For this procedure, we consider two matching techniques, nearest neighbour and kernel matching, to calculate the average treatment effect for the treated.[15]

The results are reported in Panel B of Table 10 and are consistent with the earlier findings. In both matching estimators, we impose a common support condition to restrict control groups to fall within the support of the propensity score distribution of the treated groups. Taking the nearest neighbour matching result, we find that the average treatment effect of the *pro-access-policy* on bank efficiency is 0.061. The result of kernel matching is also posi-

[14] The balancing tests are satisfied and are available from the authors.

[15] The kernel matching estimator matches the treated units with the 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.

tive. These results once again reaffirm the positive relationship between financial inclusion and bank efficiency.

6. 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 evidence that banks in countries with a more inclusive banking sector tend to have higher levels of operating efficiency. This effect is particularly strong for banks operating in developing economies, and for those countries where the financial sector is less developed in terms of the private credit to GDP ratio. We also find that banking regulation plays an important role in the relationship between financial inclusion and bank performance, as the association is stronger in countries with stringent capital regulation and fewer restrictions on banking activities. Furthermore, we also exploit the timing variations of the developing countries that made measurable commitments to advancing inclusive financial development through innovative policies, and find a positive effect of such pro-access-policy on bank efficiency in a DID setting.

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

The results are robust, even when we use the sample of developing economies only, employ an IV analysis, control for unobserved bank heterogeneity, consider the sub-samples of economic and financial development, and estimate across the efficiency distribution. For all these alternative setups, we find that greater financial inclusion increases the level of bank efficiency. Our findings suggest that a financial system, which provides easier access to finance, increases efficiency in the financial intermediation of banks, and hence makes them more operationally efficient. We conclude that financial inclusion is an important policy lever to bring more people into the formal economy and to concurrently develop an environment for efficient financial operations.

The policy implications of our results are manifold. The greater the banked population, the higher the bank efficiency in the developing countries; hence policymakers should introduce policies that are conducive for access to finance, ensuring efficient financial intermediation. They should make continuous efforts to provide a regulatory environment that is supportive of bringing about inclusive financial development and thus improve bank performance.

Although it is well documented in the development literature that financial inclusion promotes development, in this paper we attempted to combine it with the banking literature to establish a robust link between financial inclusion and bank performance. This paper therefore shows an explicit link between country-level financial inclusion and bank-level performance improvement through the deposit channel. As long as banks embrace inclusion by widening access with an aim to mobilise deposit funds without having any immediate loan exposure to these customers, such process of inclusion will be beneficial for banks as shown in this paper. As more data covering both the supply- and demand-side become available, other dimensions of financial inclusion can be incorporated into the construction of a composite index to explore the relationship further between inclusive finance and bank performance.

Declaration of Competing Interest

We confirm that it is our original unpublished research and we had no external funding to undertake this research.

Also we declare that we have no relevant or material financial interests that relate to the research described in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jbankfin.2021.106055.

Appendix A. The analytical model

We consider a modified spatial model to incorporate firm heterogeneity and customer's locational preferences for banking services (see Ali and Greenbaum, 1977, Chiappori et al., 1995, Ho and Ishii, 2011). Banks are different in their locations and in efficiency level. We assume that there is a continuum of potential consumers who are uniformly distributed on a street and have different wealth endowments, which are not fully observed by banks.

Before inclusive banking, only customers with sufficient "observable" wealth (as collaterals) are able to open an account and apply for a loan. With inclusive banking, every potential consumer can open an account, which allows the bank to retrieve information about their endowments, although there could also be more agency costs with these previously excluded customers. The bank will benefit from the increases in deposits from these customers, and the customers have the chance to earn interest or to apply for a loan.

We first characterize the equilibrium of the industry before inclusive banking and before regulating bank activities and capital adequacy ratio (CAR) (see Barth et al., 2013). Then we analyze how these two regulations can affect bank efficiency. Finally, we examine the impact of inclusive banking and its interaction effects with the two regulations considered here on bank efficiency.

A.1. Before Inclusive Banking

Following the literature, we assume that there are two banks: A and B, located on points a and b of a unit street with $0 < a < b < 1$. There is a continuum of potential customers located uniformly on [0,1], and let $x \in [0,\ 1]$ denote a customer who is located at point x. Each potential customer is endowed with an observable wealth ϖ and a privately known random income ε^{ϖ}. For simplification, we assume that ϖ is uniformly distributed over $[0,\ 1]$. The privately known income ε^{ϖ} can be interpreted as the harvest from crops, which due to weather uncertainty is uniformly distributed over $[-1,\ 1]$ with a mean 0.

A.1.1. Customer's Payoff

A customer with a total wealth $(\varpi + \varepsilon^{\varpi})$ will keep her wealth at home if there is no access to banking. On the other hand, if she deposits her wealth in a bank, she needs to calculate the expected return and the transaction cost associated with the customer's locational difference with the bank.

Specifically, let θ and $(1-\theta)$ be a customer's weight on her locational preference and the expected return from depositing, respectively. First, for customer located at x, the locational preference for depositing in bank A is $-\delta|x-a|$, and the locational preference for depositing in bank B is $-\delta|x-b|$. This setup implies that, *ceteris paribus*, customers prefer depositing with nearby banks.

Second, once opening an account, a customer has two options and therefore two possible returns. (1) She can keep all her wealth $(\varpi + \varepsilon^{\varpi})$ in the bank and earn interest, provided that the bank does not go bankrupt. Let P_a and P_b be bank A and B's survival

probabilities. This is the probability that a bank's profit remains positive (see Freixas and Rochet, 1997, p.24). As will be demonstrated, the bank efficiency is positively related to a bank's profit, and hence P_i is positively related to bank i's efficiency. In sum, a customer's expected payoff for this case is $P_i(1+r_i)(\varpi+\varepsilon^{\varpi})$, where r_i is bank i's interest rate.

(2) She can borrow L, invest in a risky project and gain $[E(\rho)-(1+\varphi)]L$. Here $E(\rho)$ is the expected rate of return from investment and φ is the interest charged for this loan L. Without loss of generality, we assume that this loan is greater than a customer's wealth $\varpi+\varepsilon^{\varpi}$. To simplify notations, let V_i be the maximum of these two payoffs, where

$$V_i(\varpi+\varepsilon^{\varpi}) \equiv \max\{P_i(1+r_i)(\varpi+\varepsilon^{\varpi}), [E(\rho)-(1+\varphi)]L+\varpi+\varepsilon^{\varpi}\}. \quad \text{(A1)}$$

Notice that during the financial crisis, the expected return from risky investments will be relatively low, and customers tend to keep their money with the bank. That is, when $E(\rho)$ is low, we have $V_i(\varpi+\varepsilon^{\varpi}) \equiv P_i(1+r_i)(\varpi+\varepsilon^{\varpi})$.

Overall, a customer's payoff for opening an account in bank $i=A,B$ is:

$$(1-\theta)V_i(\varpi+\varepsilon^{\varpi})-\theta\{\delta|x-i|\},\ i=a,b.$$

To have a non-trivial result, we assume that this value is higher than the endowments $\varpi+\varepsilon^{\varpi}$, so that every potential customer has the incentive to access banking.

A.1.2. Banks' Deposits

For simplification, we assume that before inclusive banking, only customers with sufficient "observable" wealth are able to open an account and apply for a loan. In our setup, only customers with observable wealth $\varpi>\underline{\varpi}$ can open an account. This wealth restriction $\underline{\varpi}$ is the required collateral for lending a fixed loan L. Hence, before inclusion, only $(1-\underline{\varpi})$ of potential customers can open an account.

For every $\varpi>\underline{\varpi}$, there exists a customer $\hat{x}$ who is indifferent between depositing in bank A and B; namely,

$$(1-\theta)V_a(\varpi+\varepsilon^{\varpi})-\theta\delta\left(\widehat{x}-a\right) = (1-\theta)V_b(\varpi+\varepsilon^{\varpi})-\theta\delta\left(b-\widehat{x}\right).$$

Hence

$$\hat{x}=\frac{(1-\theta)}{2\theta\delta}[V_a(\varpi+\varepsilon^{\varpi})-V_b(\varpi+\varepsilon^{\varpi})+(b-a)].$$

It is obvious that $\hat{x}$ increases with $V_a(\varpi+\varepsilon^{\varpi})$ and b, and decreases with $V_b(\varpi+\varepsilon^{\varpi})$ and a.

Therefore, there will be a proportion $\hat{x}$ of the customers with $\varpi>\underline{\varpi}$ who will deposit in bank A, and $(1-\widehat{x})$ of customers will deposit in bank B. In other words, let D_i^0 denote bank i's deposit before inclusive banking, and we have $D_a^0=(1-\underline{\varpi})\widehat{x}$, and $D_b^0=(1-\underline{\varpi})(1-\widehat{x})$.

A.1.3. Banks' Payoffs

After receiving the deposit, each bank makes a portfolio choice between risky and safe assets. To simplify, let I_i denote bank i's investment in risky assets, and let L_i be the total sum of loans made to their customers. Bank i's expected return will be:

$$\pi_i=\int_1\{(1+R)I_i\}dF(R)+\bar{P}(1+\varphi)L_i+\left(D_i^0-I_i-L_i\right)-c\left(D_i^0\right).$$

The first term is the expected return from risky investment I_i, and R is the rate of return and we assume that the distribution of R is $F(R)$. The second term is the expected return from making loans to customers, where $\bar{P}$ is the probability that $E(\rho)\geq(P_i(1+r_i)-1)(\varpi+\varepsilon^{\varpi})/L+(1+\varphi)$, when depositors choose to borrow L from the bank. The third term is the return for safe asset whose return is normalized to be one. Finally, there is a convex cost function for managing the deposit $c(D_i^0)$.

Following Li et al. (2001), Marcus (2001), Forster and Shaffer (2005), and Liebscher (2005), the bank efficiency ratio is defined as the ratio of 'non-interest expenses divided by revenue', that is,

$$c_i\left(D_i^0\right)/\left\{\int_R\{(1+R)I_i\}dF(R)+\bar{P}(1+\varphi)L_i+\left(D_i^0-I_i-L_i\right)\right\}. \quad \text{(A2)}$$

As π_i increases, this ratio will decrease and the bank efficiency will increase. Likewise, as D_i^0 increases, if the marginal cost $c'(D_i^0)$ is relatively small, then the bank efficiency will increase.

A.1.4. Impact of Regulations

With this framework, we can provide a simple analysis on the impacts of regulations on banking activities and on CAR. First, according to Barth et al. (2013), regulations on bank activities include: (a) underwriting, brokering and dealing in securities, and all aspects of the mutual fund industry; (b) insurance underwriting and selling; and (c) real estate investment, development and management.

Prohibiting these activities will reduce the investment risk and the expected return. Hence in our setup, let $F^r(R)$ be the return distribution associated with regulations on these activities. The mean of $F^r(R)$ is smaller than the mean of $F(R)$, and hence the term $\int_R\{(1+R)I_i^r\}dF^r(R)$ is smaller than $\int_R\{(1+R)I_i\}dF(R)$. Since the mean of $F^r(R)$ is smaller, the investment in risky asset I_i^r is smaller under regulations. Although more restrictions on activities can reduce the expected return of risky assets, they will increase the holding of safe assets. Thus from Eq. (A2), we expect that the efficiency ratio can either increase or decrease, and hence the bank efficiency can decrease or increase under the regulations on bank activities.

Second, under Basel III,[16] the minimum CAR that banks must maintain is 8%. The CAR measures a bank's capital in relation to its risk-weighted assets. In our terminology,

$$\bar{P}(1+\varphi)L_i+\left(D_i^0-I_i-L_i\right)/\int_R\{(1+R)I_i\}dF(R)\geq 8\%,$$

or,

$$\int_R\{(1+R)I_i\}dF(R)\leq 12.5\left\{\bar{P}(1+\varphi)L_i+\left(D_i^0-I_i-L_i\right)\right\}.$$

In this case, there will be an upper bound on the risky investment I_i^0, given by

$$\int_R\left\{(1+R)I_i^0\right\}dF(R)+12.5I_i^0=12.5\left(\bar{P}(1+\varphi)L_i+\left(D_i^0-L_i\right)\right).$$

For further use, note that I_i^0 will increase with D_i^0.

If this upper bound is binding, then the bank's risky investment will be cut down to I_i^0. From Eq. (A2), we expect that the efficiency ratio will increase, implying a decline in bank efficiency under the regulations on CAR. We have the following result regarding the impact of the two regulations.

Proposition A1. The regulations on bank activities can increase or decrease bank efficiency, and the regulations on CAR will reduce bank efficiency.

Since inclusive banking will change each bank's received deposits (i.e., D_i^0), there can be interactive effects which we will discuss next.

[16] The Basel Committee on Banking Supervision published the first version of Basel III in late 2009.

A.2. With Inclusive Banking

With inclusive banking, every potential customer including those with $\varpi < \underline{\varpi}$ is now able to open an account. Since these customers are not eligible to borrow as their observable wealth is not enough for collaterals, they can only deposit and earn interest (in the beginning). In this case, $V_i(\varpi + \varepsilon^{\varpi}) \equiv P_i(1 + r_i)(\varpi + \varepsilon^{\varpi})$ in Eq. (A1). Hence for customers with $\varpi < \underline{\varpi}$, there exists a customer $\bar{x}$ who is indifferent between depositing in bank A and B, and

$$\bar{x} = \frac{(1-\theta)}{2\theta\delta}[P_a(1+r_a)(\varpi+\varepsilon^{\varpi}) - P_b(1+r_b)(\varpi+\varepsilon^{\varpi})] + (b-a). \tag{A3}$$

It is obvious that $\bar{x}$ increases with P_a, r_a, b and decreases with P_b, r_b, a.

In other words, there will be a proportion $\bar{x}$ of the customers with $\varpi < \underline{\varpi}$ who will deposit in bank A, and $(1 - \bar{x})$ of these customers will deposit in bank B. Hence with inclusive banking, there will be an increase ΔD_i in bank *i's* deposit, where $\Delta D_a = \underline{\varpi}\bar{x}$, and $\Delta D_b = \underline{\varpi}(1 - \bar{x})$.

A.2.1. Without Regulations

First, the deposit increase (i.e., ΔD_i) will vary with a bank's survival probability and the bank efficiency. If $P_a > P_b$ and if P_a is sufficiently high such that $\bar{x} > 1$, then there is no deposit increase in the inefficient bank after inclusive banking. In this case, the inefficient bank may not benefit from inclusive banking. Alternatively, if P_a is not so high such that $\bar{x} < 1$, then it follows from Eq. (A3) that $\Delta D_a > \Delta D_b$. That is, the deposit increase in efficient bank is higher after inclusive banking

However, as deposits increase from D_i^0 to $D_i^0 + \Delta D_i$, the total amount of loan made to the customers remains the same (because customers with $\varpi < \underline{\varpi}$ are not eligible for borrowing), and hence the denominator of the efficiency ratio will increase. Since $\Delta D_a > \Delta D_b$, the increase in bank A's denominator is higher than that of bank B.

Second, more customers may also increase the agency costs and the operation costs. If more efficient banks also own better skills in investigation (so that $c_a' < c_b'$), then the increase in bank A's operation cost will be lower after banking inclusiveness. Together with the increase in the denominator, we have the following results.

Proposition A2. (1) Inclusive banking increases the efficiency of more efficient banks; (2) If the increase in agency cost is sufficiently high, then inclusive banking may reduce the efficiency of inefficient banks.

Finally, we examine the impacts from the financial crisis. During the financial crisis, the expected return from risky investment is relatively low, and customers tend to keep their money with the bank. That is, when $E(\rho)$ is low, we have $V_i(\varpi + \varepsilon^{\varpi}) \equiv P_i(1 + r_i)(\varpi + \varepsilon^{\varpi})$. Hence, following our argument in Proposition A2, inclusive banking will benefit the efficient bank more, and the efficient bank's efficiency will increase, during the financial crisis.

Corollary A3. During the financial crisis, inclusive banking will benefit the efficient bank more, and the efficient bank's efficiency will increase.

A.2.2. With Regulations

Proposition A1 describes that the regulations on bank activities can increase or reduce bank efficiency and the regulations on CAR will reduce bank efficiency, while Proposition A2 says that inclusive banking will increase the efficient bank's efficiency, and may reduce the inefficient bank's efficiency if the increase in agency cost is sufficiently high. The net effects on bank efficiency will depend on the relative magnitudes of these two effects.

Nevertheless, we can provide some results on the interaction effects. First, recall that restricting bank activities will reduce the expected return, and hence we replace $F(R)$ with $F^r(R)$, whose mean is smaller. This will also reduce bank investment in risky assets. Inclusive banking will increase deposits from D_i^0 to $D_i^0 + \Delta D_i$, but the restrictions on bank activities will impede the efficient usage (investment) of the additional fund, thus may reduce bank efficiency

Second, as we noted earlier that with regulations on CAR, the upper bound of risky investment I_i^0 will increase with D_i^0. So, when the deposit increases to $D_i^0 + \Delta D_i$, the upper bound for risky investment will increase, and hence the reduction in bank efficiency will be lessened.

Proposition A4. (1) Regulations on bank activities may decrease the positive effect of inclusive banking. (2) Inclusive banking will lessen the negative effect of CAR regulation.

Appendix B

Table B1
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; 2008a; 2013)
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 Basel 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 indicate greater stringency.	Barth et al. (2004; 2008a; 2013)
Instrumental variables		
Share of informal economy	Share of informal economy as percentage of GDP	Medina and Schneider (2018)
Woman's-ability-to-work	Can a woman legally get a job or pursue a trade or profession in the same way as a man?	Women, Business and the Law Database

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

Table B2
The effect of global financial inclusion on bank efficiency
This table reports the results of truncated regression based on Simar and Wilson (2007), Algorithm 1. In all columns, dependent variable is *EFF*. As financial inclusion indicator, we used two demand-side measures of financial inclusion (i.e., *Account* and *Saved*) extracted from Global Findex Database of the World Bank. Since Global Findex indicators are available only for two survey waves of years 2011 and 2014, we, first, collapsed our data for the period 2004-11, and then for the period 2012-14 in order to have two data points for each bank for the period 2011 and 2014, respectively. Instead of running regression on the whole sample period, we run truncated regression model using averaged values of these two periods. In this table, the only difference is that we use demand-side measure of financial inclusion in lieu of our earlier supply-side measures of financial inclusion 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. All bank-specific controls are from BankScope. The macro controls are: *GDP* is the real growth rate of gross domestic product 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 Global Findex Database of the World Bank.

Dependent variable: **EFF** Variables	Adults with an account at a formal financial institution to total adults (%) 1	Adults saving at a financial institution in the past year to total adults (%) 2
Global Findex	0.001***	0.001***
	[0.000]	[0.000]
LogTA	0.061***	0.063***
	[0.002]	[0.002]
LIQ	0.023***	0.028***
	[0.007]	[0.007]
EQA	0.523***	0.539***
	[0.045]	[0.036]
LLP	0.064	0.072
	[0.151]	[0.139]
GDP	0.004***	-0.001
	[0.001]	[0.001]
Pop_gr	0.015***	0.011***
	[0.002]	[0.002]
Constant	-0.277***	-0.229***
	[0.020]	[0.015]
Observations	3,678	3,678
# of countries	105	105
Year	Yes	Yes

Table B3
The timing of the countries that signed the Maya Declaration.

Country	Year	Country	Year	Country	Year	Country	Year
Armenia	2012	Fiji	2011	Malaysia	2012	Paraguay	2011
Bangladesh	2012	Ghana	2012	Mexico	2011	Peru	2011
Brazil	2011	Guatemala	2012	Mongolia	2012	Philippines	2011
Burundi	2011	Guinea	2011	Morocco	2013	Rwanda	2011
Chile	2012	Honduras	2014	Mozambique	2012	Samoa	2013
Colombia	2012	Indonesia	2012	Namibia	2012	Tonga	2015
Congo	2012	Kenya	2011	Nepal	2013	Trinidad And Tobago	2013
Costa Rica	2015	Liberia	2013	Pakistan	2011	Uganda	2011
Ecuador	2012	Madagascar	2013	Panama	2013	United Republic Of Tanzania	2011
El Salvador	2013	Malawi	2011	Papua New Guinea	2013	Zambia	2011

Source: http://www.afi-global.org/afi-network/members
Note: the years indicate when a country made a commitment to the Maya Declaration to take measurable steps towards having an inclusive financial system. 40 developing countries made explicit commitments to the Maya Declaration in our sample period.

References

Aghion, P., Howitt, P., Mayer-Foulkes, D., 2005. The effect of financial development on convergence: theory and evidence. Q. J. Econ. 120 (1), 173–222.
Ahamed, M.M., Mallick, S.K., 2019. Is financial inclusion good for bank stability? international evidence. J. Econ. Behav. Org. 157, 403–427.
Ali, M.M., Greenbaum, S.I., 1977. A spatial model of the banking industry. J. Finance 32 (4), 1283–1303.
Allen, F., Carletti, E., Cull, R., Senbet, L., Valenzuela, P., 2014. The African financial development and financial inclusion gaps. J. African Econ. 23 (5), 614–642.
Allen, F., Demirguc-Kunt, A., Klapper, L., Peria, M.S.M., 2016. The foundations of financial inclusion: understanding ownership and use of formal accounts. J. Financ. Intermed. 27(C), 1–30.
Arcand, J.L., Berkes, E., Panizza, U., 2015. Too much finance? J. Econ. Growth 20 (2), 105–148.
Assaf, A.G., Barros, C.P., Matousek, R., 2011. Productivity and efficiency analysis of Shinkin banks: Evidence from bootstrap and Bayesian approaches. J. Bank. Finance 35 (2), 331–342.
Aterido, R., Beck, T., Iacovone, L., 2013. Access to finance in Sub-Saharan Africa: is there a gender gap? World Dev. 47, 102–120.
Ayadi, R., Naceur, S.B., Casu, B., Quinn, B., 2016. Does Basel compliance matter for bank performance? J. Financ. Stabil. 23, 15–32.
Barth, J.R., Caprio, G., Levine, R., 2008a. Rethinking bank regulation: Till angels govern. Cambridge University Press.
Barth, J.R., Caprio, G., Levine, R., 2008b. Bank regulations are changing: For better or worse. Compar. Econ. Stud. 50 (4), 537–563.
Barth, J.R., Caprio, G.J., Levine, R., 2013. Bank Regulation and Supervision in 180 Countries from 1999 to 2011. J. Financ. Econ. Policy 5 (2), 111–219.
Barth, J.R., Caprio Jr, G., Levine, R., 2004. Bank regulation and supervision: what works best? J. Financ. Intermed. 13 (2), 205–248.
Barth, J.R., Lin, C., Ma, Y., Seade, J., Song, F.M., 2013. Do bank regulation, supervision and monitoring enhance or impede bank efficiency? J. Bank. Finance 37 (8), 2879–2892.
Beck, T., Demirgüç-Kunt, A., Martínez Pería, M.S., 2007. Reaching out: Access to and use of banking services across countries. J. Financ. Econ. 85 (1), 234–266.
Beck, T., Levine, R., Loayza, N., 2000. Finance and the Sources of Growth. J. Financ. Econ. 58 (1), 261–300.
Beck, T., Lin, C., Ma, Y., 2014. Why do firms evade taxes? The role of information sharing and financial sector outreach. J. Finance 69 (2), 763–817.
Bekaert, G., Harvey, C.R., Lundblad, C., 2005. Does financial liberalization spur growth? J. Financ. Econ. 77 (1), 3–55.
Beltratti, A., Stulz, R.M., 2012. The credit crisis around the globe: Why did some banks perform better? J. Financ. Econ. 105 (1), 1–17.
Berger, A.N., DeYoung, R., 2001. The effects of geographic expansion on bank efficiency. J. Financ. Serv. Res. 19 (2-3), 163–184.
Blundell, R., Dias, M.C., 2000. Evaluation methods for non-experimental data. Fiscal Stud. 21 (4), 427–468.
Bos, J.W., Kolari, J.W., 2005. Large Bank Efficiency in Europe and the United States: Are There Economic Motivations for Geographic Expansion in Financial Services?*. J. Bus. 78 (4), 1555–1592.
Boyd, J.H., Chang, C., Smith, B.D., 1998. Moral hazard under commercial and universal banking. J. Money Credit Bank. 426–468.
Brickley, J.A., Linck, J.S., Smith Jr, C.W., 2003. Boundaries of the firm: evidence from the banking industry. J. Financ. Econ. 70 (3), 351–383.
Calomiris, C.W., Kahn, C.M., 1991. The role of demandable debt in structuring optimal banking arrangements. Am. Econ. Rev. 497–513.
Chiappori, P.-A., Perez-Castrillo, D., Verdier, T., 1995. Spatial competition in the banking system: Localization, cross subsidies and the regulation of deposit rates. Eur. Econ. Rev. 39 (5), 889–918.
Chortareas, G.E., Girardone, C., Ventouri, A., 2013. Financial freedom and bank efficiency: Evidence from the European Union. J. Bank. Finance 37 (4), 1223–1231.
Collins, D., Morduch, J., Rutherford, S., Ruthven, O., 2009. Portfolios of the poor: how the world's poor live on $2 a day. Princeton University Press.
Czarnitzki, D., Toole, A.A., 2011. Patent protection, market uncertainty, and R&D investment. Rev. Econ. Stat. 93 (1), 147–159.
Demirgüç-Kunt, A., Huizinga, H., 2010. Bank activity and funding strategies: the impact on risk and returns. J. Financ. Econ. 98 (3), 626–650.
Demirgüç-Kunt, A., Klapper, L.F., Singer, D., 2013. Financial inclusion and legal discrimination against women: evidence from developing countries. World Bank Policy Research Working Paper(6416).
Deng, S.E., Elyasiani, E., 2008. Geographic diversification, bank holding company value, and risk. J. Money Credit Bank. 40 (6), 1217–1238.
Drake, L., Hall, M.J., Simper, R., 2006. The impact of macroeconomic and regulatory factors on bank efficiency: A non-parametric analysis of Hong Kong's banking system. J. Bank. Finance 30 (5), 1443–1466.
EIU, 2015. Global microscope 2015: the enabling environment for financial inclusion, the Economist Intelligence Unit.
Forster, J., Shaffer, S., 2005. Bank efficiency ratios in Latin America. Appl. Econ. Lett. 12 (9), 529–532.
Freixas, X., Rochet, J.-C., 1997. Microeconomics of Banking. MIT Press, Cambridge, MA 9.
Fries, S., Taci, A., 2005. Cost efficiency of banks in transition: Evidence from 289 banks in 15 post-communist countries. J. Bank. Finance 29 (1), 55–81.
Grabowski, R., Rangan, N., Rezvanian, R., 1993. Organizational forms in banking: An empirical investigation of cost efficiency. J. Bank. Finance 17 (2), 531–538.
Greene, W., 2004. Fixed effects and bias due to the incidental parameters problem in the Tobit model. Econometric Rev. 23 (2), 125–147.
Halkos, G.E., Tzeremes, N.G., 2013. Estimating the degree of operating efficiency gains from a potential bank merger and acquisition: A DEA bootstrapped approach. J. Bank. Finance 37 (5), 1658–1668.
Han, R., Melecky, M., 2013. Financial inclusion for financial stability: access to bank deposits and the growth of deposits in the global financial crisis. World Bank Policy Research Working Paper(6577).
Haselmann, R., Pistor, K., Vig, V., 2010. How law affects lending. Rev. Financ. Stud. 23 (2), 549–580.
Ho, K., Ishii, J., 2011. Location and competition in retail banking. Int. J. Ind Organiz. 29 (5), 537–546.
Huang, R., Ratnovski, L., 2011. The dark side of bank wholesale funding. J. Financ. Intermed. 20 (2), 248–263.
Imbens, G.W., Wooldridge, J.M., 2009. Recent Developments in the Econometrics of Program Evaluation. J. Econ. Lit. 47 (1), 5–86.
Jappelli, T., Pagano, M., 1994. Saving, growth, and liquidity constraints. Q. J. Econ. 83–109.
Jayaratne, J., Strahan, P.E., 1996. The finance-growth nexus: Evidence from bank branch deregulation. Q. J. Econ. 639–670.
Kacperczyk, M., Schnabl, P., 2013. How Safe are Money Market Funds? Q. J. Econ. 128 (3), 1073–1122.
Kaufmann, D., Kraay, A., Mastruzzi, M., 2010. The worldwide governance indicators: a summary of methodology, data and analytical issues. World Bank Policy Research Working Paper 5430.
King, R.G., Levine, R., 1993. Finance and growth: Schumpeter might be right. Q. J. Econ. 717–737.
Koenker, R., Bassett, G., 1978. Regression quantiles. Econometrica 46, 33–50.
Koetter, M., Kolari, J.W., Spierdijk, L., 2012. Enjoying the quiet life under deregulation? evidence from adjusted Lerner indices for US banks. Rev. Econ. Stat. 94 (2), 462–480.
Laeven, L., Levine, R., 2009. Bank governance, regulation and risk taking. J. Financ. Econ. 93 (2), 259–275.
Law, S.H., Singh, N., 2014. Does too much finance harm economic growth? J. Bank. Finance 41, 36–44.

Levine, R., 1999. Law, finance, and economic growth. J. Financ. Intermed. 8 (1), 8–35.
Levine, R., 2005. Finance and growth: theory and evidence. In: Handbook of economic growth, 1. Elsevier, Amsterdam, pp. 865–934 P. Aghion and S. Durlauf..
Li, S., Liu, F., Liu, S., Whitmore, G., 2001. Comparative performance of Chinese commercial banks: Analysis, findings and policy implications. Rev. Quant. Finance Account. 16 (2), 149–170.
Liebscher, K., 2005. Overview of financial services in Austria. BIS Rev. 47, 1–5.
Marcus, G., 2001. An approach to the consideration of bank merger issues by regulators: a South African case. BIS Papers 4, 133–147.
McDonald, J., 2009. Using least squares and tobit in second stage DEA efficiency analyses. Eur. J. Oper. Res. 197 (2), 792–798.
Medina, L., Schneider, F., 2018. Shadow economies around the world: what did we learn over the last 20 years? IMF Working Paper WP/18/17. IMF.
Mehran, H., Thakor, A., 2011. Bank capital and value in the cross-section. Rev. Financ. Stud. 24 (4), 1019–1067.
Mehrotra, A.N., Yetman, J., 2015. Financial inclusion-issues for central banks. BIS Q. Rev. March.
Papke, L.E., Wooldridge, J.M., 1996. Econometric methods for fractional response variables with an application to 401 (k) plan participation rates. J. Appl. Econometrics 11 (6), 619–632.
Poghosyan, T., Čihak, M., 2011. Determinants of bank distress in Europe: Evidence from a new data set. J. Financ. Serv. Res. 40 (3), 163–184.
Rosenbaum, P.R., Rubin, D.B., 1983. The central role of the propensity score in observational studies for causal effects. Biometrika 70 (1), 41–55.
Rossi, S.P., Schwaiger, M.S., Winkler, G., 2009. How loan portfolio diversification affects risk, efficiency and capitalization: a managerial behavior model for Austrian banks. J. Bank. Finance 33 (12), 2218–2226.
Sahay, R., Čihák, M., N'Diaye, P., Barajas, A., 2015. Rethinking financial deepening: stability and growth in emerging markets. IMF Staff Discussion Note, SDN/15/08, May.
Sealey, C.W., Lindley, J.T., 1977. Inputs, outputs, and a theory of production and cost at depository financial institutions. J. Finance 32 (4), 1251–1266.
Simar, L., Wilson, P.W., 2007. Estimation and inference in two-stage, semi-parametric models of production processes. J. Econometrics 136 (1), 31–64.
Soederberg, S., 2013. Universalising Financial Inclusion and the Securitisation of Development. Third World Q. 34 (4), 593–612.
Song, F., Thakor, A.V., 2007. Relationship banking, fragility, and the asset-liability matching problem. Rev. Financ. Stud. 20 (6), 2129–2177.
Wurgler, J., 2000. Financial markets and the allocation of capital. J. Financ. Econ. 58 (1), 187–214.