Is financial inclusion good for bank stability? International evidence

By

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ABSTRACT

This paper offers a first empirical investigation on the complementary effect of inclusive finance on soundness of individual banks. Using a unique database of financial access survey, we construct a composite index of financial inclusion for 87 countries over the period 2004 to 2012, and then investigate a new research question as to whether the global policy drive towards greater financial inclusion is good for bank stability in a sample of 2,913 banks. We find that higher level of financial inclusion leads to greater bank stability. This complementary effect is more pronounced when banks have higher market power and operate in countries where political stability, rule of law, and regulatory environment are stronger. Exploiting cross-country and temporal variations in the timing of inclusive banking agenda, we show that enabling inclusive financial environment increases soundness of banks in the treated countries by 36%. Taking industry data, we also show that financial inclusion exerts disproportionately more positive effects on growth of small firms, and firms that rely more on external finance. Our results highlight that the importance of ensuring inclusive financial system is not only a development goal but also an issue that should be prioritised by banks as such a policy drive is good for their stability.

JEL Classification: G21; G28; O16
Keywords: Financial inclusion; Bank stability; Bank competition; Institutional quality; Economic growth.

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ABSTRACT

This paper offers a first empirical investigation on the complementary effect of inclusive finance on soundness of individual banks. Using a unique database of financial access survey, we construct a composite index of financial inclusion for 87 countries over the period 2004 to 2012, and then investigate a new research question as to whether the global policy drive towards greater financial inclusion is good for bank stability in a sample of 2,913 banks. We find that higher level of financial inclusion leads to greater bank stability. This complementary effect is more pronounced when banks have higher market power and operate in countries where political stability, rule of law, and regulatory environment are stronger. Exploiting cross-country and temporal variations in the timing of inclusive banking agenda, we show that enabling inclusive financial environment increases soundness of banks in the treated countries by 36%. Taking industry data, we also show that financial inclusion exerts disproportionately more positive effects on growth of small firms, and firms that rely more on external finance. Our results highlight that the importance of ensuring inclusive financial system is not only a development goal but also an issue that should be prioritised by banks as such a policy drive is good for their stability.

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"*What improves the circumstances of the greater part can never be regarded as inconveniency to the whole. No society can surely be flourishing and happy, of which by far the greater part of the numbers are poor and miserable*".

Adam Smith (1776)

1. Introduction

While the recent empirical literature provides evidence on the positive role of financial inclusion in promoting wellbeing of households and economic growth through extending access of the disadvantaged groups to basic financial services in the form of greater use of formal bank account and savings, little attention has been devoted to investigate whether such a development goal has ramifications on soundness of banks.[1,2] The most challenging issues for the financial institutions to facilitate access to finance are the high operating costs and the risk associated with

[1] See, for example: Wurgler (2000); Beck et al. (2000); Klapper et al. (2006); Demirgüç-Kunt et al. (2008); Demirgüç-Kunt et al. (2015); Burgess and Pande (2005), and Banerjee et al. (2013), in India; Bruhn and Love (2009), and Bruhn and Love (2014), in Mexico; Karlan and Zinman (2010), in South Africa; Dupas and Robinson (2009), in Kenya.
[2] The degree of financial intermediation causally impacts economic growth and employment (see a survey in Pasalı, 2013).

servicing, monitoring and administering loans to individual households and small and medium enterprises (SMEs) who often lack required documentations, collaterals and credit histories (e.g., Conning, 1999; Demirgüç-Kunt et al., 2008, henchforth DBH; Hermes et al., 2011). Broadening access of the low income groups to formal financial services has therefore always been perceived as an antagonistic strategy, which might dampen the performance of banks.[3] Using a large sample of bank-level data on 2913 banks across 87 countries over the period 2004 to 2012, this paper focuses on a specific dimension of financial development–financial sector inclusiveness–and an important regulatory issue at the micro level–bank stability, and supports the opposing view that inclusive finance and bank performance are indeed complementary, employing a range of parametric and semi-parametric methods.[4]

In recent years, formal financial institutions are increasingly searching for new opportunities and markets, and seeing the benefits of micro-finance style of operations.[5] Since formal financial institutions have superior scale, skill and technological capacity (Peachy and Roe, 2006; DBH, 2008; Beck et al., 2011), many of them have extended their networks towards poor households and SMEs for higher profitability (Hermes et al., 2011). By exploiting technological advancements they can provide basic financial services to a large number of customers especially, those on the lower rung of the income ladder potentially at a reduced cost. With supportive regulatory environment, by exploiting scale economies banks can not only ease financial constraints to marginalised groups and small firms, but also reduce risk and become more profitable at the same time (see e.g., De la Torre et al., 2010; Montgomery and Weiss, 2011).

Since financial exclusion has been identified by policy makers as a key barrier to development globally, expanding banking services to people has been prioritised by governments to make financial inclusion a reality (Demirgüç-Kunt et al., 2015). Over the past decades, the central banks both in emerging and developed countries have taken many initiatives in conjunction with many multilateral agencies including the IMF, G20, the Alliance for Financial Inclusion (AFI), and the Consultative Group to Assist the Poor (CGAP) to enhance the inclusive banking agenda (see DBH, 2008). Furthermore, in the last two decades, the banking sectors in the

[3] Recent study suggests that almost 2.5 billion adults, just over half of the world's adult population, do not use any form of formal financial services, where 19% and 72% of them are from developed and developing countries, respectively (Kendall et al., 2010).

[4] Throughout this paper, we use the term "bank performances" and "bank stability" interchangeably.

[5] See a detailed survey in Harper and Arora (2005) on why commercial banks are so much interested in micro-finance style of operations.

developing countries observed increasing presence of foreign-owned banks, which are more sophisticated and equipped to attract larger firms and high-net-worth individuals, making domestically owned banks to search for new markets that were previously underserved and/or excluded (See DBH, 2008, p.78).[6] At the same time, over the past decade, many countries have undertaken a large number of banking regulatory reforms (Barth et al., 2008), which perhaps have had a meaningful effect on levels of financial inclusion and hence on the soundness of financial institutions. Given the changed regulatory environment, it therefore would be interesting to investigate how financial inclusion impacts banking stability.

To our knowledge, there is no direct empirical evidence on the channels through which financial inclusion affects bank stability. Existing literature implicitly indicates several potential channels through which financial inclusion may influence soundness of banks or risk-taking (see Section 2). By reaching out to more customers, banks may garner ample cheap retail deposits while reducing reliance on volatile wholesale funding. They may have new opportunity to allocate necessary credits for more productive entrepreneurial activities while reducing distance with borrowers – reduced distance alleviates asymmetric information problems and aids banks to decrease default rates through underwriting sound loan contracts. Therefore, financial outreach– banks' branch network expansion, should influence the levels of bank stability.[7]

Despite the remarkable benefits of access to finance on financial development and hence to inclusive economic growth, there is no existence of empirical literature on the issues related to bank stability. Perhaps the most closely related paper is the seminal work by Beck et al. (2007b), henchforth BDM who investigate the determinants of financial sector outreach, and its role on firm's financing obstacles. They find that firms report less severe financing obstacles in countries with better outreach. More recently Beck et al. (2014b) investigate the link between bank branch outreach and firm's tax avoidance. The limited research in this area is somewhat obvious given the limitations of supply- and demand-side data availability on access. In addition, the lack of development of reliable quantitative index of financial inclusion hitherto restricts explicit analysis of the effects of inclusive financial systems on various aspects of bank performance.

[6] Using survey data for over 16,500 households, Beck and Brown (2014) show international evidence that foreign banks "cherry pick" financially transparent customers.

[7] More recently Goetz et al. (2015) show that the geographic expansion of bank holding company (BHC) across U.S. metropolitan statistical areas lowers BHC risk.

This study fills this gap and makes several contributions to the literature. First, while most of the empirical papers assess the effect of financial inclusion on various socio-economic indicators (e.g., Butler and Cornaggia, 2011; Allen et al., 2013; Demirgüç-Kunt et al., 2013a; Demirgüç-Kunt et al., 2013b), or use disaggregated single indicator of financial inclusion (e.g., BDM, 2007), this paper constructs a multidimensional index of financial inclusion at country level, and uses to see the effect on bank-level stability in a cross-country analysis, including developed, developing, and transition economies while controlling for bank-specific, country-specific, and institutional characteristics that one typically encounters in financial development literature. Our financial inclusion index has some advantages over the measures used in the literature. Specifically, we use IMF *Financial Access Survey* (FAS) dataset to construct a composite index of financial inclusion incorporating three different dimensions, such as accessibility, availability and usage that deem to have substantial impact on inclusiveness in the financial sector. As these dimensions are highly correlated with each other, we capture common variation among them using principal component analysis (PCA). Then, we develop an index of financial inclusion deriving weight of each dimension, which is useful because it can allow us to construct a composite index that enables comparison across countries minimising concerns about measurement error. The time series dimension of this index allows us to exploit within country variation in the inclusiveness of the financial sector, and explore the effect on bank stability in a systematic way. We also test the validity and robustness of our index using data from the World Bank global financial inclusion index (henceforth Global Findex) and World Bank Enterprise Surveys (WBES).

Second, addressing the impact of financial inclusion on bank stability is non-existent both in the academic and regulatory circles.[8] This paper is the first, to our knowledge, to address this research agenda in a cross-country setting to contribute to this contemporary policy issue related to financial development and financial inclusion using bank level data. Most of the evidences are either anecdotal[9] and/or use simple analyses at macro-level (e.g., Hannig and Jansen, 2010; Han and Melecky, 2013; Morgan and Pontines, 2014). Third, we use instrumental variable (IV) estimator to extract the exogenous component of financial inclusion while controlling for unobserved bank characteristics that might affect both financial inclusion and stability reducing

[8] Throughout this paper, we use the term "access-stability" and "financial inclusion-bank stability" synonymously.
[9] Tetangco, A., "Philippines CBG: the positive influence of financial inclusion", the Banker, October 1st 2013, http://www.thebanker.com/Comment/Viewpoint/Philippines-CBG-the-positive-influence-of-financial-inclusion?ct=true

concerns about endogeneity. Fourth, our paper contributes to the literature that explores the determinants of banking stability (e.g., Berger et al., 2009; Laeven and Levine, 2009; Houston et al., 2010; Beck et al., 2013; Anginer et al., 2014). Fifth, our study offers in-depth evidence on the impact of financial inclusion on banking stability for a large number of developed and developing countries over a longer period, during a period of global financial instability for which regulators were upbeat about broadening access of the marginalised groups to formal financial services while keeping bank's excessive risk taking at check, especially in the post crisis era. As from a supervisory and policy perspective it is important to understand whether broadening access of the isolated poor people to formal financial services is complementary or antagonistic to the soundness of banks, the results of this study should prove useful to researchers and policymakers alike.

Sixth, in the presence of greater bank competition, it is important to know whether financial inclusion can still promote average bank soundness. The cross-country nature of our dataset allows us to explore the role of bank competition and institutional environment on the access-stability relationship, which are of particular interest for policy. In countries with better quality of institutions, the effect of financial inclusion on bank stability is more pronounced, while in the presence of greater bank competition, inclusive banking is still beneficial for bank stability and therefore banks should embrace inclusive finance as promoted by policy makers around the world. Finally, we run an array of sensitivity checks using other proxies of financial inclusion, bank competition and stability, by executing alternative estimation approaches (panel data vs. cross section) and by employing different sample specifications, particularly running regression for the sample of developing countries. We also exploit cross-country and temporal variations in the timing of inclusive banking agenda, and unearth a causal evidence that enabling inclusive financial environment is good for bank stability using differences-in-difference approach. To alleviate any selection bias and confounding factors in the treatment effects, we also check the robustness of our results for matched samples using a range of matching estimators.

Finally, our study complements finance-growth literature. Since higher levels of financial inclusion are likely to influence overall supply of credit, it is likely to affect the level of growth of firms. Therefore, following the seminal work by Rajan and Zingales (1998), and a recent study of Beck et al. (2008), we shed some interesting insights into the channels through which greater financial inclusion alleviates financing obstacles of private firms, which in turn affect firm growth.

Inclusive financial sector may induce banks to allocate credit to small firms, and to firms in those industries that are in need of more external finance, which enhances overall economic growth.

Our results indicate that there is a strong link between financial inclusion and bank stability. In particular, the higher the degree of financial inclusion, the better the banks' performance is, in terms of reducing risks. The evidence also suggests that any beneficial effects of financial inclusion on bank stability tend to be more pronounced in banking sectors with less competition. As banks expand their operations towards areas that were previously underserved and/or excluded, they are able to reduce excessive risk taking when they have higher market power. We also investigate the influence of institutional settings on the access-stability relationship, and find that the institutional environment in which banks operate reinforces the complementarity effects of financial inclusion on soundness of banks. Specifically, greater freedom of expression, political stability, regulatory quality, and rule of law enhance the positive relationship between financial inclusion and bank stability.

As we derive our financial inclusion measure form the IMF's FAS dataset by using supply side data at the aggregate level, we have tried to add as many dimensions as possible to get a comprehensive picture of overall financial inclusion of a country, and we have checked the robustness of our results running the same regressions using different measures of financial inclusion, and found unambiguously similar results.

The remaining part of the paper is organised as follows: Section 2 talks about the dimensions of financial inclusion and discusses various channels through which inclusive financial sectors can affect soundness of banks. Section 3 describes the data and descriptive statistics and Section 4 outlines the empirical models. Section 5 discusses the empirical results with sensitivity analyses. Section 6 relates financial inclusion to the level of industry growth. Section 7 provides evidence on the inclusive banking agenda and bank stability, while Section 8 concludes with some policy implications.

2. Inclusive financial sector and its complementary effect on bank stability

We hypothesise that broadening access of all economic agents to formal financial services–greater financial inclusion–is likely to have important influence on the degree of bank stability. In this section, we introduce the various components of financial inclusion, which are

incorporated in the construction of composite index of financial inclusion and discuss their potential effects on bank stability.

2.1. Inclusive financial systems

In an inclusive financial sector, any member of the economy, irrespective of background, should enjoy the ease of access, availability, affordability, and usage of the basic financial services provided. While measuring an index of financial inclusion one should therefore incorporate as many dimensions as possible that should have an impact on inclusiveness of the financial sector. Information on various dimensions can be obtained from demand-side surveys, such as the Global Findex database, an individual-level database comprised of survey data collected over the 2011 calendar year covering more than 150,000 adults in 148 economies. Since the costs and collection of survey data are demanding, and the availability of such data for longer period is unreasonable, we therefore focus on supply-side data–FAS database–that were collected by BDM (2007) with the joint effort of World Bank for 2003-2004, and later on extended by the Consultative Group to Assist the Poor (CGAP) and by the IMF.

Using FAS database, we measure the index of Financial Inclusion for 87 countries for the period 2004 to 2012. In general, there is a consensus, at least from the regulator's perspective, that financial inclusion can be measured using four dimensions, namely the penetration/accessibility, availability, affordability, and usage. Given the data availability constraint, the variable we use for each dimension often requires proxies. For the penetration dimension, we use the number of bank accounts per 1,000 populations to integrate the depth of the financial access.[10] The availability dimension is used to account for the pervasiveness of outreach of the financial sector in terms of banks' physical outlets, as physical distance to physical point of financial services deems to be an important impediment to financial inclusion (see Allen et al., 2014). We use two classes of penetration of banking services i.e., demographic and geographic penetration of bank branch and ATM (e.g., see BDM, 2007; Beck et al., 2014b). For the demographic penetration, we use the number of bank branches and number of ATMs per 100,000 people, and for the geographic penetration we use the number of bank branches and number of ATMs per 1,000 square

[10] The actual representation of penetration dimension would have been had data of the number of people having banking accounts rather than the number of accounts per capita. The caveat is that in the latter case the number of "banked" population might be overestimated due to dormant accounts and/or double count of accounts of the same person.

kilometres.[11] The affordability dimension can also be classified into various sub-categories that include "transaction costs" and "ease of transaction".[12] Since the data on the affordability dimension is rather scarce, this dimension is not considered in the computation of financial inclusion index. For the usage dimension, we use the volume of credit plus deposit relative to the GDP. BDM (2007) investigate financial sector outreach and its determinants by using cross-country data to identify common trends across the abovementioned indicators. It is easier for the general public to comprehend and compare an indicator across countries that is composite in nature engrained with many correlated indicators (OECD, 2008). In this paper, we overcome the shortcomings, and build upon BDM (2007) to introduce a multidimensional weighted index of all variables as a measure of financial inclusion (see Section 3.2 for details). In our analysis, we use both the composite index and the three dimensions to explore the relationship between financial inclusion and banking stability.

2.2. Financial inclusion and bank stability

From a theoretical perspective, it is a priori not clear whether inclusive financial sector is good for bank stability (i.e., less risk taking). Through financial outreach–geographical and demographical bank's branch network penetration, banks can serve a wide range of customers potentially at a reduced cost once necessary infrastructures are in place (see Berger et al., 2010). By exploiting expertise i.e., managerial and technical expertise, they can improve operating efficiency and revenues as they have cheaper funding, new lending and investment opportunities (see e.g., Saunders, 1994; Berger and DeYoung, 2001; Deng and Elyasiani, 2008; Demirgüç-Kunt and Huizinga, 2010).

It is argued in the literature that retail deposits are sluggish, insensitive to risks and provide a stable cheaper source of long term funding (e.g., see Calomiris and Kahn, 1991; Song and Thakor, 2007), 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,

[11] As the distribution of bank branches and ATMs are not always uniform and often concentrated in urban areas of the country and provide access to some individuals using area- and population-based ratios may undermine the true penetration of banking services (BDM, 2007).

[12] Having information on affordability dimension would certainly improve the quality of financial inclusion index, but comparable macro data for a large number of countries is hard to get by. For example, the annual fees charged to customers for ATM cards and/or accounts i.e. "transaction costs" and the minimum amount and/or document requires opening savings or checking accounts i.e. "ease of transaction".

2011).[13] Huang and Ratnovski (2011) show that wholesale financiers are prone to very mild negative information or rumours, and most of the time they are reluctant to rollover short-term funding as they have access to the information of the quality of bank projects. While comparing informed and arm's length debt, Rajan (1992) finds that the informed debt holders (i.e., wholesale funders) could discontinue funds for a project with negative present value unless they are compensated with higher interest rate. Recent empirical studies also show that banks relying more on retail deposits rather than on wholesale funding were more stable during the recent financial crisis (e.g., Demirgüç-Kunt and Huizinga, 2010; Poghosyan and Čihak, 2011). Demirgüç-Kunt and Huizinga (2010), using a sample of listed banks in 101 countries for the period 1995-2007, also find that higher level of non-deposit funding shares increases banking fragility. Ratnovski and Huang (2009) show that the ample retail depository funding that was the key factor behind the relative resilience of Canadian banks during the 2008 turmoil. Moreover, during the recent credit crunch when the wholesale funding dried up it was the diversified retail deposit base that cushioned financial institutions from fragility (see Hannig and Jansen, 2010). While banks extend deposit facilities to a large pool of customers they are able to attract a large number of small retail deposits which are often cheaper than wholesale funding.[14] Therefore, greater diversification in funding strategy associated with financial inclusion in mobilising deposits should reduce risks and funding costs of banks, enhancing bank stability. For example: during financial distress when panic gets into depositors, they run on banks to withdraw their savings (Diamond and Dybvig, 1983; Shin, 2009). Recently, Han and Melecky (2013) find international evidence for the period 2006-2010 that, by dint of the law of large number, correlated deposit withdrawals (i.e., bank run) could be mitigated during stressful times if bank deposits are more diversified i.e., held by more individuals and firms.

[13] The retail deposits are sluggish because the withdrawals of them are motivated by the individual depositors liquidity need, and thus it is predictable based on the law of large numbers. In addition, they are insensitive to risk partly because of the deposit insurance provided by the government (e.g., Kim et al., 2003; Song and Thakor, 2007). For example, in the all recent bank failures (e.g., Continental Illinois, Northern Rock, IndyMac), it was short-term wholesale financiers who exited faster than retail depositors without having significant losses. In the case of Northern Rock, retail depositors run on bank took place after it had nearly exhausted its liquid assets to pay short-term wholesale financiers (Shin, 2009; Goldsmith-Pinkham and Yorulmazer, 2010).

[14] Several governments, especially in the developing countries, are making financial inclusion an essential part of their national plans. For example, on 28 August 2014, government of India has launched the '*Pradhan Mantri Jan Dhan Yojana*' (Prime Minister's People Money Scheme), with the explicit aim of removing financial exclusion. Though this scheme has an option for opening new bank accounts with zero balance, banks were able to garner deposits of ₹1500 crore (US$240 million) within two weeks of the launch of the scheme, with around 30.2 million new accounts.

The greater financial inclusion is also likely to influence the overall level of lending opportunity of banks. By reaching out to unbanked/underbanked areas while extending small credits, banks can reduce distance and build strong relationship with customers. Recent literature shows that distance between lender and borrower undermines efficacy of banking services through intensification of asymmetric information problem (Degryse and Ongena, 2005; Hauswald and Marquez, 2006; Mian, 2006; Deng and Elyasiani, 2008). Hauswald and Marquez (2006) develop a model and show that lender can get precise signal about borrower's quality if it decreases distance with borrower. In addition, banks can also reduce informational asymmetry by obtaining proprietary information about borrowers while providing access to basic financial services (e.g., Black, 1975; Fama, 1985; Rajan, 1992). To deal with less creditworthy and clients who often lack collateral, banks require to adopt lending techniques that are based on soft information (i.e., relationship lending). Exploiting this lending technology, they can also reduce moral hazards and adverse selection problems, and get comparative advantage over other financial institutions seeking informational rents (see Sharpe, 1990; Petersen and Rajan, 1994; Buch et al., 2012).[15] For example, using US bank holding companies, Akhigbe and Whyte (2003) and Deng and Elyasiani (2008) find that geographic diversification enhances bank value and risk reduction. Deng and Elyasiani (2008) also find that diversification across more remote areas (in our case, the areas where financial services are hardly available) is associated with greater value enhancement and a slighter risk-reduction effect. Therefore, when banks diversify to regions where more unbanked population are located, they are better able to understand the nuances of the local household/firm environment, which should reduce the probability of default rates, cost of monitoring and enhance lender-borrower proximity, and relationship, which in turn enhances larger risk-reduction.[16]

In contrast, if bank attracts a large pool of extremely low creditworthy borrowers due to financial inclusion it can derail banking stability as they require to extend small credits to a wider

[15] Linking three unique datasets, in a more recent study, Beck et al. (2014a) show that relationship lending alleviates SMEs' credit constraints during a cyclical downturn, and this effect is strongest for smaller and more opaque firms, and in regions where the downturn is more severe.

[16] It may also be the case that geographic diversification is associated with banking stability loss due to informational asymmetries binding with poor households or small firms. It may also occur due to lack of managerial and technical expertise, agency problems related to complex organisational and product structure (Acharya et al., 2006). Investigating the impact of geographic diversification, Acharya et al. (2006) on Italy and Goetz et al. (2013) on U.S., did not find any improvement in the risk-return trade-off and market valuations, respectively.

set of borrowers.[17] In a recent study of Adasme et al. (2006) with respect to the portfolio of Chilean banks, however find that losses on large loans are greater and unpredictable than losses on small ones.[18] It suggests that providing access to credits to a large number of small borrowers bank should be able to reduce monitoring costs and volatility of earnings. In addition, disbursing small loans is always a routine and standard task, which involves less monitoring and screening cost. Moreover, according to portfolio theory, diversified banks can decrease earning volatility and adverse risk-taking incentives through cross-subsidisation (Boot and Schmeits, 2000). Rossi et al. (2009) on Austrian banking data find that increased diversification of loan portfolio requires banks to keep lower future provisioning, which in turn results in a reduction of realised risk. Using conventional and Islamic banks for the period 2002-2010, Shaban et al. (2014) find that profitability is one of the main reasons for Indonesian banks to lend to small businesses. They also find that greater diversification of loans towards small businesses is associated with lower risk provisions for Indonesian banks. Therefore, by extending access of a large pool of customers to small credits, banks can decrease potential monitoring costs and losses compared to large loans, which in turn enhances soundness of banks.

Above all, since greater financial inclusion increases the supply of bank credits, which is always the vital and cheaper source of external finance for SMEs (e.g., Petersen and Rajan, 1997; Berger and Udell, 1998), it also aids in the growth of small firms, and firms that need external finances. Literature evokes that financial development (i.e., financial inclusion) disproportionately helps industries with technologically larger shares of small firms, and also the industries with higher dependence on external finance (Rajan and Zingales, 1998; Beck et al., 2008). Since more inclusive financial systems will ameliorate market frictions–i.e., informational opacity and transaction costs–small firms and firms that rely more on external finance in the economy will grow faster because the relatively easier access to credits. With the increasing supply of credits, borrowers will get favourable loan contracts, which would be vital to disincentivise borrowers from asset substitution–where borrowers utilise the funds to invest in riskier projects, which in turn enhances bank stability as borrower's default probability decreased.

[17] Regarding the recent subprime crisis, Rajan (2011) elucidates that "easy credit" as a mechanism to reduce income inequality can create a "fault line" along the financial system undermining the financial stability owing to enormous stresses.

[18] Using randomized experiments, De Mel et al. (2008) in Sri Lanka and McKenzie and Woodruff (2008) in Mexico, estimate capital returns to investment in microenterprises, and find that micro-entrepreneurs are indeed able to pay the high interest rates charged by microfinance institutions.

Apart from the channels discussed above, there are some exogenous risks (i.e., natural disasters, social and political disruptions) that can undermine efficient financial intermediation and stability (Hawkins, 2006). Therefore, our final channel is the social and political stability. A number of recent studies find that greater financial inclusion: reduces income inequality and poverty (e.g., Burgess and Pande, 2005; Beck et al., 2007a; Bruhn and Love, 2014); increases employment (e.g., Prasad, 2010); improves mental well-being (e.g., Karlan and Zinman, 2010; Angelucci et al., 2013); favours education (e.g., Flug et al., 1998); helps making better decision (e.g., Mani et al., 2013); and enhances new firm creation (e.g., Guiso et al., 2004; Klapper et al., 2006; Banerjee et al., 2013).[19] For example: using state-level data in India, Burgess and Pande (2005) find that expanding bank branches in the rural areas had a significant positive impact on poverty alleviation.[20] Similarly, recently, Bruhn and Love (2014) provide evidence from Mexico using randomized evaluation suggesting that facilitating better access to finance to the poorest of the poor have positive impact on poverty alleviation. They also find that access to financial services has positive impact on economic development through the channel of keeping individuals employed and fostering the survival and creation of informal business. As the nature of SMEs business operations is labour intensive, Prasad (2010) observes that financial constraint to SMEs has adverse effects on employment growth. On a study of Compartamos borrowers in Mexico, Angelucci et al. (2013) find that access to credit does have a positive impact on mental well-being. Therefore, the positive effect of financial inclusion on various key socio-economic indicators is indispensable to inclusive economic growth and sociopolitical stability, which in turn could lead to greater efficiency in the financial intermediations and soundness of banks (see e.g., Hannig and Jansen, 2010; Khan, 2011; Cull et al., 2012).

Overall, since providing access to finance seems to have multiple positive effects on many aspects of the economy including banking operations, we therefore view the link between financial inclusion and bank stability as ultimately an empirical question.

[19] Bauchet et al. (2011) summarize evidence from randomized evaluations of microfinance. The general findings of these studies are that financial services have positive impact on numerous microeconomic indicators, including self-employment, business activities, household consumption, and well-being.

[20] Jayaratne and Strahan (1996), using branching deregulation implemented by different U.S. states over the period mid-1970s to mid-1990s, find that the relaxation of intra- and interstate branching had positive impact on economic growth.

3. Data and descriptive statistics

To investigate the relationship between financial inclusion and bank stability, we draw data from a number of sources: (1) the bank level dataset compiled from the BankScope database (provided by Bureau van Dijk and Fitch Ratings) that contains detailed balance sheet and income statement information for both public and private banks in any given country; (2) the macro data compiled from the World Bank World Development Indicators (WDI); (3) the instruments for IV regressions are collected form the Heritage Foundation: Doing Business database, and Entrepreneurship Database; (4) the variables used to construct financial inclusion index is compiled from the IMF's FAS database; (5) six indicators of institutional quality is taken from Kaufmann et al. (2010) Governance Index; (6) firm-level indicators are taken from the World Bank Enterprise Surveys (WBES) to check the relationship between financial inclusion index and firms' access to finance/firms' financing obstacles; and (7) industry-level data on share and growth rate of value added are taken from the Industrial Statistics Database (INDSTAT4) published in 2010 by the United Nations Industrial Development Organisation (UNIDO). Data on external finance dependence (EFD) and small firm share (<N employees) of 36 industries are from Rajan and Zingales (1998) and Beck et al. (2008), respectively. Our dataset comprises of 2,913 commercial banks, cooperative banks and Islamic banks (13,836 bank-year observations) in 87 countries over the time period 2004-2012, which represent, respectively 57.4%, 41.3%, and 1.3% of the sample. Since the objective of this study is to investigate the impact of financial inclusion on bank stability, we apply a number of selection criteria to obtain our sample. First, we exclude countries for which we have no information on different dimensions of financial inclusion index. Second, we discard unconsolidated reports of banks whenever consolidated ones of the same group are available to offset double counting. Third, we drop banks that had information for fewer than three consecutive years, as the bank stability measures computed in this study based on rolling windows over the past three years. We deflate all monetary values to 2005 (2005 = 100) prices using the GDP deflator of US obtained from the WDI. The deflated series are reported in millions of US dollar ($). The variable definitions and the data sources are described in Appendix A.

3.1. Measuring bank risk

We follow Laeven and Levine (2009) to measure *Zscore* which is widely used in the literature and considered to be an unbiased and complete indicator of bank riskiness (see, for

instance, Houston et al., 2010; Turk Ariss, 2010; Fang et al., 2014). Using assets returns, its volatility and leverage, we calculate *Z-score* as follows:

$$Z - score_{it} = \frac{ROA_{it} + EQA_{it}}{\sigma(ROA)_{it}} \quad (1)$$

where ROA and EQA are the average return-on-assets and the equity-to-assets ratio, respectively and $\sigma(ROA)$ is the standard deviation of return-on-assets. We can interpret this score as the number of standard deviation below the mean by which returns would have to drop before all equity in the bank gets depleted (Boyd and Runkle, 1993; Beck et al., 2013). If banks' profitability is normally distributed, the inverse proxy of *Zscore* can be considered as bank's probability of insolvency. In other words, higher returns and capitalisation would increase but volatile returns would decrease the stability of banks.

3.2. Measuring and verifying the strength of the financial inclusion index

The components used in the construction of financial inclusion are highly correlated with each other. To sufficiently capture the common variation among these correlated components of financial inclusion as a single measure, we develop an index that represents the overall inclusiveness in the financial sector using principal components analysis (henceforth PCA, see Online Appendix Section E1 for details on PCA).[21] The first principal component from PCA has the interpretation of being the single linear combination of the financial inclusion indicators that explains most of the variations we see in these indicators. This index will sufficiently deal with the problem of multicollinearity and over-parameterisation as a single measure of financial inclusion. Before using PCA, indicators of each dimension are normalised to have values of zero and one so that the scale in which they are measured is immaterial.[22] Since the availability dimension is comprised of four variables initially we capture common variation among four outreach variables using the PCA and construct availability dimension. Subsequently, we use the PCA to extract the common principal component (PC) of the three dimensions that capture different aspects of the inclusive financial sector: the penetration, availability and usage of the financial services.

[21] Constructing composite index using principal components analysis is well-documented in several papers (see e.g., Ellul and Yerramilli, 2013; Bali et al., 2014).

[22] Prior to normalising, we winsorise each indicator at the 95th percentile levels to reduce the influence of outliers at the upper tail.

Appendix B shows the results of the PCA. Regarding availability dimension, the eigenvalues of the four PCs are 2.81, 0.69, 0.45, and 0.05, respectively, suggesting that the first principal component explains about 70% of the corresponding sample variance (see Panel A).[23] Except the first PC, none other PCs have eigenvalue greater than one, so we just take first component and extract the availability dimension using weights (i.e., 0.52, 0.52, 0.47, and 0.48) assigned to first principal component. Regarding financial inclusion, the eigenvalues of the three PCs are 1.54, 0.99, and 0.45, respectively, indicating that the first principal component explains about 51% of the corresponding sample variance (see Panel B). Similarly, only the first principal component has eigenvalue that is more than one so we can assume that the first component sufficiently explains the common variation among the three dimensions.[24] As shown in equation (2), we construct a multidimensional index for financial inclusion using the factor loadings (weights) of each dimensions derived from the principal component analysis[25]:

$$FII_{jt} = 0.71 * Penetration_{jt} + 0.71 * Availability_{jt} + 0.06 * Usage_{jt} \quad (2)$$

Equation (2) indicates that the financial inclusion index (FII) has somewhat higher weights on the penetration and availability dimensions, whereas relatively lower weights on the usage dimension.[26] In order to facilitate analysis and interpretation, we further normalise this index assigned to each country along a 0-1 scale, where zero indicates financial exclusion, and unity indicates financial inclusion.[27]

Although our paper makes the first systematic attempt to construct a composite index of financial inclusion for a longer panel and then analyse its impact on banking stability, it is not without its limitations. In the construction of the index, affordability dimension, marketing exclusion and self-exclusion have not been addressed. However, despite these shortcomings, we

[23] See Vyas and Kumaranayake (2006).
[24] Since we drop few PCs, it also eliminates a part of the noise components from our data, which ultimately may yield more reliable estimates.
[25] Sarma and Pais (2011) measure a weighted index of financial inclusion using manual weights of the dimensions for a sample of 49 countries for the calendar year 2004.
[26] In order to check the stability and robustness of our financial inclusion index, we also use principal component analysis on a year-by-year basis in which loadings are determined annually instead of over the entire sample period. The correlation between these two indices (one where the loadings are derived over the entire sample period and the other derived annually) is very high (i.e. 0.98), indicating the robustness of our index irrespective of how loadings are determined.
[27] The primary intention of constructing this index is to see the impact of financial inclusion on banking stability. Therefore, financial inclusion is measured across countries and period in order to take into account the evolution of the index.

see this construction of composite index and the associated analysis as a useful and important first step towards developing more robust indicator of financial inclusion. In this section, we borrow ideas from BDM (2007), and also test the validity of financial inclusion index. First, we use the Global Findex survey database, and check the correlation between household-based indicators of financial inclusion and the financial inclusion index. In some recent studies (e.g., Demirgüç-Kunt et al., 2013b; Allen et al., 2014), the most common variables that are used as the indicator of financial inclusion are *adults with an account at a formal financial institution to total adults (%) (*i.e., *Share of household account)* and *adults saving at a financial institution in the past year to total adults (%) (*i.e., *Share of household saving).* We find that our index is positively and significantly correlated at the 1% significance level with these Global Findex indicators. We also assess the power of our index to see whether our index is useful in predicting these observable micro-level data.

$$\begin{aligned} \textit{Share of household account} &= 19.04\ (6.81) + 92.09\ (13.69)^{*}\ \textit{Financial Inclusion} \\ \textit{Share of household saving} &= 6.59\ (3.94) + 92.09\ (7.65)^{*}\ \textit{Financial Inclusion} \end{aligned} \tag{3}$$

We collapse our data at the country level and regress the *share of household account* (the *share of household saving*) on *financial inclusion index* using robust standard errors. The regression yields R^2 of 57% (32%) with 81 observations. T-statistics are reported in the parenthesis of equation (3). Financial inclusion index enters significantly at the 1% level, indicating that greater financial inclusion is positively associated with the more households having accounts (savings) at financial institutions. The correlation between predicted share of household account (saving) and the actual share of household account (saving) at financial institution is 76% (56%).

Second, so far we have seen that our index is powerful enough in predicting household-based measure of financial access. Now, we use firm-level data taken from the WBES in order to gauge the relationship between financial inclusion index and firms' access to finance, while controlling for firm-specific characteristics. WBES contains an expansive array of economic data on 130,000 firms in 135 countries over the period 2002-2014.[28] We run the following estimations at the firm-level:

[28] See Love and Martínez Pería (2014) for details on this database. In addition, out of 87, we could only match 64 countries' financial inclusion indices with the WBES database for the period 2004-2012.

$$F_{c,k,t} = \beta_0 + \beta_1 Financial\ Inclusion_{c,t} + \beta_2 X_{c,k,t} + \varepsilon_{c,k,t} \quad (4)$$

where F is the rating of financing obstacle reported by firm k in country c at time t and X is a set of control variables, which include firm size (employee), a dummy variable for manufacturing firms, a dummy for the firms that are involved in exporting, dummy variables for government and foreign-owned firms, age of the firms in years, GDP growth rate and regional dummies (see Appendix Table A1 for details). We run an ordered probit model to estimate equation (4), as financing obstacle is a polychotomous dependent variable with natural order where higher values indicate greater financing constraints. It is expected that the greater the financial inclusion the less financing constraints there would be for firms to get access to credits. In addition, following Love and Martínez Pería (2014), we also use an alternative measure of access to finance. In this case, we construct an indicator variable that takes one if firm k in country c at time t has a bank loan, line of credit, or overdraft.[29] A positive relationship between financial inclusion index and access to finance is expected as greater inclusive financial system would alleviate financing constrains disbursing more credits to firms.

The results are reported in Appendix Table C1. The findings confirm the expectation that firms tend to report lower (higher) financial constraints (access) in those countries where financial inclusion is greater. In particular, we find that financing obstacles are negatively related to inclusive financial system, whereas access to finance is positively associated at 1% significant level. Therefore, it once again assures the robustness of our index.

3.3 Measuring bank competition

Lerner index is used to measure the degree of bank competition. It is considered to be the most accurate measure of bank-specific competition than the so-called Panzar-Rosse H-statistics or the asset shares of the three largest banks (Carbó-Valverde et al., 2009). The essence of pricing power is reflected through Lerner index because it measures the disparity between price and marginal cost expressed as a percentage of price. In other words, it captures the degree to which a

[29] Since there is some disparity between the Old (2002-2005) and the New core modules of the surveys, we follow BDM (2007) to construct Financing Obstacle, and Love and Martínez-Peria (2014) to construct Access to Finance.

bank can increase their marginal price beyond their marginal cost. According to Berger et al. (2009), the Lerner index is the only measure of market power calculated at the bank level as:

$$Lerner_{it} = \frac{P_{it} - MC_{it}}{P_{it}} \tag{5}$$

where P_{it} is the price of total assets proxied by the ratio of total revenue (interest and non-interest income) to total assets for bank i at time t. MC_{it} is the marginal cost of producing an additional unit of output. The Lerner index is interpreted as inverse of competition; the higher the index greater is the pricing power and implies less competitive market conditions. Following conventional bank efficiency studies, in this paper we use stochastic frontier analysis (SFA) to estimate marginal cost and hence Lerner Index. The shortcoming of conventional Lerner index (C-Lerner) estimated above is that it is measured assuming full bank efficiency and therefore it fails to account for the possibilities of bankers' inability to exploit output pricing opportunities resulting from market power. Therefore, we also follow Koetter et al. (2012) to estimate efficiency adjusted Lerner index (E-Lerner) (as explained in Online Appendix Section E2). Online Appendix Table E1 reports the descriptive statistics of the variables included in the cost and profit functions.

3.4 Bank-specific and macro control variables

We control for an array of standard bank-specific characteristics and macroeconomic variables. To account for liquidity risk of individual banks, we use ratio of total loans over total assets (Fang et al., 2014). We use logarithm of total assets to account for potential size effect on banking stability and efficiency, as the too-big-to-fail attitude can destabilize the efficient financial intermediation of the entire banking system. The ratio of loan loss provision to total loans is used to account for individual bank's loan portfolio risk. The ambiguous relation of income diversification on stability necessitates considering the effect of off-balance sheet activities of individual banks. The ratio of total earning assets to total assets is used as better management quality that can mitigate excessive risk-taking. Since, well-capitalised banks are assumed to take less risk, we use the equity ratio to control for capital risk. In this paper, we also use several macroeconomic variables to control for economic development and business cycle of the economy. Since, in the last decade, World economies observed substantial volatility, we use GDP to control for economic growth. As the economic development generally coincides with an increase in

financial inclusion, it is crucial to control for per capita GDP when assessing the association between financial inclusion and bank stability. Honohan (2008) argues that it would be interesting to see whether the impact financial inclusion remains significant after controlling for per capita GDP.

3.5. Industry growth, external finance dependence, and small firm share

In our analysis, using cross-country and cross-industry data, we also examine whether financial inclusion facilitates industry growth by reducing the costs of external finance to firms. Similarly, we further investigate whether industries that are composed of small firms grow faster than large-firm industries in economies with higher levels of financial inclusion. Following Rajan and Zingales (1998), we calculate the annual (compounded) real growth rate in value added for 36 industries e.g., three- and four- digit industries of International Standard Industrial Classification (ISIC) codes. Industry-level value added data for each country are obtained from the INDSTAT4 database, which is published by UNIDO in 2010. External finance dependence (EFD) is an industry-level index that measures the fraction of desired capital expenditures that cannot be financed with internal cash flows for US firms is from Rajan and Zingales (1998). They argue that since US financial markets are relatively more open, sophisticated, and developed, US firms should encounter fewer obstacles in achieving desired level of financial structure than firms operating in other countries (Houston et al., 2010). Using industry-level data and including an interaction between an industry-level characteristic (i.e., EFD) and a country-level characteristic (i.e., financial inclusion) would provide a valid and exogenous way to identify the extent of an industry's external dependence anywhere in the world (Kroszner et al., 2007). We expect that the impact of financial inclusion on industry growth would be stronger in the sectors that rely more on external finance.

Since inclusive financial systems would reduce more financing obstacles of a small firm than a large firm, we also investigate whether financial inclusion boosts the growth of the small-firm industries more than the large-firm industries. Small firm shares are industry-level index that measure the industry's share of employment by US firms with less than N employees (N is either 5 or 10 or 20) using data from the US Census on all US firms for the year 1997 from Beck et al. (2008). They argue that technological share of small firms of US industries can serve as the appropriate benchmark for the same industries of other countries because the relatively frictionless

US financial markets should yield few policies distorting firm size. Since our industry growth regression depends on the availability of the financial inclusion data, our final matched sample includes 672 observations in 25 countries. The average growth rate in real value added in our sample is 4%. The external finance dependence, small firm shares (<5 employees, <10 employees, and <20 employees) are 3.4%, 1%, 3%, and 6%, respectively.

3.6. Descriptive statistics

Table 1 presents the descriptive statistics of the variables used in this study. The mean value of Z-score is 3.7 with a standard deviation of 1.3, implying that on average return on assets would have to fall by 3.7 times their standard deviation to wipe out bank equity. The fairly high standard deviation suggests that there is considerable cross-country variation in the level of bank stability. The mean negative logarithm of return volatility is 6.1. For the variable of interest, the mean of the financial inclusion index is 0.57, where penetration, availability and usage dimensions are 0.51, 0.62, and 0.12, respectively. The standard deviation of 0.30 indicates considerable heterogeneity in the inclusiveness of financial systems across our broad sample of 87 countries.

Table 2 reports the countries in our sample, ranked according to our index of financial inclusion. In terms of financial inclusion, South Korea (0.99), Belgium (0.98) and Japan (0.98) have the highest inclusive banking system, whereas Afghanistan (0.01), Yemen (0.02) and Malawi (0.03) have the lowest (also see Figure E1 in the Online Appendix). On average, European countries have the highest financial inclusion (0.53) and banking stability (72.4), whereas African countries have the lowest value of 0.11 and 53.3, respectively. The average financial inclusion and banking stability of Asian and American countries are almost identical. The disparity of individual constituent contributing to the index of financial inclusion is also staggering. For example: United Kingdom ranks 29 in financial inclusion index but it ranks 76 in penetration and 9 in availability dimension. Therefore, using individual dimension as a proxy for financial inclusion would provide incomprehensive picture of a country's overall inclusiveness. The correlation matrix of the independent variables used in this paper is reported in the Online Appendix Table E2. The positive correlation between institutional quality indexes and financial inclusion in Panel B is an additional indication of the robustness of the index measured in this study. With the strong positive

correlation between per capita GDP and financial inclusion further proves robustness of our index (see Honohan, 2008).[30]

4. Methodology

We examine the impact of financial inclusion on banking stability using bank-level data from 87 countries. It is possible that the results of the study may be biased because of endogeneity problem between financial inclusion and bank stability. Endogeneity can arise if bank engages in risky activities in the current set-up and venture into rural areas to offset high risk and/or if they self-select into inclusive financial activities because these reward them with greater market power and profitability. Therefore, we use instrumental variable technique with a two-step generalized method of moments (GMM) estimator using heteroskedasticity and autocorrelation consistent (HAC) variance estimation of Newey and West (1987).[31] This estimator extracts the exogenous component of financial inclusion, reducing concerns about endogeneity. We run several regressions using the following baseline model:

$$\begin{aligned} Bank\ Stability_{ijt} = {} & \beta_0 + \beta_1 Loan\ Ratio_{ijt} + \beta_2 Bank\ Size_{ijt} + \beta_3 Loan\ Loss\ \Pr ovision_{ijt} \\ & + \beta_4 Income\ Diversification_{ijt} + \beta_5 Management\ Quality_{ijt} \\ & + \beta_6 Bank\ Equity_{ijt} + \beta_7 Bank\ Competition_{ijt} + \beta_8 Financial\ Inclusion_{jt} \\ & + \beta_9 GDP\ Growth_{jt} + \beta_{10} Per\ Capita\ GDP_{jt} + \alpha_i + Year_t + \varepsilon_{ijt} \end{aligned} \quad (6)$$

where the *i, j* and *t* subscripts indicate bank, country and year, respectively. *Bank stability* is log(Zscore), measured at the bank level. We control for various bank- and country-specific characteristics. Our main explanatory variable of interest is financial inclusion index, measured at the country level. To control for time invariant bank heterogeneity and time varying global business cycle effects, we include bank fixed effects α_i and year fixed effects $Year_t$, respectively. As a robustness test, we use standard deviation of return-on-assets (ROA). Since expanding access of the low yield clienteles to basic financial services may have negative impact on the bottom line of banks, it is natural to check robustness of our results using income volatility of individual banks

[30] Since financial inclusion is generally related to per capita income, these two variables tend to be correlated. We computed the variance inflation factors (VIF) for each of our model estimates. VIF is equal to $1/(1-r^2)$, where r^2 is from the regression of an independent variable on rest of the independent variables. The average VIF never exceeds 3, indicating that multicollinearity is not a cause of concern for our results (Anginer et al., 2014). Furthermore, following previous studies on the determinants of financial development (e.g., La Porta et al., 1997; Beck et al., 2003), as a robustness test we exclude per capita GDP in all estimations and the results are broadly consistent with the main findings of this study. The results are available from the authors upon request.

[31] Since GMM accounts for heteroskedasticity and autocorrelation it is more efficient than 2SLS (Hall, 2005).

as an alternative measure of banking stability. Furthermore, considering the recent development in the measures of bank competition, we employ both conventional and efficiency adjusted Lerner indices as the measures of *Bank Competition*, which should also serve the purpose of robustness of our results.[32]

5. Empirical results

First, we report the specification tests and results for financial inclusion and stability based on the IV regression model in equation (6). Second, we report the contingent effects of financial inclusion with bank competition on banking stability.

5.1. Financial inclusion and bank stability

In this section, we examine how financial inclusion affects bank stability after controlling for bank and country level variables. Results are reported in Table 3, where we use two different measures of bank stability. In column 1-2 and 3-4, we regress log(Zscore) and –log(sd(ROA)) on financial inclusion, respectively. For the latter case, we follow Beck et al. (2013), and transform return volatility to make it directly proportional to banking stability. To check for the robustness of our results, we use two variant measures of market power denoted as C-Lerner and E-Lerner. Before choosing which estimator we should use for equation (6), we conduct endogeneity test for the financial inclusion measures, which is reported at the bottom of the Table. For rejecting the null hypothesis of exogeneity, we employ the IV-GMM estimator. In case we cannot reject the exogeneity of financial inclusion, we use the OLS estimator as it is more efficient. In both cases, we calculate heteroskedasticity and autocorrelation consistent (HAC) standard errors which are reported in the square brackets. We test the validity of our instrumental variables as in GMM procedures using the under-identification LM test by Kleibergen and Paap (2006) and the over-identification test by Hansen (1982). The results on these tests show that the instruments used are valid as the p-value of the former (latter) requires a value lower (higher) than 0.05 to reject the null hypothesis at the 5% level.

[32] We use lagged values of Lerner indices to mitigate any remaining endogeneity issues that may be associated with market power and stability (see e.g., Turk Ariss, 2010; Love and Martínez Pería, 2014).

Online Appendix Table E3 shows the First-stage regressions of financial inclusion on instruments used in this study.[33] We find that all instruments have statistically significant effects on financial inclusion- the direct effect and interaction. Moreover, the signs and magnitudes of the coefficients are economically important, as financial inclusion increases more in markets with greater financial freedom and higher density of newly registered companies. A system with higher financial freedom and entry density would facilitate access to finance through augmenting banking competition and creates a milieu for efficient financial intermediation between households, financial institutions, firms and entrepreneurs.[34] For example: to assess economic significance of whole set of instruments, consider column 4, at the mean for entry density (2.61), the marginal effect of financial freedom equals 0.002 (0.002-0.0001*2.61 = 0.002). This effect implies that one standard deviation above average increase in financial freedom (70.83) leads to 0.14 units increase in financial inclusion (equals little less than ½ standard deviation of financial inclusion).

It is clear from the results that more inclusive financial system is associated with greater banking stability, as indicated by its positive and significant (at the 1% level) coefficients (once again, a greater estimated Zscore indicates more stability i.e., less risk taking). Given the mean of log(Zscore) is 3.71, the effect is not only statistically significant but also economically significant. Since we use the natural logarithm of Zscore, the coefficients can be interpreted as semi-elasticity. In column 1, a one standard deviation increase in the index of financial inclusion, which equals 0.30, is associated with an increase in the log(Zscore) of 189% (6.3*0.30). Put differently, our financial inclusion index lies between zero and unity, where one standard deviation increase would be a substantial increase for any given economy, for a ¼ standard deviation increase in the index of financial inclusion leads to 45% (6.4*0.07) increases in the bank stability (based on averaging the results across column 1 and 2). The effect is economically important as it suggests that financial inclusion enhances banks to have secure deposit base as well as wider lending opportunities. In particular, inclusive financial sector alleviates financing constraints of SMEs and also mitigate the post-lending moral hazard problems. Therefore, with inclusive financial sector, banks enjoy greater financial stability. To illustrate the effect, we compare the improvement in the banking

[33] The significant negative relationship between market power and financial inclusion in Table A3 is consistent with the existing literature and should serve as another indication of the robustness of our index (see for example Carbó-Valverde et al., 2009; Ryan et al., 2014).

[34] Entry density is one of the channels through which financial development fosters economic growths (Klapper et al., 2006).

stability of two countries with different levels of financial inclusion (i.e., at the 25th and 50th of the index). Take the example of column 1. The estimation suggests that banks in Trinidad and Tobago (25th Percentiles; ranks 40 in our sample) would be 112% more stable if it has the financial inclusion of Chile (50th Percentiles; ranks 10 in our sample). This result also corroborates with the additional risk measures used in this study. The negative of return volatility –log(sd(ROA)), in columns 3 and 4, is also positively related to financial inclusion, suggesting that an increase in the index of financial inclusion is associated with reduction in return volatility.

These results are consistent with the view that a system with inclusive financial services tend to reinforce banking stability (e.g., Han and Melecky, 2013; Khan, 2011; Morgan and Pontines, 2014) and that higher degree of financial inclusion mitigates excessive risk-taking of individual bank. Since greater financial inclusion reduces distance between financial institutions and low-end customers it is able to decrease the probability of loan defaults, and hence bank fragility. This result is also supported by Agarwal and Hauswald (2007) and DeYoung et al. (2008), who use US data and find that loan default probability increases with the distance between lender and borrowers. Recent empirical evidence also finds positive impact of geographic diversification and reducing distance between banks and borrowers (e.g., Berger and DeYoung, 2001; Bos and Kolari, 2005; Deng and Elyasiani, 2008; Rossi et al., 2009). Since banks operate in more inclusive banking sectors are able to reduce income volatility and increase soundness, we therefore argue that financial inclusion is good for bank stability.

Our results on control variables are also consistent with existing literature. As might be expected, larger banks, and banks with better management, higher equity capital and pricing power are more stable. Regarding country-level macro controls, banks engage in less risk-taking if the economic growth is high. However, they indulge in more risk-taking when they operate in countries where the levels of economic development is high.

5.2. The interactive effect of bank competition and financial inclusion

We have shown in the previous section that financial inclusion is good for banking stability consistent with the notion that inclusive financial sector mitigates excessive risk taking of banks. Since the impact of lack of access to finance may rely on the competitiveness in the markets, and bank competition being one of the important determinants through which banking soundness

gets affected, it is imperative to investigate how the relationship between financial inclusion and bank stability changes due to competitiveness in the markets.[35]

Recent studies show that bank competition is instrumental in broadening financial access (e.g., Petersen and Rajan, 1995; Beck et al., 2004; Carbó-Valverde et al., 2009; Chong et al., 2013; Love and Martínez Pería, 2014; Ryan et al., 2014).[36] The literature is divided into two streams. The information hypothesis argues that greater market power may persuade banks to establish relationship lending and internalise benefits of supporting informationally opaque or risky customers, and hence lead to more credit availability (Petersen and Rajan, 1995; Di Patti and Dell'Ariccia, 2004). In addition, when banks enter into a new market to facilitate access to finance, in a competitive environment, they tend to earn lower informational rents from their relationship with borrowers, decreasing incentives to monitor borrowers, which in turn lead to banking fragility (see e.g., Boot and Thakor, 1993; Allen and Gale, 2004). Recent theoretical models show that fiercer competition not only induces banks to acquire less information on borrowers (Dell'Ariccia and Marquez, 2004) but also persuade them towards more risky and opaque customers (Hauswald and Marquez, 2006). Therefore, if there is more interbank competition in an unbanked area, banks should have a portfolio of risky borrowers, again undermining their stability.

On the other hand, based on the traditional industrial organisation theory, the market power hypothesis argues that higher competition results in more loan supply ensuring lower lending rates, thereby improving credit availability (Beck, Demirguc-Kunt and Maksimovic, 2004; Carbó-Valverde, Rodriguez-Fernandez and Udell, 2009; Ryan, O'Toole and McCann, 2014). When bank enters into a new market with high market power they may charge higher interest rate on loans which may incentivise households and small firms to search for higher returns and make risky investments, increasing probability of default, and hence losses of the banks. Again, it may be the case that fewer large banks with high market power in a banking system often enjoys "too-big-to-fail" subsidies from safety net policies it may induce them to take excessive risk and

[35] Numerous studies investigate the relationship between bank competition and stability with little consensus about the unambiguous direction of the relationship. Literature argues about two offsetting effect of bank competition on stability. On one hand, the traditional competition-fragility hypothesis argues that greater competition increases banking fragility as it induces excessive risk-taking due to reduced profit margins (Keeley, 1990; Hellmann et al., 2000). On the other hand, competition-stability hypothesis argues that greater competition increases banking stability because it facilitates low interest rates for smoother repayment of loans, and decreases default risk of borrowers and thereby bank loses (Boyd and De Nicolo, 2005). However, we do not test the validity of either of these hypotheses, rather we investigate the relative importance of bank competition on the financial inclusion-stability relation. See Beck et al. (2013) for detailed discussion on bank competition and stability.

[36] See DBH (2008).

destabilise the entire financial system (cf. Anginer et al., 2014, and references therein). Regarding financial inclusion, this situation may get worse when large banks pursuing inclusive banking agenda without adhering to proper screening and monitoring procedures while serving low-end customers who often lack collateral and credit histories, increasing banking fragility. Therefore, in this section, we introduce an interaction term between financial inclusion and bank competition in the equation (6), and examine whether competition reduces or reinforces the positive relationship between financial inclusion and bank stability.

$$\begin{aligned} Bank\ Stability_{ijt} = {} & \beta_0 + \beta_1 Loan\ Ratio_{ijt} + \beta_2 Bank\ Size_{ijt} + \beta_3 Loan\ Loss\ \text{Pr}ovision_{ijt} \\ & + \beta_4 Income\ Diversification_{ijt} + \beta_5 Management\ Quality_{ijt} \\ & + \beta_6 Bank\ Equity_{ijt} + \beta_7 Bank\ Competition_{ijt} + \beta_8 Financial\ Inclusion_{jt} \\ & + \beta_9 (Financial\ Inclusion_{jt} \bullet Competition_{ijt}) + \beta_{10} GDP\ Growth_{jt} \\ & + \beta_{11} Per\ Capita\ GDP_{jt} + \alpha_i + Year_t + \varepsilon_{ijt} \end{aligned} \quad (7)$$

In equation (7), all other variables remain unchanged as in equation (6) except the interaction term, where we are interested in the coefficient β_9. The results of the interaction between financial inclusion and bank competition are reported in Table 4. Consistent with the earlier regressions, we also use IV estimator where both financial inclusion and interactive terms (i.e., financial inclusion and Lerner indices) are treated as endogenous variables, and instrumented via analogous instruments as in Table 3. For column 1 of Table 4, we find significant positive interactive effect on banking stability. The positive coefficient suggests that the complementary effect of financial inclusion on bank stability is more pronounced in less competitive markets. Using the coefficients estimated in column 2, our result suggests that for a banking system with average market power (0.12), the marginal effect of financial inclusion is 6.6, whereas for a banking sector with market power of one standard deviation above average (0.36), the impact reaches to 6.9. Translating these into changes in the banking stability, we find that a banking sector with average market power, ¼ standard deviation increase in the financial inclusion (0.07) results in an approximately 46% increase in the banking stability, whereas it is 48% if market power increases by one standard deviation above average. This finding is corroborated by the significant positive coefficients of the interaction terms in column 3 and 4. The evidence suggests that the magnitude of the positive impact of financial inclusion on banking stability increases if banks have

higher market power. In other words, financial inclusion has significant positive impact on banking stability but greater competition affects this relation adversely.

This result is not only significant statistically but also economically important as greater financial inclusion may limit the extent to which banks can or will engage in correlated risk taking activities in absence of competition because they are able to venture into new markets, or seek new lines of business or clients. By dint of higher financial inclusion, banks have ample opportunities to lend many small loans, for which losses are negligible and predictable (see Adasme et al., 2006), indicating imperfect correlation of loan defaults. Recently, Martinez-Miera and Repullo (2010) show that at a lower correlation of loan defaults, greater bank competition is detrimental to bank stability, supporting our result of positive coefficient on interaction term. Petersen and Rajan (1995) and Agarwal and Hauswald (2010) show that "relationship banking" and/or "borrower proximity" is the efficient method through which banks can collect soft information to reduce asymmetric information. As financial inclusion reduces distance and informational asymmetry, banks with market power can provide finances to less creditworthy households/firms and monitor carefully to reduce loan default rates, and thus enhance banking stability.

5.3. Institutional quality and financial inclusion

The impact of greater financial inclusion may depend on the larger institutional environment in which bank operates, and can potentially be fortified through better institutional quality. For example, freedom of expression, political stability, regulatory quality and rule of law may limit the extent to which banks can engage in correlated risk taking activities where the financial inclusion is lower. In this section, we examine how the interaction between financial inclusion and each country's institutional environment affect the positive role of financial inclusion on banking stability as follows.

$$\begin{aligned} Bank\ Stability_{ijt} = {} & \beta_0 + \beta_1 Loan\ Ratio_{ijt} + \beta_2 Bank\ Size_{ijt} + \beta_3 Loan\ Loss\ \text{Pr}ovision_{ijt} \\ & + \beta_4 Income\ Diversification_{ijt} + \beta_5 Management\ Quality_{ijt} \\ & + \beta_6 Bank\ Equity_{ijt} + \beta_7 Bank\ Competition_{ijt} + \beta_8 Financial\ Inclusion_{jt} \\ & + \beta_9 Institutional\ Quality_{jt} + \beta_{10}(Financial\ Inclusion_{jt} \bullet Institutional\ Quality_{jt}) \\ & + \beta_{11} GDP\ Growth_{jt} + \beta_{12} Per\ Capita\ GDP_{jt} + \alpha_i + Year_t + \varepsilon_{ijt} \end{aligned} \quad (8)$$

In equation (8), we add six indicators of institutional quality taken from Kaufmann et al. (2010) *Governance Index*. As these indicators are highly correlated, we run regression using each indicator and its interaction term with financial inclusion one at a time to avoid multicollinearity problem. However, we capture common variation among these six governance indicators using the principal component analysis and construct a composite index of institutional quality (*IQI*). For sake of simplicity, we use logarithm of Zscore as the dependent variable keeping all other bank and macro controls analogous.[37] The financial inclusion and the interaction term are treated as endogenous and instrumented via variables that are reported at the bottom of the Table 5 with main results. For expositional brevity, and because we are interested in the interaction effects, the results of the controls are not reported.

Most of the interaction terms enter positively and significantly at 5% level. Column 1, 2, 4, and 5 of Table 5 suggest that the benefit of having greater freedom of expressions and free media (*Voice*), political stability (*Political*), regulatory quality (*Regulatory*), and rule of law (*Law*) in reducing bank risk-taking is more pronounced in the markets where financial inclusion is higher. At the bottom of the table, we report marginal effect of financial inclusion at the mean of each indicator. Column 6 shows that at the mean value of control of corruption greater financial inclusion reduces banking fragility. In column 7, we use the first principal component (the only component that has eigenvalue more than one i.e., 5.27 with 87% variation) of all institutional variables (e.g., *Voice, Political, Government, Regulatory, Law and Corruption*) and created a composite index of '*Institutional Quality*' and run regression. The interaction term in column 7 also confirms our results that the positive impact of institutional quality on reducing risk is higher if banks operate in an inclusive financial system.

In terms of the economic significance, the magnitude of the coefficient suggests that there is significant effect of financial inclusion on banking stability in the countries with highest levels of institutional development. For instance, using estimated coefficients in column 7, the derivative (partial) of bank stability with respect to financial inclusion at the mean level of our composite institutional quality index (*IQI*) is 10.88 (significant at 1% level). The same derivative evaluated at the 25th percentiles (lower) of *IQI* is 6.24 (significant at 1% level). On the other hand, when the *IQI* is at 75th percentile (higher), it increases by more than two factors (15.22) (significant at 1% level). These findings are consistent with existing empirical literature as Beck et al. (2005) show

[37] In all these regressions, we use efficiency adjusted Lerner indices as the proxy of bank competition.

that greater institutional development (e.g., financial, legal and corruption) facilitates better access to finance especially for the smallest firms. For example: more effective rule of law provides more flexibility in terms of contract enforcement without much delay. Overall, the positive interactive effects seem to suggest that the beneficial effects of financial inclusion on banking stability reinforces if the market within which banks operate have greater quality of institutional settings.[38]

5.4. Additional sensitivity analysis

In this section, we discuss various additional robustness tests of our study. In each specification, we conduct endogeneity test. In case it is not statistically significant at 5% level, we use ordinary least square regression as it is more efficient. The definitions of rest of the variables are same as in equation (6). At the bottom of each table, we report the Kleibergen and Paap (2006) test for weak instruments and the Hansen over-identification test.

5.4.1. Alternative financial inclusion index

Although we construct financial inclusion index incorporating as many dimension as possible given the data availability constraints it is possible that our results are inferred incorrectly because of poorly constructed index. Therefore, we use alternative financial inclusion index that is taken from the Global Findex Database, which collects information how people in 148 countries manage their financial activities. The variable we use as the financial inclusion proxy is the percentage of adults that had savings at a financial institution in the year prior to the survey (see e.g., Demirgüç-Kunt et al., 2013b; Allen et al., 2014). This database is new and just covers the year 2011. We had to collapse our dataset at bank-level to run two-stage cross-sectional instrumental variable regressions. Global Findex and its interaction with Lerner indices are treated as endogenous variables. These variables are instrumented via the financial freedom, entry density and their interactions. The regression results are presented in Table 6, showing that the relationship between Global Findex and bank stability is still positive and statistically significant. Regarding the interactive effect, it also corroborates with the earlier finding that the positive impact of

[38] Interestingly, we find that the derivative of log(Zscore) with respect to financial inclusion at the minimum level of institutional quality (i.e., -6.30) is -3.89, whereas the derivative of log(Zscore) with respect to institutional quality at the minimum level of financial inclusion (i.e., 0.008) is -0.59, suggesting institutional quality has greater impact on banking stability than financial inclusion (see Baltagi et al., 2009, p295).

financial inclusion on bank stability is robust in less competitive markets. It reiterates that financial inclusion is good for banking stability.

5.4.2. Using disaggregated dimensions of financial inclusion index

The results reported in Tables 3-7 indicate that there is a strong link between financial inclusion index and banking stability. In this section, we disaggregate financial inclusion index into its components (i.e., Accessibility, Availability, and Usage dimensions), to further explore whether individual dimension of financial inclusion has a particular important influence on bank stability. Table 7 reports the results of the regressions in which dependent variables are analogous as in Table 3. We use the same control variables, but now we separately explore the impacts of three dimensions of the financial inclusion index.[39] The results indicate that each of the dimensions has a positive effect on bank stability. Among the three dimensions, the absolute value of the estimated coefficient is largest for the accessibility dimension (i.e., the number of deposit and loan accounts per 1,000 adults), and smallest for the usage dimension (i.e., total volume of deposit and loans relative to GDP). All of these dimensions are significant at the 1% level, which confirms that individual dimensions of financial inclusion index also has similar effect on bank stability. It also reiterates about the appropriateness of using these dimensions in the construction of financial inclusion index.

5.4.3. Alternative banking stability measure

Following Beck et al. (2013), we use alternative measure of bank stability in which the denominator in equation (1) is calculated using five years rolling windows. As usual, financial inclusion is instrumented via the financial freedom, entry density and their interactions. The results are reported in Table 8. The main results remain unaltered with a slight increase in the magnitude of the coefficients.

[39] For brevity, we only use efficiency-adjusted Lerner index as the measure of bank competition.

5.4.4. Split samples based on financial inclusion

We split our sample into terciles according to the financial inclusion index and re-run six regressions.[40] The results are reported in Table 9 (column 1-6). The low, medium and high terciles of financial inclusion are instrumented via the investment freedom (ranges 0-100, higher value implies less constraints on the flow of investment capital) entry density and investment freedom times entry density (the result of the first-stage regression is available from the authors). The result indicates that the effect of financial inclusion at the lower terciles is negative with banking stability. It becomes significant at the medium terciles. We can see that the magnitude of the coefficient of the highest terciles is twofold higher than medium terciles. This is consistent with our argument that greater inclusive banking sector is good for soundness of banks.

5.4.5. Different sample selection

We also conduct a battery of sensitivity checks using different sample selection criteria such as excluding cooperative and Islamic banks, excluding Japan and Italy, and finally excluding developed countries. Our dataset comprises 1549 commercial banks, 1084 cooperative banks and 37 Islamic banks. We drop all cooperative and Islamic banks from our dataset and keep only commercial banks. The result of the regressions, which is reported in Table 9 (column 7 and 8), shows that the magnitude of the positive effects of financial inclusion on banking stability is even higher in the case of only commercial banks, reiterating beneficial effect of financial inclusion on soundness of banks. The number of banks in Japan and Italy is 457 and 489, respectively which constitute the lion's share of our sample. We drop these two countries and re-run regressions, which are reported in Table 9 (column 9 and 10). Dropping Japan and Italy does not alter the main findings of this study. Finally, we also drop all banks of the developed countries keeping only 708 banks that operate in developing countries, and re-run regressions. The result also corroborates the earlier findings that financial inclusion is good for banking stability.

[40] The summary statistics of the group with the lowest financial inclusion index has an average (median) bank stability (Z-score) of 70.2 (34.3), the group with the medium financial inclusion index has an average (median) bank stability of 94.8 (45.9), and the group with the highest financial inclusion index has an average (median) bank stability of 138.8 (56.1).

6. Financial inclusion, external finance dependence, small firm share, and economic growth

So far, the results reported in Section 5 clearly indicate that financial inclusion is good for bank stability. While these findings are important for public policy-making, a natural question arises whether greater banking stability is good or bad for the growth of the sectors that rely more on external finance as well as of the sectors that have larger share of small firms. Though answering these questions and finding the optimal level of banking stability across countries is well beyond the scope of this paper, we shed some light on the consequence of greater bank stability. Banks with greater stability may broaden financial services to underbanked sectors of the economy: sectors that rely more on external finance, and that are naturally composed of small firms for technological reasons. If market frictions–e.g., transaction costs and informational opacity–hinder small firms and firms that are heavy users of external finance to get access to credit, higher levels of financial inclusion will ameliorate these frictions and will aid in the faster growth of firms, which in turn leads to higher economic growth.

Following the seminal work by Rajan and Zingales (1998), in this section, we therefore investigate whether the sectors which depend more on external finance have higher growth in the countries with higher levels of financial inclusion. In addition, we also test whether inclusive financial systems exert a disproportionately positive effect on the growth of industries that are traditionally composed of small firms. With this point in mind, we adopt a methodology that is extensively used in the recent literature (e.g., Cetorelli and Gambera, 2001; Kroszner et al., 2007; Beck et al., 2008; Houston et al., 2010). We estimate the following model:

$$Growth_{i,k} = \xi\, Industry\ characteristics_i + \varphi Country\, characteristics_k + \psi\, Industry\ share_{i,k} + \eta(Financial\ inclusion\ index_k\ \mathrm{X}\ IES_i) + \varepsilon_{i,k} \quad (9)$$

where $Growth_{i,k}$ is the annual (compounded) growth rate in real value added for 2000-2010 for industry i in country k. In addition to the industry and country dummies, following previous studies (e.g., Kroszner et al., 2007; Houston et al., 2010) more country characteristics are included such as bank competition, the levels of economic development, efficiency of a country's legal system, property rights, credit information depth, and institutional quality index. $Industry\ share_{i,k}$ is the industry $i's$ share of total value added in manufacturing in 2000 in country *k*.

The focus of our analysis is on the interaction between *Financial inclusion index* and *IES*.[41] *IES* is a vector of two variables such as *External finance dependence*$_i$ and *Small firm share*$_i$. First, *External finance dependence*$_i$ is a measure of the industry $i's$ dependence on external finance is based on the US firms from Rajan and Zingales (1998). Second, *Small firm share*$_i$ is the industry $i's$ share of employment by firms with less than *N* employees (*N* is either 5 or 10 or 20) is based on the US firms in 1997 from Beck et al. (2008). $\varepsilon_{i,k}$ is the error term. If η is positive and significant, this suggests inclusive financial system exerting a disproportionately positive effect on industries that rely more on external finance (or on small firm industries).

The results of the OLS regressions are reported in columns 1-4 in Table 10. Though the adopted methodology reduces potential endogeneity problems, we explore the robustness of our results using an instrumental variable approach in column 5-8. Looking at column 1, we find that industries that are heavy users of external finance grow faster in economies with inclusive financial systems, as indicated by the positive and significant interaction between *Financial inclusion index* and *External finance dependence*. In columns 2-4, the interactions of *Financial inclusion index* and *Small firm share* (< 5 or 10 or 20 employees) enter positively and significantly at the 5% level. It suggests that small firm industries–i.e., industries with larger shares of small firms–grow faster in economies with higher levels of financial inclusion, and the magnitude of this effect is relatively stronger in the industries that have relatively smaller share of employment of firms. All these results are in line with previous studies (e.g., Rajan and Zingales, 1998; Beck et al., 2008).

7. Enabling inclusive financial environment: difference-in-differences approach

In this section, we exploit the exogenous variation of developing counties' membership timing into a global network of policymakers with inclusive finance agenda, and evaluate the effects of enabling inclusive financial environment on banking stability by using both parametric (difference-in-differences) and non-parametric matching estimators while employing bank- and country-level data.

[41] We do not include financial inclusion index on its own, since we focus on within-country, within-industry growth rates (see e.g., Kroszner et al., 2007; Beck et al., 2008).

In the aftermath of the global financial crisis that took place in 2008, the leaders of the Group of Twenty (G20) recognised the mutually reinforcing policy objectives of financial inclusion, stability and consumer protection.[42] They committed to increase access of the disadvantaged groups to financial services through principles for innovative financial inclusion at the ***Pittsburgh Summit in 2009***. These principles were drafted by three Financial Inclusion Experts Group namely the Alliance for Financial Inclusion (funded by the Bill and Melinda Gates Foundation), the Consultative Group to Assist the Poor (CGAP), and the World Bank Group's private financing arm, the International Finance Corporation (IFC) (Soederberg, 2013). Among these expert groups, AFI is founded in 2008 and known as the first global knowledge sharing network for policymakers on financial inclusion. At present, AFI's network is composed of central banks and other financial institutions from more than 90 countries. In 2011, to complement G20 principles, the Maya Declaration was signed by a group of developing country regulatory institutions at the third Global Policy Forum of the AFI held in Mexico to strengthen and expand financial inclusion policy (see Online Appendix Table E4 for detail on the G20 principles and Maya Declaration commitments). However, we find 30 out of 87 countries in our sample that become member of the AFI network after the first Global Policy Forum of ***AFI held in Nairobi in 2009***. Since they become member of this network, they could share knowledge on financial inclusion as well as develop and implement policies designed to expand access of the poor people to financial services. Since then, broadening financial inclusion has become an important policy objective for these member countries and has set the stage for many enabling laws and regulations to support the poor.[43]

[42] http://www.afi-global.org/sites/default/files/afi%20g20%20principles.pdf

[43] The list of supporting laws and regulations that have been taken by developing countries to broaden financial inclusion are exhaustive and not limited to the following selective instances. For example: In 2009, Pakistan created consultative group on branchless banking and launched risk sharing facility for small and rural enterprises; Fiji established national taskforce on financial inclusion and agreed on medium-term financial inclusion strategy to reach 150,000 unbanked. In 2010, Bangladesh established microcredit regulatory authority regulations; Ethiopia developed growth and transformation plan that includes a national financial inclusion strategy; and Morocco implemented financial inclusion strategy. In 2011, El Salvador passed a law appointing the Central Bank the head of public policies on the financial system, including financial inclusion; Mexico created the National Council for Financial Inclusion (CONAIF) through Presidential Decree; Democratic Republic of Congo launched mobile banking services. In 2012, Bangladesh began licensing mobile banking; Brazil launched action plan for the national partnership for financial inclusion; Colombia undertook massive expansion of mobile financial services and expanded the number of banking agents; India, issued policy guidelines for expanding the banking network to unbanked customers. For more please visit AFI's website.

Since the banks of these member countries are exposed to various financial access policies, we assume that the changing inclusive financial environment will have discernible effect on the risk-taking of the banks. Therefore, using bank— and country—level data, we investigate whether the financial access policies have any effect on banking stability applying a difference-in-differences approach as followings:

$$\begin{aligned} Bank\ Stability_{ijt} = {} & \alpha_0 + \alpha_i + \gamma(\text{Pro}-\ financial\ Access\ Policy)_{jt\text{-}1} + \beta_1 Loan\ Ratio_{ijt} + \beta_2 Bank\ Size_{ijt} \\ & + \beta_3 Loan\ Loss\ \ \text{Pr}ovision_{ijt} + \beta_4 Income\ Diversification_{ijt} \\ & + \beta_5 Management\ Quality_{ijt} + \beta_6 Bank\ Equity_{ijt} + \beta_7 Bank\ Competition_{ijt} \\ & + \beta_9 GDP\ Growth_{jt} + \beta_{10} Per\ Capita\ GDP_{jt} + Year_t + \varepsilon_{ijt} \end{aligned} \tag{10}$$

where i indexes bank, j indexes countries, and t indexes years. $Bank\ stability_{ijt}$ is the financial stability of banks as defined earlier. The country and year fixed effects are denoted as α_j and α_t, respectively (we also use bank fixed effects as a robustness test in Table 11). The analogous bank- and country-specific controls are used as in equation (6). Lagged values of efficiency adjusted Lerner indices are used as the proxy for bank competition in order to eliminate any endogeneity issue. *Pro-financial Access Policy*$_{jt\text{-}1}$ is an indicator variable that takes a value equal to one if the bank is in a country that became a member of AFI's network in 2009 and thereafter or else zero (see Table D1 for membership timing across countries). In this case, our variable of interest is γ. If exposure to AFI's network is congenial to broadening financial inclusion, then the estimated coefficient of banking stability will show a positive outcome. This coefficient captures the sensitivity of the dependent variable to the changes in financial inclusion between a group of countries that is exposed to a treatment (henceforth treated) and a group that is not exposed to the treatment (henceforth control) after becoming member of the AFI network.[44] Since we are controlling both groups before and after the events and same group is acting as control and treated in this methodology we are able to control for both observables and unobservable factors that may have changed over time as well. By so doing, we are able to eliminate any bias that emanates from changes other than the *Pro-financial access policies* that could have affected the treated group (Imbens and Wooldridge, 2009). Similar type of regression is used by Jayaratne and Strahan (1996) and Koetter et al. (2012) on cross-state setup for US banking sector, Haselmann et al. (2010) on cross-country setup for East European countries.

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

For the DID approach to be meaningful, there are two aspects that should be taken into consideration. First, the changes in the efforts of broadening financial inclusion need to be exogenous and second, comparison groups should be homogeneous. The first issue whether changes in the efforts of financial inclusion are exogenous or endogenous has little effect on our DID result as most of the policy suggestions were encouraged by various multilateral organisations (e.g., G20, AFI and World Bank). This shows the exogenous nature and randomness in embracing innovative access policy initiatives. In addition, endogeneity is less of a concern for our analysis as we investigate the impact of a country-level indicator on bank-level stability. We are mostly concerned about the second issue of getting a comparison group that should serve as a valid counterfactual. To eradicate selection bias and confounding factors, in the spirit of Ho et al. (2007), we use propensity score matching, developed by Rosenbaum and Rubin (1983) to get a matched comparison group and then run difference-in-differences regression on the matched sample. This doubly robust technique provides unbiased estimates of the treatment effects even if either or both of the procedures are correctly specified and could be considered of the exposure similar to that from a randomised trial (Funk et al., 2011). This approach also allows us to estimate the treatment effects while controlling for both observed and unobserved bank- and country-specific characteristics. First, we adopt a nearest-neighbor logit propensity score matching strategy to identify non-member countries of AFI which are similar to the member countries on the basis of observable characteristics.[45] Second, each member country of AFI is matched with non-member country that has the closest propensity score within a given caliper (i.e., threshold). Third, regressions are run on the matched sample using difference-in-differences approach.

Panel A of Table 11 reports the results of DID estimation on a matched sample. In all specifications, year dummies are included to control for the business cycle. Standard errors are clustered at the country-level as omitted country characteristics might cause error terms to be correlated for banks within the same country. While we control for country fixed effects in column 1-4, we consider bank fixed effects in column 5-8. The result shows that financial stability of the banks that operate in the treated countries has increased substantially following the changes in financial access policies. As can be seen from column 1 and 3 that the indicator *Pro-financial*

[45] Observable characteristics are the industry average total asset, GDP per capita, GDP growth rate, financial freedom, and regulatory quality. Balancing tests are satisfied and reported along with the Logit model in the Online Appendix Table E5.

Access Policy is positive and significantly related with banking stability, to reduce the residual variance while increasing efficiency of the DID results, we use the analogous controls as in equation (6) in columns 2 and 4. The outcomes are robust even after controlling for bank- and country-specific control variables. The economic impact of the financial access policies on banking stability is considerable. The increasing efforts of having inclusive financial system have improved the soundness of the banks that operate in the treated countries by 36%.[46] The results also corroborate when we control for unobserved bank-specific characteristics in column 5-8.

To further alleviate any potential selection bias and confounding in the treatment effects, that might yet remain in the DID results, we use two other matching techniques (i.e., kernel and stratification) and recently developed covariate matching estimator of Abadie and Imbens (2006) to estimate the average treatment effect for the treated (ATT).[47] For the latter case, ATT is estimated matching on four nearest neighbours (Abadie et al., 2004). The advantage of this approach is that it employs covariates to match treatment group and control group.[48] It also corrects for bias if matching is imperfect, and calculates heteroskedasticity robust standard errors of the treatment effects without making any assumption about the functional form.

Panel B of Table 11 reports the results of the matching estimators. In all matching estimators, we impose common support condition to restrict control groups to fall within the support of the propensity score distribution of the treated groups. The result corresponds to the earlier findings that after changes in the efforts of having inclusive financial system the stability of the banks that operate in the treated countries increases by 42% (averaging across all matching estimators). The results once again reiterate that inclusive financial sector has causal effect on the soundness of banks. The result is also consistent with the economic rationale that greater institutional pursuit to financial inclusiveness helps reducing the informational asymmetry between borrowers and lenders.

We subject our findings to a series of additional sensitivity checks. The results are robust to (i) using an alternative measure of financial inclusion that is taken from Global Findex database,

[46] We follow Halvorsen and Palmquist (1980), and calculate the effect of the indicator variable (i.e., *AFI*) averaging across column 1-4 as $(\exp(\gamma)-1)$, where γ is the coefficient of interest in our semi-logarithmic equation.

[47] While kernel matching estimator matches the treated units with weighted average of all control units, with weights that are inversely proportional to the distance in terms of their propensity score, stratification matching estimator divides the common support into different strata and measures the treatment's effect within each interval. For details on the matching methods see Lin and Ye (2007) and De Mendonça and e Souza (2012).

[48] In Abadie and Imbens, we use similar pre-treatment characteristics as in the Online Appendix Table E5 for matching.

(ii) using an alternative measure of bank stability, which is calculated taking five years rolling windows of standard deviation of return on assets, (iii) dropping cooperative banks and Islamic banks from the sample, where regressions are run keeping only commercial banks, (iv) dropping countries (e.g., Japan and Italy) that constitute the lion's share of the sample, (v) running regressions only for the sample of developing country, and finally (vi) exploiting cross-country and cross-time variation in the inclusive banking agenda, and investigating causal effect of enabling inclusive financial environment on banking stability. For all of these alternative setups the main findings of this study largely remain unaltered.

8. Concluding remarks and policy implications

Broadening access of the disadvantaged groups to formal financial system has numerous benefits as documented in the literature, including greater efficiency in the allocation of resources, social and political stability, more innovation, and economic growth. When financial system becomes more inclusive, this generally results in greater opportunity for banks to diversify lending and funding strategies while reducing distance facilitating strong relationship with customers who were previously excluded from the formal financial sectors. But, since expanding access of low income groups to financial services is perceived as risky, whether financial inclusion is complementary or antagonistic to the issue of bank stability remains the subject of a continuing debate among academics and policymakers alike both from a theoretical and from an empirical perspective.

This paper has therefore contributed to this debate addressing the most contemporary policy issue related to financial development, financial inclusion, and bank stability, using an international sample of 2,913 banks in 87 countries for the period 2004 to 2012. First, we have constructed a new country-level composite index of financial inclusion using principal components analysis, and ranked countries based on the score of this index. Despite the shortcomings of data availability, the constructed index has good predictive power in tracking the micro-level indicators of Global Findex such as the share of households with savings and bank accounts at formal financial institutions as well as the WBES's firm-level access to finance (and/or financing obstacles). Second, given the changing milieu of banking operations, where formal financial institutions increasingly searching for new opportunities and markets and seeing the benefits of micro-finance style of operations, this is the first study that investigates such an important issue to

provide some understanding on the access to finance and bank stability nexus. Considering the overriding interest of inclusive economic growth and relatively substantive emphasis on the financial stability in the post crisis era, we therefore investigate the influence of inclusive financial systems on banking stability in a panel setting. Third, since one of the tasks of bank regulation is to curb the adverse effect of banking competition on stability (see Beck et al., 2013), we also check whether the relationship between financial inclusion and bank stability changes due to higher competition, as measured by lower level of Lerner indices of two variants. Fourth, we check whether the institutional settings in which banks operate have any influence on the access-stability nexus. Finally, we subject our findings to an array of sensitivity checks including splitting sample into terciles based on the financial inclusion index, using alternative measures of banking stability and financial inclusion, and using different sample specifications, particularly running regressions on the sample of developing countries. We also exploit the cross-country and temporal variation in the membership timing of developing countries' into a network of financial inclusion of policymakers and explore whether enabling inclusive financial environment has any causal effect on banking stability, using parametric (difference-in-differences) as well as semi-parametric matching estimators.

Our results indicate that there is a strong link between financial inclusion and bank stability. In particular, the higher the degree of financial inclusion, the better is the banking stability. The evidence also suggests that any beneficial effects of financial inclusion on bank stability tend to be more pronounced in banking sectors with less competition. As banks expand operations towards new markets to serve previously underserved and/or excluded adult population, they are able to reduce excessive risk taking if the environment in which they operate is less competitive. Furthermore, investigating the influence of institutional settings on the access-stability relationship, we also find that the positive impact of financial inclusion on stability reinforces if the country in which banks operate has greater institutional quality. Specifically, greater freedom of expression, political stability, regulatory quality, and rule of law enhance the positive relationship between financial inclusion and bank stability. The DID approach shows that supporting inclusive financial system increases soundness of banks of the treated countries by almost 36%. Consistent with these findings, we also find that industries that are naturally composed of small firms, and that are heavy users of external finance grow faster in economies

with higher levels of financial inclusion as more inclusive financial sectors mitigate market frictions while ensuring efficient allocation of credit to the real sector of an economy.

Our results have important policy implications. The findings suggest that banking stability is strongly influenced by the degree to which the poorest of the poor individuals and small enterprises have access to basic financial services, which indicates the importance of ensuring an inclusive financial system. An inclusive financial system will allow banks to exploit the untapped potential of customers who were previously unbanked or under-banked, and strengthen their balance sheets while making them more resilient against a possible future shock. Since expanding access to financial services is a key ingredient of financial development strategies, the concerted and sustained efforts of formal financial institutions to allocate resources in more productive areas of the economy would make them more profitable. Existing evidence supports this notion that average profitability is higher if lenders provide loans repeatedly to the same customer because of less default probabilities associated with experienced borrowers (see Karlan and Zinman, 2010). As only 41% people in the developing countries compared to 89% in developed ones have bank accounts (see Demirgüç-Kunt and Klapper, 2012), additional policies should focus on ensuring access for all of the excluded from formal financial services, especially in the developing ones.

Furthermore, our results also stress the importance of the underlying competitive and institutional framework. The beneficial effects of financial inclusion on bank stability are more in countries where market power of banks and country's institutional qualities are high. In this respect, since competition is perceived to be instrumental to broadening access to finance but detrimental to banking stability, broadening access without paying attention to potential negative consequences of competition on financial stability is obviously suboptimal. Therefore, it is important for the authorities to strike the right balance between financial inclusion and bank competition while avoiding financial fragility. They should also continue the efforts of establishing an institutional environment that will complement the access-stability nexus. In the end, however, only more empirical research using both supply- and demand-side data on access will provide comprehensive picture of the effects of financial inclusion on banking stability and whether bank competition and institutional quality reduces or reinforces this relation.

Appendix A

See Table A1.

Appendix B

See Table B1.

Appendix C

See Table C1.

Appendix D

See Table D1.

Online Appendix E

See supplementary material.

Table A1
Variable definitions and data sources

Variable	Definitions	Source
Dependent Variables		
Zscore	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)	BankScope
Volatility of ROA	Standard deviation of ROA for each bank, calculated over past 3 years	BankScope
Financial Inclusion		
Penetration	The number of deposit and loan accounts per 1000 adults	IMF
Availability	The outreach dimension constructed using principal component analysis (PCA) from the variables related to geographic and demographic availability of branches and ATMs	Authors' calculation
Usage	Total volume of deposit and loans relative to GDP	IMF
Financial inclusion index	Financial inclusion index is constructed using PCA from the penetration, availability and usage dimensions.	Authors' calculation
Bank competition		
C-Lerner	A bank-level non-structural indicator of bank competition, measured by using a stochastic frontier analysis approach assuming full bank efficiency, with lower values indicating higher competition in the banking sector	Authors' calculation
E-Lerner	A bank-level non-structural indicator of bank competition, an efficiency-adjusted Lerner index, measured by using a stochastic frontier analysis approach, with lower values indicating higher competition in the banking sector	Authors' calculation
Firm-specific variables		
Access to finance	Dummy variable equal to 1 if the firm has access to bank finance (loan, overdraft or line of credit)	WBES
Financing Obstacle	Financing obstacle is defined on five point scale how problematic is financing for the operation and growth of business: (0) No obstacle (1) minor obstacle (2) moderate obstacle (3) major obstacle, and (4) very severe obstacle.	WBES
Firm size (employees)	The number of permanent full-time employees	WBES
Manufacturing	Dummy variable equal to 1 if the firm is in the manufacturing sector	WBES
Exporter	Dummy variable equal to 1 if 10 percent or more of sales are exported directly or indirectly by the firm	WBES
Foreign-owned	Dummy variable equal to 1 if 50 percent or more of the firm is owned by foreign organisations	WBES
Government-owned	Dummy variable equal to 1 if 10 percent or more of the firm is owned by the government	WBES
Firm age	Age of the firm in years	WBES
Industry-specific variables		
Growth rate in real value added	Annual (compounded) growth rate in real value added for 2000-2010 in a particular industry in each country over 2000-2010.	UNIDO INDSTAT4, 2010
Share in value added in 2000	The industry's share in total value added in manufacturing in 2000 for each industry in each country.	UNIDO INDSTAT4, 2010
External finance dependence	The fraction of capital expenditures not financed with internal funds for US firms in the same industry between 1980 and 1990. It is defined as the difference between capital expenditures and cash flow from operations scaled by capital expenditures.	Rajan and Zingales (1998)
Small firm share (< N employees)	Small firm share is the industry's share of employment by firms with less than N employees (N is either 5 or 10 or 20). These industry level variables are calculated by using data from the US Census on all US firms for the year 1997.	Beck et al. (2008)

Variable	Definitions	Source
Bank-specific variables		
Loan ratio	Total performing loans divided by total assets	BankScope
Loan loss provisions (LLP)	Total loan loss provision divided by total assets	BankScope
Income diversification	Non-interest income divided by total operating income	BankScope
Management quality	Total earning assets divided by total assets	BankScope
Equity ratio	Total equity divided by total assets	BankScope
Country-specific variables		
GDP growth rate	The growth rate of GDP	World Bank
GDP per capita	The natural logarithm of per capita GDP	World Bank
Voice and accountability (Voice)	The indicator measures the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and free media. Higher values mean greater political rights	Kaufmann, Kraay and Mastruzzi (2010)
Political stability (Political)	The indicator measures the perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including political violence and terrorism. Higher values mean more stable political environment	Kaufmann, Kraay and Mastruzzi (2010)
Government effectiveness (Government)	The indicator measures the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Higher values mean higher quality of public and civil service	Kaufmann, Kraay and Mastruzzi (2010)
Regulatory quality (Regulatory)	The indicator measures the ability of the government to formulate and implement sound policies and regulations that permit and promote market competition and private-sector development. Higher values mean higher quality of regulation	Kaufmann, Kraay and Mastruzzi (2010)
Rule of law (Law)	The indicator measures the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence. Higher values mean stronger law and order.	Kaufmann, Kraay and Mastruzzi (2010)
Control of corruption (Corruption)	The indicator measures the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as ''capture'' of the state by elites and private interests. Higher values indicate better control of corruption.	Kaufmann, Kraay and Mastruzzi (2010)
Institutional quality index (IQI)	Institutional quality index is constructed using principal component analysis from the Voice, Political, Government, Regulatory, Law, and Corruption indexes of Kaufmann, Kraay and Mastruzzi (2010)	Authors' calculation
Legal efficiency	Legal efficiency is the country's efficiency of the legal system. Higher values indicate more efficient legal system.	La Porta et al. (1998)
Property rights	Property rights is a measure of the degree to which a country's laws protect private property rights and the degree to which its government enforces those laws.	Heritage Foundation (2014)
Credit information depth	Credit information depth is a measure of the degree to which credit information is available through either a public credit registry or a private credit bureau.	Djankov et al. (2007), World Bank "Doing Business" Database

Table B1
Principal component analysis for financial inclusion index

Panel A	Notation	PC1	PC2	PC3	PC4
Eigenvalue		2.81	0.69	0.45	0.05
% of variance		0.70	0.17	0.11	0.01
Variable					
Geographic penetration of Branches	AGB	0.52	-0.46	-0.38	-0.61
Geographic penetration of ATMs	AGA	0.52	-0.50	0.34	0.61
Demographic penetration of Branches	ADB	0.47	0.55	-0.59	0.36
Demographic penetration of ATMs	ADA	0.48	0.50	0.63	-0.35
Panel B		PC1	PC2	PC3	
Eigenvalue		1.54	0.99	0.46	
% of variance		0.51	0.33	0.15	
Variable					
Accessibility/Penetration Dimension	Penetration	0.71	-0.02	-0.71	
Availability Dimension	Availability	0.71	-0.06	0.71	
Usage Dimension	Usage	0.06	1.00	0.03	

Note: AGB = the number of branches per 1,000 km2; AGA = the number of ATMs per 1,000 km2; ADB = the number of branches per 100,000 adults; ADA = the number of ATM per 100,000 adults; Penetration = the number of deposit and loan accounts per 1000 adults; Availability = The Outreach Dimension; Usage = Total volume of deposit and loans relative to GDP.

Table C1
Inclusive financial system and firm financing obstacle or access to finance, firm level results

We run ordered probit model when *Financing Obstacle* is the dependent variable and logit model for the case of *Access to Finance*. In both cases, robust standard errors are reported in the brackets. Both dependent variables are constructed using the World Bank Enterprise Surveys. In the case of former, firms were asked to rate on a five point scale how much of an obstacle is access to finance for the operation and growth of the business: (0) No obstacle (1) minor obstacle (2) moderate obstacle (3) major obstacle (4) very severe obstacle. For the latter case, *Access to Finance* is a dummy variable that indicates whether the firm has access to a loan, overdraft, or a line of credit. The *firm size* is the logarithm of the firms' total number of permanent employees. The dummy variable *Exporter* indicates that firms are involved in exporting. The *Manufacturing* dummy indicates that a firm is in the manufacturing sector. *Government-owned* and *Foreign-owned* are dummies that is equal one if the firm has government or foreign ownership, respectively. Log *firm age* is the logarithm of the firm's age in years. *GDP growth rate* is the annual growth rate in percentage. Regional dummies are Sub-Sahara Africa, Asia and Pacific, Europe, Americas, and South Asia, with the Middle East and North Africa being the omitted category. . ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: World Bank Enterprise Surveys and WDI. Coverage: 2004-2012.

	Financing Obstacle		**Access to Finance**	
VARIABLES	coefficient	se	coefficient	se
Financial Inclusion	-0.361***	[0.040]	2.570***	[0.088]
Log firm size (employees)	-0.046***	[0.004]	0.174***	[0.009]
Exporter	-0.024*	[0.015]	0.594***	[0.031]
Manufacturing	0.143***	[0.012]	-0.193***	[0.025]
Foreign-owned (>=50% shares)	-0.250***	[0.020]	-0.199***	[0.041]
Government-owned (>=10% shares)	-0.065*	[0.037]	-0.894***	[0.076]
Log Firm Age	-0.079***	[0.011]	0.370***	[0.022]
GDP growth rate	0.002*	[0.001]	-0.066***	[0.003]
Sub-Sahara Africa	0.374***	[0.057]	0.512***	[0.120]
Asia and Pacific	-0.371***	[0.057]	0.337***	[0.121]
Europe	0.268***	[0.059]	-0.245**	[0.125]
Americas	0.199***	[0.057]	1.109***	[0.121]
South Asia	0.230***	[0.067]	0.560***	[0.139]
Observations	38,987		38,987	
No of countries	64		64	
Pseudo R-squared	0.02		0.11	

Table D1
The Alliance for Financial Inclusion membership timing across countries

Country	Year	Country	Year	Country	Year	Country	Year
Afghanistan	2009	Colombia	2009	Malaysia	2009	South Africa	2010
Angola	2011	Ecuador	2010	Mongolia	2010	Tanzania	2010
Armenia	2011	El Salvador	2009	Mozambique	2011	Thailand	2009
Bangladesh	2009	Ghana	2010	Namibia	2011	Uganda	2009
Brazil	2010	India	2009	Pakistan	2009	Yemen, Rep.	2009
Burundi	2009	Indonesia	2009	Panama	2009	Zambia	2010
Cameroon	2009	Jamaica	2010	Philippines	2009		
Chile	2011	Kenya	2009	Rwanda	2009		

Source: http://www.afi-global.org/afi-network/members
Note: the years indicate when country become member of AFI and participated into cooperative and consultative efforts to enhance financial inclusion in their countries. 30 out of 87 countries' central bank become member of AFI since 2009 in our sample period.

Table 1
Summary Statistics

Panel A: Bank-level analysis	Mean	Median	SD	Min	Max	N
Z-score	3.72	3.76	1.35	0.30	7.72	13836
Volatility of ROA	6.08	6.01	1.41	0.81	12.13	13836
Penetration	0.51	0.38	0.35	0.00	1.00	13836
Availability	0.63	0.79	0.34	0.01	1.00	13836
Usage	0.12	0.00	0.22	0.00	1.00	13836
Financial inclusion index	0.57	0.61	0.30	0.01	0.98	13836
C-Lerner	0.05	0.09	0.29	-1.39	0.80	13836
E-Lerner	0.13	0.14	0.24	-0.75	0.88	13836
Loan ratio	0.55	0.57	0.19	0.00	1.00	13836
Total assets	7.12	6.96	1.90	-1.83	14.91	13836
LLP ratio	0.01	0.01	0.04	-0.28	2.69	13836
Income diversification	0.16	0.14	0.82	-24.25	82.21	13836
Management quality	0.91	0.95	0.10	0.03	1.11	13836
Equity ratio	0.11	0.09	0.09	0.00	0.93	13836
Systemic banking crisis dummy	0.06	0.00	0.24	0.00	1.00	13836
GDP growth rate	0.02	0.02	0.04	-0.18	0.23	13836
GDP per capita	9.52	10.28	1.35	4.99	11.12	13836
Property rights	59.41	55.00	21.43	0.00	90.00	13836
Credit information depth	4.69	5.00	1.60	0.00	6.00	13784
Voice and accountability	0.68	0.95	0.70	-2.10	1.75	13836
Political stability	0.33	0.51	0.81	-2.81	1.49	13836
Government effectiveness	0.71	0.45	0.86	-1.37	2.43	13836
Regulatory quality	0.71	0.95	0.73	-1.62	1.96	13836
Rule of law	0.61	0.42	0.91	-1.69	1.98	13836
Control of corruption	0.58	0.25	0.98	-1.46	2.27	13836
Institutional quality index	0.00	-0.01	2.31	-6.30	3.71	13836
Panel B: Firm-level analysis	**Mean**	**Median**	**SD**	**Min**	**Max**	**N**
Access to Finance	0.61	1.00	0.49	0.00	1.00	38987
Financing Obstacle	1.54	1.00	1.36	0.00	4.00	38987
Log firm size (employees)	2.55	2.30	1.49	0.00	11.51	38987
Exporter	0.20	0.00	0.40	0.00	1.00	38987
Manufacturing	0.58	1.00	0.49	0.00	1.00	38987
Foreign-owned (>=50% shares)	0.10	0.00	0.30	0.00	1.00	38987

Government-owned (>=10% shares)	0.03	0.00	0.16	0.00	1.00	38987
Log Firm Age	3.01	2.94	0.55	0.69	5.37	38987
Panel C: industry growth analysis	**Mean**	**Median**	**SD**	**Min**	**Max**	**N**
Growth rate in real value added	0.04	0.03	0.08	-0.20	0.84	672
Share in value added in 2000	0.03	0.02	0.04	0.00	0.38	672
External finance dependence	0.34	0.24	0.38	-0.15	1.49	672
Small firm share (< 5 employees)	0.01	0.01	0.01	0.00	0.04	578
Small firm share (< 10 employees)	0.03	0.02	0.02	0.00	0.10	578
Small firm share (< 20 employees)	0.06	0.04	0.05	0.01	0.20	603
Financial inclusion index	0.49	0.46	0.28	0.06	0.99	672
E-Lerner	0.12	0.17	0.27	-0.74	0.63	672
GDP per capita	9.23	9.82	1.34	6.33	11.09	672
Legal efficiency	7.50	7.25	2.12	2.50	10.00	672
Property rights	4.11	4.00	0.84	3.00	5.00	672
Credit information depth	4.60	5.00	1.46	0.00	6.00	672
Institutional quality index	0.03	0.53	2.31	-3.64	3.64	672

Table 2
The estimation results for the banking stability and financial inclusion.
Source: Author's calculation.

Country	Zscore	Financial inclusion index	Penetration	Availability	Usage	No. of Banks
Asia						
Afghanistan	16.83	**0.012 (87)**	0.015 (80)	0.01 (87)	0.015 (37)	9
Armenia	48.67	0.224 (56)	0.254 (51)	0.187 (51)	0.097 (18)	14
Azerbaijan	29.07	0.136 (65)	0.121 (61)	0.134 (63)	0 (86)	21
Bangladesh	79.28	0.46 (23)	0.32 (41)	0.594 (16)	0.08 (19)	12
Cambodia	42.98	0.072 (74)	0.023 (77)	0.043 (77)	0.906 (4)	12
Cyprus	27.84	0.365 (37)	0 (83)	0.732 (13)	0.001 (67)	13
Georgia	21.59	0.285 (47)	0.385 (30)	0.187 (52)	0.001 (69)	12
Hong Kong SAR, China	81.60	0.389 (31)	0 (83)	0.775 (10)	0.037 (26)	28
India	94.71	0.373 (35)	0.317 (42)	0.421 (23)	0.025 (33)	62
Indonesia	59.24	0.233 (54)	0.286 (48)	0.097 (67)	1 (1)	61
Japan	124.72	**0.977 (3)**	1 (1)	0.937 (4)	0.195 (14)	457
Jordan	102.00	0.272 (48)	0.382 (32)	0.167 (54)	0.001 (72)	12
Kazakhstan	59.26	0.304 (44)	0.488 (23)	0.116 (65)	0.065 (23)	27
Korea, Rep.	57.60	**0.991 (1)**	0.927 (6)	0.992 (1)	1 (1)	14
Kuwait	52.57	0.292 (46)	0.294 (46)	0.292 (32)	0 (87)	12
Lebanon	109.28	0.496 (18)	0.347 (37)	0.555 (18)	1 (1)	33
Malaysia	46.29	0.48 (21)	0.709 (13)	0.251 (38)	0.005 (46)	14
Mongolia	31.58	0.421 (26)	0.336 (39)	0.285 (33)	0.652 (7)	3
Pakistan	55.04	0.076 (73)	0.079 (64)	0.074 (70)	0.021 (34)	11
Philippines	68.94	0.116 (66)	0.089 (63)	0.141 (60)	0.032 (30)	22
Saudi Arabia	55.85	0.271 (49)	0.373 (33)	0.141 (62)	0.002 (63)	12
Singapore	84.71	0.368 (36)	0 (83)	0.736 (12)	0.003 (50)	13
Thailand	78.85	0.475 (22)	0.652 (15)	0.295 (31)	0.037 (25)	21
Turkey	56.40	0.524 (16)	0.812 (11)	0.236 (41)	0.001 (77)	27
United Arab Emirates	76.16	0.296 (45)	0.345 (38)	0.214 (48)	0.003 (53)	24
Uzbekistan	85.38	0.138 (64)	0.01 (82)	0.233 (42)	0.404 (9)	9
Yemen, Rep.	43.20	**0.021 (86)**	0.02 (78)	0.018 (86)	0.037 (27)	6
Average/Total	**62.58**	**0.336**	**0.318**	**0.328**	**0.208**	**961**
Europe						
Austria	112.13	0.354 (39)	0.274 (49)	0.434 (22)	0.001 (79)	158
Belgium	79.91	**0.981 (2)**	0.939 (4)	0.961 (2)	0.002 (56)	27
Bosnia and Herzegovina	91.98	0.312 (43)	0.327 (40)	0.264 (35)	0.001 (73)	19
Bulgaria	46.98	0.711 (8)	0.835 (9)	0.586 (17)	0.002 (59)	17
Croatia	81.44	0.386 (33)	0.261 (50)	0.459 (20)	0.003 (49)	29
Estonia	46.91	0.618 (11)	0.931 (5)	0.3 (30)	0.008 (40)	7
Finland	53.05	0.542 (15)	0.885 (8)	0.252 (37)	0.001 (78)	10
Greece	59.62	0.545 (14)	0.627 (17)	0.457 (21)	0.001 (66)	10
Hungary	49.68	0.417 (27)	0.412 (28)	0.407 (24)	0.186 (15)	22
Iceland	26.78	0.206 (58)	0 (83)	0.401 (25)	0.139 (17)	5
Ireland	38.98	0.489 (20)	0.368 (35)	0.611 (15)	0.001 (64)	8

Country	Zscore	Financial inclusion index	Penetration	Availability	Usage	No. of Banks
Italy	92.70	0.564 (12)	0.184 (54)	0.944 (3)	0.001 (82)	489
Latvia	22.59	0.393 (30)	0.482 (24)	0.305 (29)	0.001 (75)	19
Macedonia, FYR	52.70	0.492 (19)	0.685 (14)	0.247 (39)	0.027 (32)	13
Malta	131.28	0.921 (4)	1 (1)	0.841 (7)	0.001 (65)	7
Moldova	34.96	0.327 (42)	0.528 (20)	0.126 (64)	0.005 (45)	12
Montenegro	64.28	0.386 (32)	0.429 (26)	0.307 (28)	0.001 (71)	7
Netherlands	67.89	0.83 (5)	0.913 (7)	0.747 (11)	0.001 (74)	27
Norway	40.00	0.089 (69)	0 (83)	0.179 (53)	0.015 (38)	12
Portugal	31.27	0.785 (7)	0.647 (16)	0.923 (5)	0.002 (61)	18
Serbia	36.48	0.385 (34)	0.401 (29)	0.337 (27)	0.073 (21)	28
Spain	115.74	0.816 (6)	0.752 (12)	0.879 (6)	0.001 (68)	89
Switzerland	330.24	0.694 (9)	0.585 (18)	0.803 (8)	0.002 (54)	124
Ukraine	38.50	0.52 (17)	0.824 (10)	0.202 (50)	0.004 (48)	14
United Kingdom	62.97	0.405 (29)	0.026 (76)	0.785 (9)	0 (83)	95
Average/Total	**72.36**	**0.527**	**0.533**	**0.510**	**0.019**	**1266**
Americas						
Argentina	38.53	0.256 (51)	0.373 (34)	0.141 (61)	0.001 (81)	50
Bahamas, The	98.50	0.429 (25)	0.522 (21)	0.34 (26)	0.001 (80)	11
Bolivia	42.00	0.083 (70)	0.071 (67)	0.075 (69)	0.003 (51)	10
Brazil	38.95	0.455 (24)	0.357 (36)	0.467 (19)	0.002 (55)	104
Chile	81.40	0.622 (10)	0.995 (3)	0.222 (46)	0.31 (12)	24
Colombia	68.90	0.414 (28)	0.545 (19)	0.149 (58)	0.77 (6)	21
Costa Rica	66.25	0.362 (38)	0.417 (27)	0.264 (36)	0.512 (8)	42
Dominican Republic	45.88	0.184 (61)	0.132 (59)	0.228 (45)	0.007 (42)	57
Ecuador	76.19	0.191 (60)	0.175 (56)	0.209 (49)	0 (84)	19
El Salvador	56.15	0.206 (57)	0.182 (55)	0.232 (43)	0 (85)	13
Honduras	81.41	0.143 (63)	0.142 (58)	0.144 (59)	0.009 (39)	15
Jamaica	79.12	0.343 (41)	0.471 (25)	0.229 (44)	0.019 (35)	5
Nicaragua	37.53	0.081 (71)	0.108 (62)	0.055 (71)	0.006 (43)	5
Panama	67.11	0.258 (50)	0.3 (45)	0.216 (47)	0.002 (62)	41
Peru	60.55	0.24 (52)	0.244 (52)	0.238 (40)	0.002 (58)	15
Trinidad and Tobago	72.20	0.345 (40)	0.382 (31)	0.273 (34)	0.002 (57)	9
Venezuela, RB	27.79	0.236 (53)	0.306 (44)	0.15 (57)	0.001 (70)	27
Average/Total	**61.09**	**0.285**	**0.337**	**0.214**	**0.097**	**468**
Africa						
Algeria	52.52	0.079 (72)	0.127 (60)	0.028 (82)	0.051 (24)	12
Angola	29.28	0.047 (80)	0.04 (70)	0.05 (73)	0.065 (22)	12
Botswana	31.01	0.199 (59)	0.307 (43)	0.086 (68)	0.002 (60)	7
Burundi	22.35	0.051 (79)	0.027 (75)	0.043 (76)	0.387 (10)	5
Cameroon	56.97	0.033 (83)	0.015 (81)	0.047 (75)	0.077 (20)	8
Egypt, Arab Rep.	52.70	0.102 (68)	0.155 (57)	0.05 (74)	0.004 (47)	21
Ghana	41.46	0.059 (76)	0.072 (66)	0.041 (78)	0.019 (36)	17
Kenya	63.71	0.055 (77)	0.072 (65)	0.037 (79)	0.034 (29)	29
Libya	151.23	0.051 (78)	0.053 (69)	0.051 (72)	0.001 (76)	6
Malawi	57.49	**0.027 (85)**	0.028 (73)	0.025 (83)	0.032 (31)	5
Mauritius	59.91	0.557 (13)	0.497 (22)	0.616 (14)	0.036 (28)	12
Mozambique	35.35	0.03 (84)	0.027 (74)	0.034 (80)	0.008 (41)	10
Namibia	108.44	0.231 (55)	0.292 (47)	0.109 (66)	0.003 (52)	6
Rwanda	20.65	0.112 (67)	0.06 (68)	0.151 (56)	0.186 (16)	7
South Africa	43.07	0.182 (62)	0.209 (53)	0.155 (55)	0.006 (44)	14
Tanzania	74.09	0.034 (82)	0.028 (72)	0.02 (85)	0.27 (13)	21
Uganda	35.78	0.044 (81)	0.036 (71)	0.025 (84)	0.341 (11)	14
Zambia	22.05	0.071 (75)	0.018 (79)	0.032 (81)	0.837 (5)	12
Average/Total	**53.23**	**0.109**	**0.115**	**0.089**	**0.131**	**218**

Table 3
The effect of financial inclusion on banking stability

The dependent variable is the Zscore–defined as the sum of return-on-assets and equity ratio divided by standard deviation of return-on-assets of each bank over past three years–reported in columns 1-2. As robustness tests, we use alternative bank stability proxy i.e., the (negative of the) standard deviation of a bank's return-on-assets. In this case, we follow Beck et al. (2013), and transform standard deviation of return-on-assets to make it directly proportional to bank stability–reported in columns 3-4. Bank competition is proxied by two variants of the Lerner indices i.e., conventional Lerner (*C-Lerner*) and efficiency-adjusted Lerner (*E-Lerner*). The Lerner index is interpreted as inverse of competition; the higher the index greater is the pricing power and implies less competitive market conditions. *Loan ratio* is measured as loans as a percentage of total assets. *Bank size* is the logarithm of total assets valued in million US dollar. *Loan loss provision* ratio is measured as a percentage of total assets, where income diversification is the ratio of non-interest income over total income. *The management quality* is measured as the total earning assets over total assets. *Capitalisation* is the bank total equity to asset ratio. To control for economic development, logarithm of *GDP per capita* is used, and *GDP growth rate* is used to account for condition of business cycle in each country. We employ instrumental variable (IV) technique with a GMM estimator. All regressions include year and bank fixed effects. *Financial inclusion index* is treated as endogenous variable, and it is instrumented via financial freedom, entry density and financial freedom times entry density. We report heteroskedasticity-autocorrelation robust standard errors (HAC). ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: BankScope and WDI. Coverage: 2004-2012.

Variables	**log(Zscore)**		**-log[sd(ROA)]**	
	1	2	3	4
	C-Lerner	E-Lerner	C-Lerner	E-Lerner
Loan Ratio	0.115	0.074	-0.06	-0.09
	[0.230]	[0.232]	[0.219]	[0.221]
Bank Size	0.397***	0.440***	0.420***	0.452***
	[0.080]	[0.080]	[0.076]	[0.076]
Loan Loss Provision	-2.102	-2.032	-2.091	-2.039*
	[1.448]	[1.336]	[1.300]	[1.220]
Income Diversification	0.003	0.004	0.005	0.005
	[0.014]	[0.013]	[0.015]	[0.014]
Management Quality	1.432***	1.474***	1.242***	1.277***
	[0.343]	[0.347]	[0.335]	[0.337]
Capitalisation	4.110***	3.900***	1.264***	1.135***
	[0.495]	[0.496]	[0.433]	[0.435]
C-Lerner (-1)	0.714***		0.527***	
	[0.072]		[0.066]	
E-Lerner (-1)		1.331***		0.929***
		[0.135]		[0.127]
Financial inclusion index	6.272***	6.518***	6.299***	6.489***
	[1.795]	[1.810]	[1.715]	[1.731]
GDP Growth Rate	5.253***	5.269***	5.062***	5.090***
	[0.881]	[0.881]	[0.842]	[0.843]
Per Capita GDP	-2.137***	-2.565***	-2.551***	-2.854***
	[0.702]	[0.721]	[0.676]	[0.696]
Observations	11,499	11,499	11,499	11,499
2nd-stage F-test	41.95***	42.34***	41.58***	40.73***
Under id test: KP LM statistic	80.54***	77.81***	80.54***	77.81***
Hansen J-test (p-value)	5.12 (0.08)	3.33 (0.19)	5.31 (0.07)	3.98 (0.14)
Endogeneity test	31.35***	31.28***	31.49***	31.71***

Table 4
Interactive effect of financial inclusion and bank competition on stability

The dependent variable is the Zscore–defined as the sum of return-on-assets and equity ratio divided by standard deviation of return-on-assets of each bank over past three years–reported in columns 1-2. As robustness tests, we use alternative bank stability proxy i.e., the (negative of the) standard deviation of a bank's return-on-assets. In this case, we follow Beck et al. (2013), and transform standard deviation of return-on-assets to make it directly proportional to bank stability–reported in columns 3-4. Bank competition is proxied by two variants of the Lerner indices i.e., conventional Lerner (*C-Lerner*) and efficiency-adjusted Lerner (*E-Lerner*). The Lerner index is interpreted as inverse of competition; the higher the index greater is the pricing power and implies less competitive market conditions. *Loan ratio* is measured as loans as a percentage of total assets. *Bank size* is the logarithm of total assets valued in million US dollar. *Loan loss provision* ratio is measured as a percentage of total assets, where income diversification is the ratio of non-interest income over total income. *The management quality* is measured as the total earning assets over total assets. *Capitalisation* is the bank total equity to asset ratio. To control for economic development, logarithm of *GDP per capita* is used, and *GDP growth rate* is used to account for condition of business cycle in each country. We employ instrumental variable (IV) technique with a GMM estimator. All regressions include year and bank fixed effects. *Financial inclusion index* and *Financial inclusion index times C-Lerner (E-Lerner)* are treated as endogenous variables, and they are instrumented following Table 3. We report heteroskedasticity-autocorrelation robust standard errors (HAC). ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: BankScope and WDI. Coverage: 2004-2012.

Variables	**log(Zscore)**		**-log[sd(ROA)]**	
	1	2	3	4
	C-Lerner	E-Lerner	C-Lerner	E-Lerner
Loan Ratio	0.119	0.058	-0.055	-0.101
	[0.231]	[0.232]	[0.220]	[0.221]
Bank Size	0.404***	0.441***	0.428***	0.453***
	[0.081]	[0.080]	[0.077]	[0.076]
Loan Loss Provision	-2.104	-2.051	-2.095	-2.053*
	[1.451]	[1.336]	[1.303]	[1.220]
Income Diversification	0.003	0.004	0.005	0.005
	[0.014]	[0.013]	[0.015]	[0.014]
Management Quality	1.460***	1.480***	1.271***	1.282***
	[0.343]	[0.348]	[0.335]	[0.338]
Capitalisation	4.146***	3.880***	1.302***	1.120**
	[0.497]	[0.497]	[0.435]	[0.436]
C-Lerner (-1)	0.334		0.089	
	[0.209]		[0.186]	
E-Lerner (-1)		1.135***		0.786***
		[0.153]		[0.142]
Financial inclusion index	6.418***	6.552***	6.454***	6.519***
	[1.787]	[1.813]	[1.709]	[1.733]
Financial inclusion index X C-Lerner	0.543**		0.626***	
	[0.258]		[0.233]	
Financial inclusion index X E-Lerner		0.410***		0.298**
		[0.139]		[0.117]
GDP Growth Rate	5.367***	5.315***	5.190***	5.127***
	[0.871]	[0.880]	[0.834]	[0.842]
Per Capita GDP	-2.257***	-2.649***	-2.685***	-2.917***
	[0.689]	[0.719]	[0.664]	[0.694]
Observations	11,499	11,499	11,499	11,499
2nd-stage F-test	41.63***	40.72***	41.15***	39.03***
Under id test: KP LM statistic	80.82***	77.44***	80.82***	77.44***
Hansen J-test (p-value)	5.44 (0.07)	3.59 (0.17)	5.68 (0.06)	4.19 (0.12)
AR chi-squared test	28.28***	25.54***	30.75***	28.18***
Endogeneity test	33.74***	32.02***	34.04***	32.35***

Table 5
The impact of financial inclusion and institutional quality interactions on banking stability

This table reports IV-GMM regressions of banking stability (i.e., log(Zscore)) on financial inclusion, six measures of institutional quality and their interactions. The analogous bank and macro controls are used as in equation (6). We use lagged values of efficiency adjusted Lerner index as the proxy for bank competition. Each interaction and its constituents are entered one at a time. For the sake of brevity, the results of the controls are not reported in this table but available upon request. Financial inclusion index and financial inclusion index times each institutional quality variables are treated as endogenous variables. The instrumental variables are financial freedom, a measure that shows the degree of openness of the banking system; labour freedom, a measure that considers various aspects of the legal and regulatory framework of a country's labour market including regulations concerning minimum wages, laws inhibiting layoffs, severance requirements, and measurable regulatory restraints on hiring and hours worked from the Heritage Foundation; entry density, a variable refers to the number of newly registered companies with limited liability per 1,000 working-age people (those ages 15-64) is from World Bank Doing Business Database; credit information depth, a measure that shows the degree to which credit information is available through either a public credit registry or a private credit bureau is from Djankov et al. (2007), World Bank Entrepreneurship Database. Instruments are reported at the bottom of this table. The institutional variables are collected from Kaufmann et al. (2010) dataset. The variable Voice and accountability (Voice) measures the degree of freedom of expressions and free media in a country. Political stability (Political) captures the perception of probability that the government is destabilized or overthrown by nonviolent or non-constitutional means. The variable Government effectiveness (Government) measures the quality in formulation and implementation and the commitment of the government with related policies. The regulatory quality (Regulatory) indicates the perception ability of a government to formulate and to implement political regulations that allow promoting development of the private sector. The variable rule of law (Law) measures the perception of agents about its confidence in the existing norms and the degree in which they can rely that the contracts will be fulfilled and the property rights will be protect by the courts. The variable control of corruption (Corruption) indicates the perception on magnitude in which the public power is exerted to obtain private gains. These six indicators are measured in units ranging from about -2.5 to 2.5, with higher values corresponding to better governance and institutional quality. In column 7, we capture common variation among these six governance indicators using the principal component analysis and construct a composite index of institutional quality (IQI).

	log(Zscore)						
Variables	1	2	3	4	5	6	7
Financial inclusion index (FII)	3.426***	8.197***	5.298***	1.277	5.804***	6.216***	10.878***
	[1.275]	[2.413]	[1.580]	[2.213]	[1.714]	[1.947]	[2.977]
Voice and accountability (Voice)	-2.135*						
	[1.162]						
FII x Voice	7.391***						
	[2.105]						
Political stability (Political)		-2.228**					
		[1.127]					
FII x Political		5.946**					
		[2.677]					
Government effectiveness (Government)			0.744				
			[1.402]				
FII x Government			-2.697				
			[3.161]				
Regulatory quality (Regulatory)				-10.640**			
				[5.118]			
FII x Regulatory				21.321**			
				[10.272]			
Rule of law (Law)					-2.792***		
					[0.980]		
FII x Law					5.983**		
					[3.008]		
Control of corruption (Corruption)						0.639	
						[0.862]	
FII x Corruption						0.207	
						[1.436]	
Institutional quality index (IQI)							-0.606
							[0.477]
FII x IQI							2.347**
							[1.139]
Observations	11,450	11,499	11,499	11,499	11,499	11,499	11,499
Bank and Macro controls	√	√	√	√	√	√	√
Bank and year fixed effects	√	√	√	√	√	√	√
2nd-stage F-test	42.66***	36.51***	40.37***	26.08***	38.85***	42.58***	39.56***
Under id test: KP LM statistic	54.32***	46.39***	63.11***	9.28***	74.99***	85.81***	71.97***
Hansen J-test (p-value)	1.19 (0.28)	0.02 (0.90)	4.57 (0.10)	0.62 (0.43)	1.07 (0.30)	4.72 (0.09)	1.62 (0.44)
AR chi-squared test	29.05***	21.32***	24.04***	25.25***	24.72***	27.75***	26.75***
Endogeneity test	29.04***	31.18***	21.47***	31.67***	20.77***	23.82***	38.23***
Instruments							
Financial freedom	√	√	√	√	√	√	√
Labour freedom		√	√	√		√	√
Entry density	√		√	√	√	√	√
Entry density * Financial freedom			√		√	√	
Entry density * Labour freedom							√
Credit information depth	√						
Marginal effect	8.42***	10.13***	2.97	16.46**	9.44***	6.34*	10.88***
One standard deviation above average ↑	13.61***	14.95***	0.01	32.01***	14.88***	6.54**	16.29***

Table 6
The effect of Global financial inclusion (GFI) on banking stability

In this table, we use Global Financial Inclusion Index (Global Findex) based on World Bank. Since this measure is only available for the year 2011, we had to collapse our dataset at bank-level to run cross-sectional regression. Initially we conduct endogeneity test for the Global financial inclusion index, which is reported at the bottom of the table. In case of rejecting the null hypothesis of exogeneity, we employ the instrumental variable (IV) estimator; otherwise we use the ordinary least square (OLS) estimator with robust standard error, as it is more efficient. When we added interaction with GFI (e.g., column 3, 4, 7, and 8), we treated both GFI and its interaction as endogenous variables. We used financial freedom, entry density and their interactions as instruments. The underidentification (UT) and over identification (OT) tests are reported by the Anderson canonical correlations LM statistic and Sargan's *J-test*, respectively to show the relevance and validity of the instruments used for the Global financial inclusion index. The definitions of rest of the variables are same as Table 3. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: BankScope and World Bank.

	log(Zscore)				**-log[sd(ROA)]**			
Variables	1	2	3	4	5	6	7	8
	C-Lerner	E-Lerner	C-Lerner	E-Lerner	C-Lerner	E-Lerner	C-Lerner	E-Lerner
Loan Ratio	0.310*	0.188	-0.009	0.364	0.019	0.115	-0.036	0.776*
	[0.182]	[0.131]	[0.129]	[0.275]	[0.123]	[0.124]	[0.123]	[0.407]
Bank Size	0.030**	0.047***	0.038***	0.122**	0.064***	0.071***	0.063***	0.146***
	[0.012]	[0.011]	[0.011]	[0.055]	[0.010]	[0.010]	[0.010]	[0.045]
Loan Loss Provision	-5.746***	-6.510*	-6.375*	-4.851***	-6.240**	-6.463*	-6.279**	-4.335***
	[0.605]	[3.454]	[3.281]	[1.379]	[3.163]	[3.315]	[3.131]	[1.383]
Income Diversification	-0.016	0.01	-0.067	0.034	-0.07	-0.027	-0.094	0.027
	[0.058]	[0.065]	[0.054]	[0.104]	[0.066]	[0.061]	[0.063]	[0.112]
Management Quality	2.121***	2.288***	2.051***	1.508*	2.320***	2.355***	2.204***	1.056
	[0.303]	[0.326]	[0.306]	[0.830]	[0.297]	[0.305]	[0.292]	[0.833]
Capitalisation	2.605***	2.067***	2.104***	3.250***	-	-	-	-1.198
	[0.318]	[0.313]	[0.309]	[0.905]	[0.273]	[0.275]	[0.276]	[0.914]
C-Lerner	0.980***		0.337**		0.615***		0.240*	
	[0.103]		[0.146]		[0.077]		[0.131]	
E-Lerner		0.356***		-4.307		0.06		-4.776*
		[0.101]		[3.177]		[0.092]		[2.537]
Global financial inclusion (GFI)	0.018**	0.001	0.005***	0.009	0.012***	0.010***	0.014***	0.040**
	[0.007]	[0.002]	[0.002]	[0.008]	[0.002]	[0.002]	[0.002]	[0.016]
GFI x C-Lerner			1.443***				1.086***	
			[0.313]				[0.289]	
GFI x E-Lerner				7.501				8.146*
				[5.113]				[4.166]
GDP Growth Rate	-7.360***	-	-	1.283	-	-	-	-2.618
	[1.719]	[0.999]	[0.976]	[3.794]	[0.929]	[0.942]	[0.929]	[3.706]
Per Capita GDP	-0.181**	0.013	-0.025	0.02	-0.014	0.007	-0.028	-0.204
	[0.080]	[0.027]	[0.027]	[0.077]	[0.026]	[0.026]	[0.026]	[0.162]
Constant	2.396***	0.802**	1.447***	0.715	3.630***	3.374***	3.877***	4.953***
	[0.675]	[0.392]	[0.384]	[0.734]	[0.357]	[0.365]	[0.362]	[1.327]
Observations	2,238	2,497	2,497	2,238	2,497	2,497	2,497	2,238
Estimator	IV	OLS	OLS	IV	OLS	OLS	OLS	IV
F-statistics	45.80	24.69	36.37	10.06	123.10	114.90	112.80	27.23
Adjusted R2	-	0.14	0.19	-	0.39	0.37	0.39	-
UT: Anderson canon. corr. LM	137.60	-	-	2.70	-	-	-	4.53
OT (Sargan) (p-value)	2.14	-	-	1.10	-	-	-	3.05
p-value of endogeneity test	0.04	0.10	0.43	0.04	0.07	0.21	0.23	0.01

Table 7
Bank stability and detailed financial inclusion sub-indices

In this table, we use sub-indices of financial inclusion index, and see the impact of three different dimensions on bank stability individually. Initially we conduct endogeneity test for each dimensions, which is reported at the bottom of the table. In case of rejecting the null hypothesis of exogeneity, we employ the instrumental variable (IV) estimator; otherwise we use the ordinary least square (OLS) estimator as it is more efficient. In both cases, we use heteroskedasticity and autocorrelation consistent (HAC) variance estimation to alleviate both of the problems. In case IV regression, each dimensions are instrumented following Table 3. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: BankScope, FAS, and WDI. Coverage: 2004-2012.

VARIABLES	**log(Zscore)**	**-log[sd(ROA)]**	**log(Zscore)**	**-log[sd(ROA)]**	**log(Zscore)**	**-log[sd(ROA)]**
	1	2	3	4	5	6
Loan Ratio	0.242	-0.177	0.666***	0.462***	0.676***	0.479***
	[0.205]	[0.195]	[0.080]	[0.079]	[0.080]	[0.079]
Bank Size	0.499***	0.347***	0.024***	0.056***	0.020***	0.052***
	[0.071]	[0.064]	[0.008]	[0.007]	[0.008]	[0.007]
Loan Loss Provision	-1.998	-2.238*	-5.328**	-5.432**	-5.317**	-5.407**
	[1.333]	[1.222]	[2.615]	[2.515]	[2.642]	[2.543]
Income Diversification	0.003	0.002	-0.004	-0.017	-0.004	-0.018
	[0.013]	[0.013]	[0.012]	[0.011]	[0.012]	[0.011]
Management Quality	1.287***	1.108***	1.877***	2.064***	2.071***	2.302***
	[0.308]	[0.306]	[0.188]	[0.184]	[0.192]	[0.188]
Capitalisation	4.015***	0.587	1.904***	-3.330***	1.808***	-3.447***
	[0.479]	[0.374]	[0.200]	[0.180]	[0.199]	[0.178]
E-Lerner	1.286***	1.188***	0.536***	0.066	0.559***	0.100*
	[0.126]	[0.123]	[0.061]	[0.056]	[0.062]	[0.058]
Accessibility dimension	2.639***	2.383***				
	[0.732]	[0.707]				
Availability dimension			0.586***	0.737***		
			[0.077]	[0.076]		
Usage dimension					0.404***	0.540***
					[0.060]	[0.058]
GDP Growth Rate	4.454***	3.877***	3.120***	3.401***	1.656***	1.545***
	[0.704]	[0.364]	[0.550]	[0.528]	[0.503]	[0.488]
Per Capita GDP	-1.414***	-0.986***	0.057***	0.095***	0.163***	0.229***
	[0.446]	[0.368]	[0.018]	[0.018]	[0.016]	[0.016]
Constant			0.505**	2.754***	-0.302	1.724***
			[0.240]	[0.231]	[0.258]	[0.246]
Observations	11,499	11,499	13,524	13,524	13,524	13,524
Estimator	IV	IV	OLS	OLS	OLS	OLS
F-statistics	44.98	39.64	61.04	180.10	53.79	164.70
Adjusted R2	-	-	0.12	0.26	0.11	0.26
Under id test: KP LM statistic	141.9***	126.1***	-	-	-	-
Hansen J-test (p-value)	5.43 (0.07)	6.14 (0.05)	-	-	-	-
p-value of endogeneity test	0.00	0.00	0.16	0.19	0.39	0.46

Table 8
The effect of financial inclusion on bank stability (alternative measure)

In this table, following Beck et al. (2013), we use an alternative measure of bank stability in which the denominator in equation (1) is calculated using five years rolling windows. *Financial inclusion index* and *Financial inclusion index times C-Lerner (E-Lerner)* are treated as endogenous variables, and they are instrumented following Table 3. The underidentification (UT) and over identification (OT) tests are reported by the Kleibergen and Paap (2006) test for weak instruments and Hansen *J-test*, respectively to show the relevance and validity of the instruments used. The Anderson-Rubin Chi2 test shows that *financial inclusion index* and *financial inclusion index times C-Lerner (E-Lerner)* are jointly significant. The definitions of rest of the variables are same as Table 3. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: BankScope and World Bank.

Variables	**log(Zscore5)**				**-log[sd5(ROA)]**			
	1	2	3	4	5	6	7	8
	C-Lerner	E-Lerner	C-Lerner	E-Lerner	C-Lerner	E-Lerner	C-Lerner	E-Lerner
Loan Ratio	0.17	0.109	0.166	0.106	-0.012	-0.058	-0.012	-0.06
	[0.215]	[0.214]	[0.216]	[0.214]	[0.208]	[0.208]	[0.208]	[0.208]
Bank Size	0.338***	0.357***	0.336***	0.361***	0.314***	0.330***	0.314***	0.333***
	[0.075]	[0.075]	[0.076]	[0.075]	[0.071]	[0.071]	[0.071]	[0.072]
Loan Loss Provision	-2.518***	-2.413***	-2.516***	-2.420***	-2.367***	-2.272***	-2.366***	-2.279***
	[0.842]	[0.805]	[0.842]	[0.807]	[0.748]	[0.719]	[0.748]	[0.721]
Income Diversification	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002
	[0.007]	[0.007]	[0.007]	[0.007]	[0.008]	[0.007]	[0.008]	[0.007]
Management Quality	1.186***	1.199***	1.192***	1.198***	0.934***	0.945***	0.942***	0.944***
	[0.339]	[0.335]	[0.337]	[0.336]	[0.318]	[0.314]	[0.316]	[0.315]
Capitalisation	2.691***	2.463***	2.689***	2.457***	1.033**	0.870**	1.037**	0.865**
	[0.452]	[0.448]	[0.450]	[0.449]	[0.409]	[0.412]	[0.408]	[0.413]
C-Lerner	0.488***		0.541***		0.401***		0.366**	
	[0.062]		[0.202]		[0.055]		[0.181]	
E-Lerner		1.099***		0.956***		0.832***		0.713***
		[0.124]		[0.144]		[0.119]		[0.138]
Financial Inclusion index	6.688***	7.032***	6.724***	7.016***	6.628***	6.883***	6.671***	6.873***
	[1.811]	[1.812]	[1.802]	[1.816]	[1.711]	[1.718]	[1.704]	[1.721]
Financial Inclusion X C-Lerner			-0.071				0.05	
			[0.237]				[0.212]	
Financial Inclusion X E-Lerner				0.278**				0.231*
				[0.133]				[0.127]
GDP Growth Rate	4.414***	4.518***	4.423***	4.539***	4.315***	4.402***	4.340***	4.421***
	[0.891]	[0.889]	[0.879]	[0.890]	[0.855]	[0.857]	[0.845]	[0.858]
Per Capita GDP	-2.125***	-2.524***	-2.132***	-2.562***	-2.404***	-2.697***	-2.431***	-2.729***
	[0.806]	[0.818]	[0.790]	[0.818]	[0.779]	[0.794]	[0.766]	[0.794]
Observations	9,338	9,338	9,338	9,338	9,338	9,338	9,338	9,338
2nd-stage F-test	16.01***	16.86***	15.52***	16.11***	15.71***	14.95***	15.47***	14.24***
Under id test: KP LM statistic	58.79***	57.42***	58.78***	57.20***	58.79***	57.42***	58.78***	57.20***
AR chi-squared test	35.49***	35.13***	35.65***	35.32***	37.26***	36.73***	37.62***	36.96***
Hansen J-test	4.39 (0.11)	3.37 (0.19)	4.37 (0.11)	3.43 (0.18)	4.17 (0.12)	3.32 (0.19)	4.20 (0.12)	3.40 (0.18)
Endogeneity test	34.11***	35.02***	34.52***	35.19***	31.99***	32.75***	32.47***	32.89***

Table 9
Financial inclusion and banking stability: robustness checks

	Tercile 1: the lowest financial inclusion		Tercile 2: medium financial inclusion		Tercile 3: the highest financial inclusion		Commercial banks: Cooperative and Islamic banks excluded		Rest of the sample: Japan and Italy excluded		Only Developing Countries: Developed Countries excluded	
	1	2	3	4	5	6	7	8	9	10	11	12
Variables	log(Zscore)	-log(sd(ROA)	log(Zscore)	-log(sd(ROA)	log(Zscore)	-log(sd(ROA)	log(Zscore)	-log(sd(ROA)	log(Zscore)	-log(sd(ROA)	log(Zscore)	-log(sd(ROA)
Loan Ratio	0.591*	0.341	0.282	0.063	1.626***	1.760***	0.462*	0.27	0.339	0.176	0.376	0.113
	[0.309]	[0.308]	[0.372]	[0.355]	[0.483]	[0.471]	[0.260]	[0.249]	[0.249]	[0.237]	[0.315]	[0.293]
Bank Size	0.715***	0.660***	0.381***	0.453***	0.678***	0.613***	-0.001	0.049	0.103	0.143	-0.075	-0.037
	[0.140]	[0.131]	[0.138]	[0.133]	[0.202]	[0.192]	[0.102]	[0.097]	[0.093]	[0.088]	[0.137]	[0.129]
Loan Loss Provision	-3.722***	-3.286***	-5.561***	-4.944***	-0.366	-0.591	-1.181	-1.237	-1.328	-1.355	-3.770***	-3.451***
	[0.926]	[0.951]	[1.344]	[1.228]	[0.916]	[0.894]	[1.036]	[0.927]	[1.070]	[0.950]	[0.944]	[0.898]
Income Diversification	0.191	0.173	0.129	0.159	-0.002	-0.001	0.236*	0.228**	0.046	0.071	0.486**	0.461**
	[0.176]	[0.163]	[0.146]	[0.129]	[0.009]	[0.010]	[0.126]	[0.109]	[0.069]	[0.057]	[0.224]	[0.190]
Management Quality	0.337	0.255	1.942***	1.535**	0.791	0.355	1.346***	1.111***	1.502***	1.243***	1.864***	1.700***
	[0.424]	[0.412]	[0.744]	[0.754]	[1.018]	[0.898]	[0.406]	[0.393]	[0.392]	[0.378]	[0.542]	[0.518]
Capitalisation	2.525***	-0.064	3.883***	1.233*	7.493***	3.961***	1.469***	-1.000**	2.067***	-0.481	1.652***	-0.806*
	[0.701]	[0.635]	[0.789]	[0.726]	[1.859]	[1.507]	[0.444]	[0.407]	[0.437]	[0.396]	[0.527]	[0.478]
E-Lerner	0.196	-0.12	0.31	0.028	2.605***	1.931***	1.162***	0.790***	1.052***	0.689***	1.079***	0.738***
	[0.219]	[0.208]	[0.213]	[0.196]	[0.320]	[0.290]	[0.177]	[0.168]	[0.164]	[0.155]	[0.236]	[0.226]
Financial Inclusion	-11.597**	-10.137**	13.601***	12.266***	26.586***	24.286***	8.081***	7.833***	7.998***	7.697***	6.386***	6.381***
	[4.724]	[4.471]	[4.720]	[4.399]	[8.511]	[8.019]	[2.241]	[2.119]	[2.166]	[2.045]	[2.227]	[2.110]
GDP Growth Rate	-1.237	-0.942	2.066	1.654	2.688	3.104	5.634***	5.464***	6.033***	5.830***	3.831***	3.683***
	[1.246]	[1.204]	[1.413]	[1.316]	[2.448]	[2.305]	[0.906]	[0.854]	[0.810]	[0.764]	[0.927]	[0.880]
Per Capita GDP	4.154***	3.613***	-5.649***	-5.542***	-7.808	-7.285	-2.222**	-2.287***	-2.677***	-2.654***	-1.454*	-1.544*
	[1.387]	[1.339]	[2.065]	[1.914]	[5.156]	[4.925]	[0.866]	[0.825]	[0.874]	[0.831]	[0.838]	[0.802]
Observations	3,223	3,223	4,123	4,123	3,938	3,938	5,516	5,516	6,390	6,390	3,439	3,439
Number of banks	733	733	995	995	678	678	1,117	1,117	1,283	1,283	708	708
2nd-stage F-test	10.54***	9.03***	14.76***	17.69***	33.53***	31.13***	17.56***	15.96***	20.0***	18.02***	12.13***	11.5***
Under id test: KP LM statistic	35.69***	35.69***	24.14***	24.14***	40.69***	40.69***	41.32***	41.32***	44.4***	44.4***	29.2***	29.2***
Hansen J-test	0.21 (0.90)	0.21 (0.90)	0.84 (0.36)	2.23 (0.14)	0.23 (0.64)	1.37 (0.24)	0.38 (0.54)	0.75 (0.39)	0.89 (0.35)	1.17 (0.28)	0.81 (0.37)	1.34 (0.25)
Endogeneity test	4.71***	3.87***	18.73***	18.67***	5.11***	3.76***	29.14***	27.63***	28.85***	26.97***	19.27***	19.61***

This table reports robustness tests of financial inclusion and banking stability. We use as usual IV-GMM estimators. In the first six columns, we split the sample into three terciles based on financial inclusion index and re-run regressions. In this case, we use investment freedom, entry density and investment freedom times entry density as instruments. The validity of the instruments is confirmed by the under-identification and over-identification tests reported at the bottom of the table. In the columns 7 and 8, we dropped observations of the cooperative and Islamic banks keeping only commercial banks. In the last two columns, we dropped observations of Japan and Italy as they comprise lion shares of our sample and re-run regressions. For the specification of 7, 8, 9 and 10, we use financial freedom and entry density as the instruments. The results of the first-stage regressions are available from the authors upon request. The analogous bank and macro controls are used as in equation (6). We use lagged values of efficiency adjusted Lerner index as the proxy for bank competition.

Table 10
Financial inclusion, external finance dependence, small firm share, and growth

The dependent variable is the growth rate in real value added for 2000-2010 for each industry in each country, using data from UNIDO INDSTAT4, 2010. Industrial sectors in US is excluded from the analysis as it serves as the benchmark (Rajan and Zingales, 1998). In column 1-4, estimation is by ordinary least squares (OLS) while column 5-8 is by instrumental variables (IV) technique. Unreported country and industry dummies are included in OLS and IV, respectively. Instrumental variable include investment freedom index is from the Heritage Foundation, adults borrowing from a formal financial institution in the past year to total adults (borrowing) is from Demirgüç-Kunt and Klapper (2012), and interaction of investment freedom and borrowing. Note that first-stage regression and other controls are not reported but available upon request from the authors. Share in value added is the industry's share of total value added in manufacturing in 2000. External finance dependence is a measure of the industry's dependence on external finance, from Rajan and Zingales (1998). It is the fraction of capital expenditures not financed with internal funds. Small firm share is the industry's share of employment by firms with less than *N* employees (*N* is either 5 or 10 or 20) is taken from Beck et al. (2008). BDLL (2008) calculate these industry-level variables by using data from the US Census on all US firms for the year 1997. Legal efficiency is the country's efficiency of the legal system from La Porta et al. (1998), which is taken from Beck et al. (2008). Property rights is a measure of the country's protection of property rights from the Heritage Foundation (average for the years 2004-2012). Credit information depth is the measure of degree to which credit information is available through either a public credit registry or a private credit bureau from Djankov et al. (2007), World Bank "Doing Business" Database (average for the years 2004-2012). Heteroskedasticity-robust standard errors are reported in the brackets. *, **, *** Represent statistical significance at the 10%, 5%, and 1% levels, respectively.

	Annual (compounded) growth rate in real value added							
VARIABLES	OLS				IV			
	1	2	3	4	5	6	7	8
Share in value added in 2000	0.026	0.053	0.05	0.074	-0.219	-0.187	-0.181	-0.171
	[0.094]	[0.101]	[0.101]	[0.097]	[0.161]	[0.173]	[0.170]	[0.167]
Financial inclusion X External finance dependence	0.020**				0.293**			
	[0.010]				[0.121]			
Financial inclusion X Small firm share (< **5** employees)		0.864**				14.264**		
		[0.354]				[5.675]		
Financial inclusion X Small firm share (<**10** employees)			0.345***				5.277**	
			[0.132]				[2.049]	
Financial inclusion X Small firm share (< **20** employees)				0.133**				2.425***
				[0.065]				[0.870]
Constant	0.365***	0.367***	0.368***	0.364***	0.485***	0.502***	0.499***	0.517***
	[0.131]	[0.142]	[0.142]	[0.138]	[0.076]	[0.086]	[0.084]	[0.081]
Observations	672	578	578	603	646	556	556	580
Country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.32	0.32	0.32	0.31	0.20	0.16	0.19	0.23
F	16.38***	13.63***	13.68***	14.34***	8.83***	8.20***	8.38***	8.78***
Under id test: KP LM statistic					23.06***	23.16***	25.14***	31.19***
Hansen J-test (p-value)					6.25 (0.04)	3.77 (0.15)	3.734 (0.16)	3.19 (0.2)
Endogeneity test (p-value)					0.02	0.01	0.01	0.01

Table 11
The causal effects of enabling inclusive financial environment on banking stability

This table presents difference-in-differences (Panel A) and Matching (Panel B) estimations relating pro-financial access policy and bank stability. In Panel A, the dependent variables are the log(Zscore) and –log(sd(ROA)). The variable of interest is *Pro-financial Access Policy*, that takes one if a country enters into the global network of financial inclusion policymakers (i.e., Alliance for Financial Inclusion) and agrees to share knowledge for developing and implementing 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 with a set of year dummies. To get homogenous comparison groups, we use a nearest-neighbor logit propensity score matching strategy to identify control groups which are similar to the treated groups on the basis of observable characteristics, and then run difference-in-differences regression on the matched sample. While we use country fixed effects in column 1-4, bank fixed effects is used in column 5-8. Standard errors are robust and clustered at the country-level. In Panel B, we use three different matching methods include Kernel matching, Stratification matching and the nearest-neighbour bias-corrected matching estimators proposed by Abadie and Imbens (2006). Abadie and Imbens method adjusts the differences within the matches for the differences in covariate values. *ATT* is the average treatment effect for the treated. The standard errors in Abadie and Imbens are heteroskedasticity-consistent, and *z*-stats are reported. For the rest, we report absolute values of bootstrapped *t*-stats in bracket. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: BankScope and AFI. Coverage: 2004-2012.

Panel A: DID approach	**log(Zscore)**		**-log(sd(ROA)**		**log(Zscore)**		**-log(sd(ROA)**	
Variables	1	2	3	4	5	6	7	8
Pro-financial Access Policy	0.314**	0.270*	0.385**	0.274**	0.341**	0.311**	0.310*	0.254
	[0.123]	[0.136]	[0.124]	[0.135]	[0.152]	[0.148]	[0.157]	[0.161]
Loan Ratio		0.793***		0.580**		0.632		0.402
		[0.243]		[0.226]		[0.566]		[0.625]
Bank Size		0.066**		0.122**		0.289		0.269
		[0.029]		[0.022]		[0.188]		[0.171]
Loan Loss Provision		-7.652***		-		-5.066***		-
		[1.328]		[1.045]		[1.273]		[1.324]
Income Diversification		-0.114		-0.453		0.207		0.192
		[0.345]		[0.296]		[0.498]		[0.522]
Management Quality		0.232		0.289		0.019		0.157
		[0.369]		[0.342]		[0.769]		[0.766]
Capitalisation		1.836***		-		1.535		-1.255
		[0.515]		[0.433]		[1.326]		[1.306]
E-Lerner		0.107		-0.334		0.156		-0.165
		[0.263]		[0.218]		[0.342]		[0.331]
GDP Growth Rate		0.283		-0.182		0.19		0.117
		[1.465]		[1.349]		[1.208]		[1.260]
Per Capita GDP		0.83		1.109		1.633		1.462
		[1.123]		[1.142]		[1.246]		[1.333]
Constant	3.381***	-4.184	5.368**	-3.916	3.379***	-11.792	5.443**	-7.799
	[0.114]	[8.554]	[0.108]	[8.698]	[0.132]	[9.368]	[0.124]	[10.095]
Observations	2,071	2,027	2,071	2,027	2,071	2,027	2,071	2,027
Bank fixed effects	No	No	No	No	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	No	No	No	No
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.16	0.23	0.23	0.36	0.61	0.63	0.64	0.65
F-statistics	5.32	14.71	4.16	24.04	4.80	3.67	2.57	2.44

Panel B: Matching estimator	**Kernel**		**Stratified**		**Abadie-Imbens**	
Treatment effects	**log(Zscore)**	**-log(sd(ROA)**	**log(Zscore)**	**-log(sd(ROA)**	**log(Zscore)**	**-log(sd(ROA)**
	1	2	3	4	5	6
ATT	0.109**	0.088**	0.114***	0.081*	0.889***	1.267***
S.E.	[0.045]	[0.041]	[0.039]	[0.043]	[0.308]	[0.252]
t-stat	[2.430]	[2.164]	[2.952]	[1.871]	[2.886]	[5.028]
Observations	13,836	13,836	13,836	13,836	13,524	13,524
Common support condition	Yes	Yes	Yes	Yes	Yes	Yes

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Is financial inclusion good for bank stability? International evidence

ONLINE APPENDIX

ABSTRACT

This paper offers a first empirical investigation on the complementary effect of inclusive finance on soundness of individual banks. Using a unique database of financial access survey, we construct a composite index of financial inclusion for 87 countries over the period 2004 to 2012, and then investigate a new research question as to whether the global policy drive towards greater financial inclusion is good for bank stability in a sample of 2,913 banks. We find that higher level of financial inclusion leads to greater bank stability. This complementary effect is more pronounced when banks have higher market power and operate in countries where political stability, rule of law, and regulatory environment are stronger. Exploiting cross-country and temporal variations in the timing of inclusive banking agenda, we show that enabling inclusive financial environment increases soundness of banks in the treated countries by 36%. Taking industry data, we also show that financial inclusion exerts disproportionately more positive effects on growth of small firms, and firms that rely more on external finance. Our results highlight that the importance of ensuring inclusive financial system is not only a development goal but also an issue that should be prioritised by banks as such a policy drive is good for their stability.

Section E1

Principal Component analysis (PCA)

Using individual dimension in an equation may provide incomprehensive picture of financial inclusion. In addition, modelling various dimensions of financial inclusion in the same equation would lead to multicollinearity. We use PCA to combine these dimensions together and create an index of financial inclusion. Using PCA to construct indices is well-documented in several papers (see Ellul and Yerramilli, 2013; Bali, Brown and Caglayan, 2014). It is a multivariate statistical technique used to reduce a large number of variables in a data set into a smaller number of 'dimensions' (i.e., principal components) by parsing any redundancies among the original variables while retaining most of the variance in the original variables.[1] In mathematical terms, from an initial set of n correlated variables, PCA generates uncorrelated principal components (PC_i), where each component is a linear weighted combination of the original variables and components themselves are orthogonal to each other. It can be shown as:

$$\begin{aligned} PC_1 &= w_{11}X_1 + w_{12}X_2 + \cdots + w_{1n}X_n \\ &\vdots \\ PC_m &= w_{m1}X_1 + w_{m2}X_2 + \cdots + w_{mn}X_n \end{aligned} \tag{E1.1}$$

which can be re-written as

$$PC = \sum_{i=1}^{n} w_{ij}X_i \quad for\ (j = 1,2,\cdots m) \tag{E1.2}$$

where $P = [P_1, P_2, \ldots, P_m]$ are the principal components; $W = [w_{ij}]\ for\ i = (1,2,\ldots,m)$ and $j = (1,2,\ldots,n)$ are component loadings or weights; and $X = [X_1, X_2, \ldots, X_n]$ are the original variables. The eigenvectors of the correlation matrix is proportional to the weights of each principal component, and it reflects the variance contribution of principal components to original variables. The eigenvalue of the analogous eigenvector is the variance for each principal component. The components are ranked, and they are extracted in decreasing order of importance so that the first component (PC_1) explains the largest possible amount of variations in the original data conditional to the constraint that the sum of the squared weights $(w_{11}^2 + w_{12}^2 + \cdots + w_{1n}^2)$ is equal to one. The second component (PC_2) is entirely uncorrelated with the first component and explains the second largest variations, less than the first component, subject to the same constraint. The subsequent components are

[1] See Jolliffe (2002) for a detailed discussion on PCA.

independent from the previous components and explain smaller and smaller proportions of the variation of the original data. The greater correlation among original variables necessitates fewer principal components to capture common information.

It is noted that principal component can be extracted by using original variables or by their deviations from their averages, or by the standardised variables.[2] As the indicators of financial inclusion are measured in different units, we deem to follow the latter approach in this study. We use the following equation to construct the composite index of financial inclusion (FII):

$$FII = \sum_{i=1}^{n} w_{ij} X_i \tag{E1.3}$$

Section E2

Estimating marginal cost using a translog cost function

The inputs and outputs choices are specified according to the intermediation approach of Sealey and Lindley (1977). Following Koetter, Kolari and Spierdijk (2012), a production technology is specified with three inputs (i.e., labour, capital and borrowed funds) and one output (i.e., total assets). Since the information on the prices of loans and deposits are limited, we use total assets as an aggregate measure of banking activity, as previously used by Berger, Klapper and Turk-Ariss (2009) and Beck, De Jonghe and Schepens (2013). We include equity in the production function to account for various risk attitudes of banks. The following translog total cost function is specified for bank $i = 1,...,N$ at time $t = 1,...,T$ as:

$$\begin{aligned} \ln TOC_{it} = {} & \beta_0 + \sum_{j=1}^{3} \beta_j \ln \mathrm{W}_{j,it} + \gamma_1 \ln \mathrm{Q}_{it} + \delta \ln \mathrm{Z}_{it} + \sum_{j=1}^{3} \left(\frac{\varsigma_j}{2} \right) \ln \mathrm{W}_{j,it}^2 + \sum_{j}^{3} \sum_{k}^{3} \eta_{jk} \ln W_{j,it} \ln W_{k,it} \\ & + \left(\frac{\theta}{2} \right) \ln \mathrm{Q}_{it}^2 + \sum_{j=1}^{3} \lambda_j \ln W_{j,it} \ln Q_{it} + \sum_{k=1}^{2} \rho_k trend^k + \sum_{j=1}^{3} \varepsilon_j \ln W_{j,it} trend + \omega_1 \ln \mathrm{Q}_{it}\, trend + \varepsilon_{it} \end{aligned} \tag{E2.1}$$

[2] We used standardized variables with mean of zero and standard deviation of one instead of min-max normalisation and construct financial inclusion index. These two indices are perfectly correlated, indicating the robustness of our index.

where TOC_{it} is the total costs including financial and operating cost; Q_{it} represents for one output i.e., total assets, and $w_{j,it}$ ($j = 1,2,3$) are input prices where w_1 is the price of funds; w_2 is the price of labour; w_3 is the price of capital of bank i at time t ; z_{it} is total equity of bank i at time t ; and *trend* is the time trend to capture technical change. We impose homogeneity of degree one on input prices and divided all factor prices and TOC_{it} by w_3 . The marginal cost is measured by taking the first derivative with respect to output for each bank in the sample after estimating cost function as:

$$\mathrm{MC}_{it} = \frac{TOC_{it}}{Q_{it}}\left[\gamma_1 + \theta_1 \ln \mathrm{Q}_{it} + \sum_{j=1}^{3} \lambda_{1j} \ln W_{j,it} + \omega_1 trend\right] \tag{E2.2}$$

The shortcoming of conventional Lerner index estimated above is that it is measured assuming full bank efficiency and therefore it fails to account for the possibilities of bankers inabilities to exploit output pricing opportunities resulting from market power. Following Koetter, Kolari and Spierdijk (2012), we estimate efficiency-adjusted Lerner indices from a single structural model as:

$$(\widehat{AR_{it}} - MC_{it}) / \widehat{AR_{it}} \tag{E2.3}$$

where $\widehat{AR_{it}}$ is the average revenue computed as $\widehat{TR / TA}$, where, $TR = \widehat{PBT} + \widehat{TOC}$. In order to obtain efficiency-adjusted Lerner indices we have to estimate expected profit $\widehat{PBT}$ from an alternative profit function[3] and expected total costs $\widehat{TOC}$ from equation (B1). Dissimilar to conventional Lerner indices in equation (5), the estimation of efficiency-adjusted Lerner accounts for both bank efficiency and degree of market power simultaneously.

[3] To estimate expected profits ($\widehat{PBT}$) we use PBT (i.e. profit before tax) instead of TOC in equation (B1) as the dependent variable. Following (Bos and Koetter (2011)), to account for individual bank losses, we use a negative profit indicator (NPI) in the profit function as many banks in our sample period incurred losses.

Table E1
Descriptive statistics of the variables included in the cost and profit functions. Source: BankScope.

Region	Cost	Profit	Assets	w1	w2	w3	Equity	
Asia	8.9	7.1	7.6	-5.0	-4.7	-5.0	5.0	Mean
	8.8	6.9	7.6	-5.5	-4.8	-5.2	4.8	Median
	1.9	2.3	1.7	1.7	0.6	0.7	1.7	SD
	2.9	-2.6	2.6	-7.6	-8.1	-7.7	0.9	Min.
	14.4	13.6	12.6	-1.6	-1.4	-0.9	9.7	Max.
Europe	8.3	6.3	6.8	-3.8	-4.5	-4.6	4.5	Mean
	7.8	5.9	6.4	-3.7	-4.4	-4.7	4.2	Median
	2.2	2.3	2.0	0.7	0.7	0.8	1.8	SD
	2.7	-2.2	2.6	-7.6	-11.6	-9.5	0.9	Min.
	17.4	14.8	12.6	-1.6	-1.2	0.8	9.7	Max.
Americas	7.6	5.8	6.3	-3.0	-3.9	-3.7	4.3	Mean
	7.6	5.9	6.3	-3.0	-3.8	-3.7	4.2	Median
	2.1	2.5	2.0	0.8	0.8	0.9	1.8	SD
	3.0	-3.0	2.6	-7.3	-8.8	-8.3	0.9	Min.
	14.5	13.2	12.6	-1.6	-0.8	-0.5	9.7	Max.
Africa	7.4	6.1	6.2	-3.5	-4.0	-3.9	4.0	Mean
	7.2	6.1	6.1	-3.3	-3.9	-3.7	3.9	Median
	2.0	2.4	1.7	0.9	0.8	0.9	1.6	SD
	2.9	-2.0	2.6	-7.6	-8.5	-8.4	0.9	Min.
	14.1	13.4	11.8	-1.6	-1.9	-1.4	9.0	Max.
Total	8.4	6.5	7.0	-4.0	-4.5	-4.5	4.6	Mean
	8.1	6.3	6.8	-3.7	-4.5	-4.7	4.4	Median
	2.1	2.4	1.9	1.4	0.8	0.9	1.8	SD
	2.7	-3.0	2.6	-7.6	-11.6	-9.5	0.9	Min.
	17.4	14.8	12.6	-1.6	-0.8	0.8	9.7	Max.

The dataset comprises of 2913 banks in 87 countries.
Note: All variables are in logarithmic format.

Table E2

This table provides information on the correlation between the bank- and country-specific variables used throughout the paper.

Panel A: Correlation matrix of bank level variables		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**				
C-Lerner	**1**	1											
E-Lerner	**2**	0.67***	1										
Loan Ratio	**3**	0.11***	0.02**	1									
Bank Size	**4**	0.04***	-0.09***	0.02*	1								
Loan Loss Provision	**5**	0	0.02*	-0.05***	-0.03**	1							
Income Diversification	**6**	0.04***	0.06***	-0.05***	-0.01	0.02*	1						
Management Quality	**7**	-0.05***	-0.19***	0.21***	0.10***	-0.13***	-0.08***	1					
Capitalisation	**8**	0.07***	0.28***	-0.06***	-0.37***	0.11***	0.07***	-0.29***	1				
Panel B: Correlation matrix of country level variables		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Financial inclusion index	**1**	1											
GDP Growth Rate	**2**	-0.43***	1										
Per Capita GDP	**3**	0.70***	-0.51***	1									
Voice and accountability	**4**	0.58***	-0.41***	0.77***	1								
Political stability	**5**	0.57***	-0.36***	0.80***	0.75***	1							
Government effectiveness	**6**	0.66***	-0.33***	0.82***	0.80***	0.80***	1						
Regulatory quality	**7**	0.60***	-0.42***	0.85***	0.86***	0.80***	0.92***	1					
Rule of law	**8**	0.63***	-0.35***	0.82***	0.84***	0.82***	0.97***	0.94***	1				
Control of corruption	**9**	0.62***	-0.29***	0.79***	0.79***	0.80***	0.97***	0.89***	0.97***	1			
Institutional quality index	**10**	0.65***	-0.38***	0.86***	0.89***	0.88***	0.97***	0.96***	0.98***	0.96***	1		
Property rights	**11**	0.56***	-0.27***	0.76***	0.81***	0.75***	0.95***	0.89***	0.96***	0.95***	0.94***	1	
Credit information depth	**12**	0.48***	-0.29***	0.55***	0.45***	0.40***	0.43***	0.46***	0.42***	0.39***	0.45***	0.35***	1

Table E3
First-stage regression: Financial inclusion

Variables	Dependent variable: Financial inclusion			
	1	2	3	4
Financial freedom	0.0017***	0.0018***	0.0020***	0.0020***
	[6.62]	[6.74]	[6.98]	[7.00]
Entry density	0.0035***	0.0034***	0.0079***	0.0074***
	[6.92]	[6.77]	[5.80]	[5.51]
Financial freedom x Entry density			-0.0001***	-0.0001***
			[-3.39]	[-3.13]
C-Lerner	-0.0080**		-0.0083***	
	[-2.55]		[-2.64]	
E-Lerner		-0.0348***		-0.0343***
		[-5.42]		[-5.37]
Observations	11,499	11,499	11,499	11,499
Bank and Macro controls	Yes	Yes	Yes	Yes
Bank and Year fixed effect	Yes	Yes	Yes	Yes
R-squared	0.36	0.36	0.36	0.36
F-statistics	86.42	86.73	82.21	82.72

Note: This table reports regressions of financial inclusion on financial freedom, entry density and financial freedom times entry density. In order to make our identification strategy as transparent as possible, we also report (in column 1 and 2) the regression results that exclude interaction term in the specification. All regressions include bank-specific and country-specific controls as in equation (6), except financial inclusion. All regressions also include bank fixed effect and year fixed effects. Unreported heteroskedasticity and autocorrelation consistent standard error are calculated. T-statistics are reported at the bracket.

Table E4
G20 Principles for Innovative Financial Inclusion and the Commitments of the Maya Declaration

Panel A	**G20 Principles for Innovative Financial Inclusion**
Leadership	Cultivate a broad-based government commitment to financial inclusion to help alleviate poverty
Diversity	Implement policy approaches that promote competition and provide market-based incentives for delivery of sustainable financial access and usage of a broad range of affordable services (savings, credit, payments and transfers, insurance) as well as a diversity of service providers
Innovation	Promote technological and institutional innovation as a means to expand financial system access and usage, including by addressing infrastructure weakness
Protection	Encourage a comprehensive approach to consumer protection that recognises the roles of government, providers, and consumers
Empowerment	Develop financial literacy and financial capability
Cooperation	Create an institutional environment with clear lines of accountability and coordination within government; and also encourage partnerships and direct consultation across government, business, and other stakeholders
Knowledge	Utilise improved data to make evidence-based policy, measure progress, and consider an incremental 'test and learn' approach acceptable to both regulator and service provider
Proportionality	Build a policy and regulatory framework that is proportionate with the risks and benefits involved in such innovative products and services and is based on an understanding of the gaps and barriers in existing regulation
Framework	Consider the following in the regulatory framework, reflecting international standards, national circumstances, and support for a competitive landscape: an appropriate, flexible, risk-based Anti-Money Laundering and Combating the Financing of Terrorism ML/CFT) regime; conditions for the use of agents as a customer interface; a clear regulatory regime for electronically stored value; and market-based incentives to achieve the long-term goal of broad interoperability and interconnection
Panel B	**Four commitments of the Maya Declaration**
1	Create an enabling environment to harness new technology that increases access and lowers costs of financial services
2	Implement a proportional framework that advances synergies in financial inclusion, integrity, and stability.
3	Integrate consumer protection and empowerment as a key pillar of financial inclusion.
4	Utilise data for informed policymaking and tracing results

Source: Soederberg (2013, p.598-599)

Table E5
The propensity score matching analysis: Logit model and balancing tests

Variables	coefficients	z-statistics	Treated	Control	t-stats	p-value
Log of total assets	0.590***	[0.123]	6.66	6.92	-1.07	0.29
log of per capita GDP	-1.265***	[0.179]	7.31	7.44	-0.69	0.49
GDP growth rate	-0.117	[3.262]	0.05	0.05	0.32	0.75
Financial freedom	0.008	[0.013]	49.49	50.47	-0.44	0.66
Regulatory Quality	0.163	[0.341]	-0.18	-0.15	-0.25	0.8
Constant	3.862***	[1.374]				
Observations	539					
Chi-squared	95.42***					
Pseudo R-squared	0.19					
Hosmer–Lemeshow test (p-value)	0.3					
Standard deviation of the propensity score	0.17					

Note: The dependent variable, AFI takes the value of 1 for a country which participate in the AFI network in year 2009 and thereafter, or else zero. The detailed description of the independent variables is given in Table 1. *Z-statistics* are reported on brackets. The Hosmer–Lemeshow test confirms the goodness-of fit of logit model. Regarding balancing tests, we conduct t-tests of each of independent variables used in the logit model. T-stats and P-values are reported along with respective values of the treated and control groups of the entire sample. Based on p-values, we cannot reject the null hypothesis that each characteristic is equal across the control and treatment groups in the full sample.

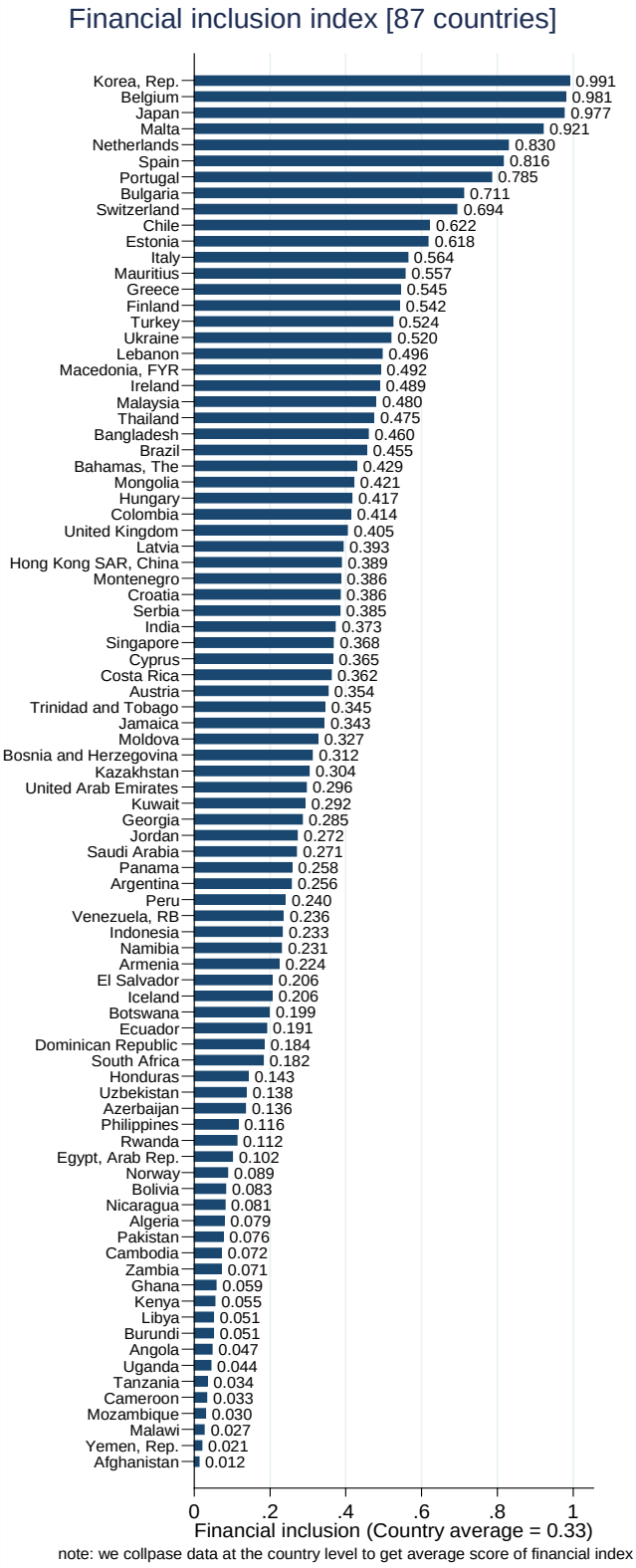

Figure E1: Financial inclusion index of 87 countries.

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