

INTERNATIONAL MONETARY FUND

# Fintech: Financial Inclusion or Exclusion?

Yoke Wang Tok and Dyna Heng

WP/22/80

**IMF Working Papers describe research in progress by the author(s) and are published to elicit comments and to encourage debate.**

The views expressed in IMF Working Papers are those of the author(s) and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

**2022  
MAY**



WORKING PAPER

**IMF Working Paper**

Institute of Capacity Development

**Fintech: Financial Inclusion or Exclusion?  
Prepared by Yoke Wang Tok and Dyna Heng\***

Authorized for distribution by Paul Cashin

May 2022

**IMF Working Papers describe research in progress by the author(s) and are published to elicit comments and to encourage debate.** The views expressed in IMF Working Papers are those of the author(s) and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

**ABSTRACT:** This paper examines the role of Fintech in financial inclusion. Using Global Findex data and emerging fintech indicators, we find that Fintech has a higher positive correlation with digital financial inclusion than traditional measures of financial inclusion. In the second stage of our empirical investigation, we examine the key factors that are correlated with the Fletcher School's three digital divide – gender divide, class (rich-poor) divide and rural divide. The results indicate that greater use of fintech is significantly associated with a narrowing of the class divide and rural divide but there was no impact on the gender divide. These findings imply that Fintech alone may not be sufficient to close the gender gap in access to financial services. Fintech development may need to be complemented with targeted policy initiatives aimed at addressing the gender gap directly, and at changing attitudes and social norms across demographics.

**RECOMMENDED CITATION:** Tok, Yoke Wang; Heng, Dyna. Fintech: Financial Inclusion or Exclusion? IMF Working Paper no. WP/2022/080

JEL Classification Numbers:	G2; G3; G16
Keywords: [Type Here]	Fintech, Financial Inclusion, Financial Development, Inequality.
Author's E-Mail Address:	<a href="mailto:ytok@imf.org">ytok@imf.org</a> ; <a href="mailto:dheng@imf.org">dheng@imf.org</a>

\* The authors would like to thank Ogawa Sumiko, Majid Bazarbash, Ashley Lannquist, and Tao Sun for valuable input and feedback at various stages of the research. We would also like to thank Mrs. Chantavam Sucharitakul, (Assistant Governor, Bank of Thailand), Ms. Pirajit Padmasuta (Senior Director, Financial Development Strategy Department), H.E. Dr. Chea Serey (Assistant Governor, National Bank of Cambodia), and Ms. Jo Yeo (Deputy Director, Monetary Authority of Singapore) for making the time to take part in our interviews. We are also indebted to Ravi Shankar Chaturvedi and his Digital Planet research team at The Fletcher School, Tufts University, for providing the Digital Intelligence Index dataset, the Edelman Trust for providing the Edelman Trust Index, and MCM for providing the digital financial inclusion measures. We also thank Mr. Thitipat Chansrinyom for his excellent research support.

WORKING PAPERS

# **Fintech: Financial Inclusion or Exclusion?**

Prepared by Yoke Wang Tok and Dyna Heng

# Contents

<b>Glossary</b> .....	<b>3</b>
<b>Executive Summary</b> .....	<b>4</b>
<b>I. Introduction</b> .....	<b>5</b>
<b>II. RECENT TRENDS AND LITERATURE</b> .....	<b>5</b>
<b>III. Mind The Gap</b> .....	<b>10</b>
<b>IV. Data and Empirical Approach</b> .....	<b>13</b>
<b>V. Empirical Assessment</b> .....	<b>17</b>
A. Does Fintech Promote Financial Inclusion? .....	17
B. Does Fintech Bridge the Gender, Class and Rural Divides? .....	19
<b>VI. Policy Implications</b> .....	<b>22</b>
<b>VII. Conclusion</b> .....	<b>23</b>
<b>Appendix A. Data Definitions and Source</b> .....	<b>24</b>
<b>Appendix B: Methodology Underlying the Compilation of the Indices</b> .....	<b>26</b>
<b>References</b> .....	<b>30</b>

## Glossary

ASEAN	Association of Southeast Asian Nations
DAI	Digital Adoption Index
DII	Digital Intelligence Index
EAP	East Asia and Pacific
IMF	International Monetary Fund
LAC	Latin America and Caribbean
MEA	Middle East and North Africa
OECD	The Organization for Economic Co-operation and Development
SSA	Sub-Saharan Africa
WB	The World Bank

## Executive Summary

This paper examines the role of Fintech in financial inclusion. Using Global Findex data and emerging fintech indicators, we find that Fintech has a higher positive correlation with digital financial inclusion than traditional measures of financial inclusion. In the second stage of our empirical investigation, we examine the key factors that are correlated with the Fletcher School's three digital divide – gender divide, class (rich-poor) divide and rural divide. The results indicate that greater use of fintech is significantly associated with a narrowing of the class divide and rural divide but there was no impact on the gender divide. These findings imply that Fintech alone may not be sufficient to close the gender gap in access to financial services. Fintech development may need to be complemented with targeted policy initiatives aimed at addressing the gender gap directly, and at changing attitudes and social norms across demographics.

## I. Introduction

Fintech is transforming financial services. By leveraging technology and cloud-based data, financial institutions are offering products better tailored to consumers' needs at a lower cost (Arner et al., 2020; Boot et al., 2020; Philippon, 2020; Thakor, 2020). As a result, many expected that Fintech would promote financial inclusion and benefit disadvantaged groups (Demirguc-Kunt et al., 2018; Breza et al., 2020). However, despite the plethora of papers on this topic, very few have provided direct empirical evidence of the impact of Fintech on financial inclusion. This is due to challenges in measuring Fintech as its products differ greatly in scope and scale, and in measuring the "digital" aspect of financial inclusion. The patchy data and short time series have also compounded the challenge.

This paper examines two research questions. First, does Fintech improve digital financial inclusion? Second, are there segments of society that are not included because they do not have the capacity and means to adopt Fintech – such as women, the poor and people living in rural areas?

Traditional indicators of financial inclusion, such as bank accounts and branches, cannot capture the role of Fintech in digital financial inclusion. To better assess this role, we use new digital financial inclusion indicators and various Fintech proxies in this paper. They are the Digital Financial Inclusion Index (Sahay et al. 2020), the Fletcher School's Digital Intelligence Index (DII), and the World Bank's digital adoption index (DAI).

Based on our panel regression, the paper draws three conclusions. First, Fintech has a positive correlation with financial inclusion, with the largest correlation occurring when digital financial inclusion is used. Second, Fintech has a negative association with the class divide and rich-poor divide (i.e. it has the potential to make it better). Third, Fintech has no impact on the gender digital gap. These findings imply that Fintech alone may not be sufficient to close the gender gap in access to financial services. Fintech development may need to be complemented by targeted policy initiatives aimed at addressing the gender gap directly, and at changing attitudes and social norms across demographic groups.

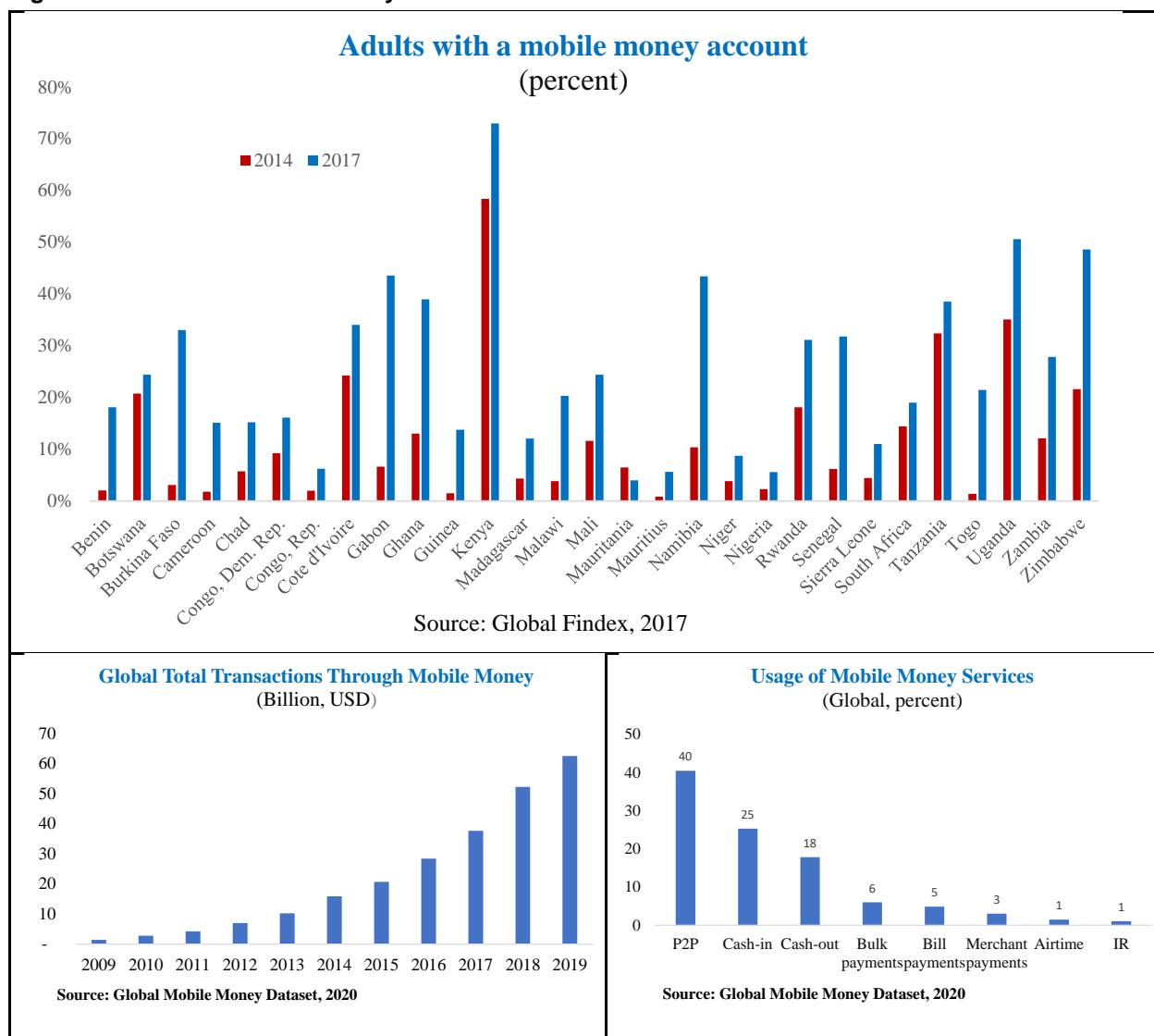
The paper is organized as follows: Section 2 reviews the recent trends and research on the role of Fintech in financial inclusion; Section 3 discusses the gender, rural, and rich-poor gap; Section 4 reviews the traditional and new indices of digital financial inclusion and the methodology used in this paper; Section 5 discusses the empirical analysis; and Section 6 describes the results. Section 7 sets out the conclusions and provides various policy recommendations.

## II. RECENT TRENDS AND LITERATURE

Fintech products differ greatly in scope and scale: cross-border payments, peer-to-peer loans, and credit risk assessments. Overall, the areas that Fintech covers can be categorized into: (i) credit, deposits, and capital-raising services; (ii) payments, clearing and settlement services, including digital currencies; (iii) investment management services; and (iv) insurance. Fintech is growing rapidly and at varying speeds across regions and countries. For instance, there has been a significant increase in the number of mobile accounts and usage of mobile money services (Figure 1).

Digital financial inclusion refers to the digital access and usage of formal financial services through mobile phones and computers. These include digital payments, digital lending/credit, marketplace lending, mobile money, and mobile banking (Sahay et al. 2020). In many countries, digital financial inclusion increased between 2014 and 2017, even where traditional financial inclusion was stalling or declining (World Bank 2018). Fintech is expected to fill gaps in both payments and lending, especially where the traditional delivery of financial services is less available. Demirgüç-Kunt et al. (2017) provided a comprehensive survey on financial inclusion. Fuster et al. (2019) and Tang (2019) showed that Fintech often serves as a complement to, rather than a substitute for, traditional banking services. On the contrary, Hau et al. (2018), Jagtiani and Lemieux (2018), Sumit et al. (2019), and Frost et al. (2019) argued that Fintech and big tech lenders serve borrowers who are traditionally underserved by banks.

**Figure 1: The rise of mobile money accounts and services**





Despite the rapid growth of Fintech, studies of its impact on financial inclusion have been limited. Studies of how Fintech has narrowed the digital gaps across gender, income and rural areas are even scarcer. This is largely due to the lack of comprehensive data on Fintech variables and digital financial inclusion indicators. The traditional financial inclusion indicators fall short of capturing digital financial inclusion, and analysis of the effect of Fintech on financial inclusion could lead to wrong conclusions if we are unable to measure financial inclusion properly.

Fintech can have negative correlations with the traditional measures of access and usage, such as the number of ATMs, bank branches and bank account per capita. For example, Tashin et al. (2018) found that leapfrogging (mobile phone over fixed lines) has negative correlations with the number of deposits and loans per capita in many countries. However, in the Pacific Islands, Tashin et al. (2018) found leapfrogging to be complementary to traditional banking services. In the Solomon Islands, mobile banking has complemented traditional banking in the areas of remittances.

Sahay et al. (2020) went beyond the anecdotal evidence to provide empirical support that Fintech promotes financial inclusion. Fintech solutions such as mobile money, mobile-point-of-sale devices and crowdfunding have provided low-cost, efficient, and collateral-less avenues for households and firms to pay, obtain credit, and support their cash management. They constructed a new indicator of digital financial inclusion using digital payment services data provided through mobile phones and the internet, and another traditional financial inclusion index for financial services provided by traditional financial institutions. Their new measure suggests that digital financial inclusion increased significantly in the years preceding the COVID-19 crisis, particularly in Africa. In eight countries, including Zimbabwe (where mobile payments have replaced cash transactions), South Africa and Nigeria, the improvement in financial inclusion has been entirely driven by Fintech. They also showed that Fintech has contributed to closing gender gaps in financial inclusion. In other words, digital financial inclusion gender gaps are lower on average than the traditional financial inclusion gender gaps. This is true overall and specifically for countries in Africa, the Middle East and Central Asia. However, for countries in Asia-Pacific, Latin America and the Caribbean, digital financial inclusion gender gaps are actually higher than the traditional financial inclusion gender gaps, demonstrating that the more Fintech is used the greater the gender divide.

On the contrary, Chen et al. (2021) used an individual-level survey dataset for 28 countries and found a persistent “Fintech gender gap” that could pose an obstacle to financial inclusion. They also found that the gender gap was smaller among products that complement traditional banking services relative to those that are substitutes. Women are more likely to adopt Fintech products that complement familiar services. This suggests that the gap in the use of Fintech is closely linked to differences in attitudes towards technology and price sensitivity. In their survey, more women than men said that they worry about their security when dealing with companies online. Women also reported being significantly less willing to adopt new financial technology, for example digital banks, and less willing to use a Fintech product even if it what it offers is superior or better suited to the respondent’s lifestyle.

Similarly, Cheah et al. (2021) look at the gender divide in the ASEAN payment system (both traditional and digital) and find that gender gap persists in digital models like mobile money. Their results show that women are more likely to use traditional payment methods like cash and that age exacerbates the gender divide in the usage of financial institutions for payment.

The literature is evolving as the evidence remains scarce and sometimes contradictory. This paper looks at the issue from a different angle – that of exclusion instead of inclusion. Exclusion is the flipside of inclusion, for instance, if the percent of population making digital payments is 60%, this means that 40% do not use digital payments. By doing so, we alert policymakers to the segments of society that have been left behind by the push for digitalization. Not all gaps need to be closed because there will always be voluntary exclusion, and not all firms and households need financial services (e.g., farmers in Thailand). It is not the policy objective to close all gaps because there may be structural reasons why a gap exists, and there are risks and costs involved in closing those gaps.

### **The Dark Side of Fintech**

Fintech has been touted as a force for good. The business models of Fintech startups are geared towards solving real-life problems such as payment apps that make it almost free and painless for migrant workers to send money home to the most remote villages. These payments and FinTech lending services are seen to fill a gap where traditional delivery of financial services is lacking; for example, crowdfunded lending to SMEs fills a financing gap and improves cash flows (Tok, Tan and Chansrinoyom. (2020)). However, as digital financial services become more ubiquitous and gain greater traction, researchers and regulators are becoming more aware of the “dark side of Fintech” and the need to address it urgently.

What do we mean by the “dark side” of Fintech? It is about the exclusion of certain groups in society: women, the aged, the poor and minority groups. The “dark side” also refers to algorithm biases and predatory lending practices that have a negative impact on vulnerable groups. As the pandemic accelerated the switch towards digital financial services there is a risk that the “dark side” has grown even bigger. For example, those without access to digital payments or deposit accounts are excluded from government support that is delivered via government-to-person (G2P) payments. Even in the US, where financial inclusion is high – 93% of adults have a bank account – there exists a 13 percent point gap between the wealthiest households and the poorest. Financial exclusion could arise from various sources, including the lack of access to digital infrastructure such as mobile phones, computers or the internet, financial and digital illiteracy, potential biases in algorithms, and/or lack of trust. The following paragraphs highlight the areas where financial exclusion might arise. However, our focus in this paper is on the Fintech gender, rural and class divide as this was dictated by the data available.

**Fintech gender gap:** Women in general have lower rates of bank account ownership than men (Demirguc-Kunt et al., 2017), are less likely to manage household finances (Guiso and Zaccaria, 2021) or to participate in the stock market (Ke, 2020). Sahay et al. (2020) found that while Fintech has contributed to closing gender gaps in financial inclusion in most countries, there is a concern that this gender gap might widen in the post-COVID era. This finding is supported by interviews with stakeholders who pointed out that Fintech does not address barriers such as cultural or social norms, financial and digital literacy, and safety and disparity in access to resources, and that such barriers are higher for women.

A recent paper by the BIS<sup>1</sup> found that 29% of men use Fintech products and services as compared to 21% of women.<sup>2</sup> The Fintech gender gap (8 percent point) was larger than the gap in bank account ownership between

---

<sup>1</sup> BIS Working Paper No. 931.

<sup>2</sup> The paper used micro-level survey data from the 2019 Ernst and Young Global Fintech Adoption Index. The survey covers over 27,000 adults from 28 major economies.

men and women<sup>3</sup> (7 percent point)<sup>4</sup>, and existed in all countries. The authors found that the gap could not totally be explained by either country-specific circumstances or individual characteristics such as age, education, income, and marital and employment status. Their results suggest that the gap in Fintech use is due to differences in attitudes and preferences towards new financial technology between genders. Women are more risk averse than men and are less willing to adopt new financial technology, irrespective of whether it is offered by new players or incumbents. The authors postulated that the gender gap could narrow as these new Fintech products become more standardized and regulated over time. This difference in attitudes between men and women could reflect social norms. For example, women worry more about privacy and personal data protection than men. It could also reflect gender-based discrimination, such as previous bad experiences with financial institutions (Bartlett et al, 2019). In addition, the fintech gender gap could be traced to the lack of access to the internet. According to the Alliance for affordable internet (2021), only 48% of women has access to the internet compared to 55% for men globally. The answer could also lie in the design of Fintech applications that are too male-centric and do not cater to women. Further research is needed in this area.

The following paragraphs highlight two other aspects of financial exclusion that are important but not covered in this paper.

**Aging and financial exclusion:** The G20 Fukuoka Policy Priorities on Aging and Financial Inclusion (2019)<sup>5</sup> noted ten factors that could contribute to financial exclusion of elderly people. They are: low digital capability; low financial literacy; cognitive decline; physical decline; social isolation; living on a fixed income, pension or annuity; reliance on family members; difficulty accessing financial advice; lack of financial products for older persons; and reliance on financial professionals. This is an important area that deserves more research. As many developed and developing economies are aging rapidly, technology could be leveraged to help the aged and understand the factors that drive financial exclusion for this segment of the population. It would also help in the design of products and policies to address this gap.

**Biases in algorithmic scoring:** Several papers have raised the issue of fairness and accuracy in data and algorithmic credit scoring that lead to biases against lower income and minority groups as well as women. Algorithms used by banks to predict credit card debt defaults typically favor wealthier white applicants (Heaven 2021). This is primarily due to the noise in the data that led to inaccurate predictions. A fairer algorithm would not fix the problem. In another study of mortgage data, Laura and Blattner ((2021) similarly concluded that differences in mortgage approvals between minority and majority groups were not attributed only to bias but to the fact that minority and low-income groups have less data, which in turn leads to less precise predictions. It is this lack of precision and not just bias that leads to inequality. In addition, even a gender-blind algorithm could end up biased against women as long as it draws on any input that happens to correlate with gender (Abuhamad, 2020). Similarly, Gilis (2021) showed that discrimination is already inherent in the data and excluding protected characteristics such as race did not solve the problem. As such, she advocated that fair lending laws should shift to an outcome-focused, welfare-oriented approach.

---

<sup>3</sup> IMF (2020), The Promise of Fintech: Financial Inclusion in the Post Covid-19 Era.

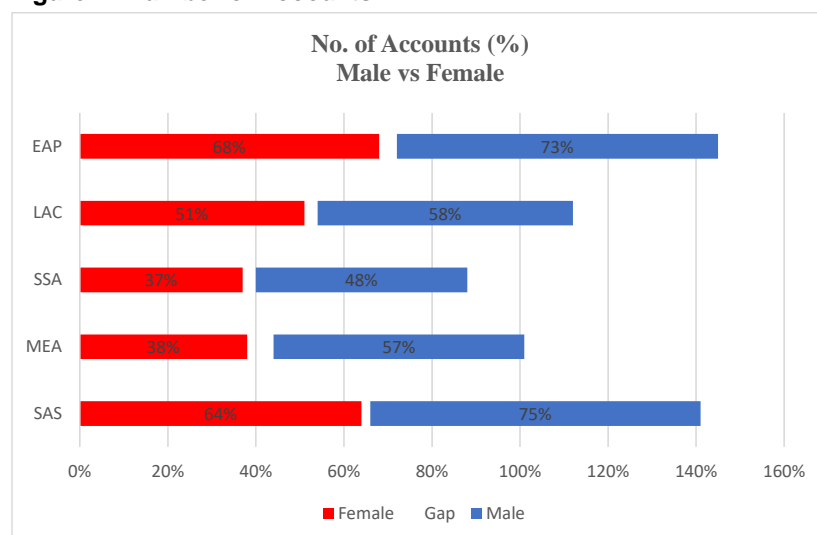
<sup>4</sup> Demircuc-Kunt et al. (2018).

<sup>5</sup> The report was prepared by Global Partnership for Financial Inclusion (GPFI) and OECD, 2019.

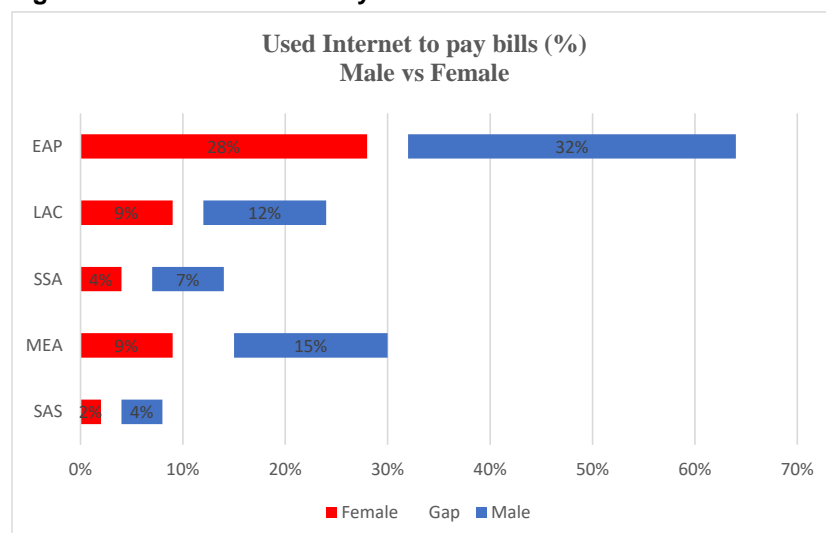
### III. Mind The Gap

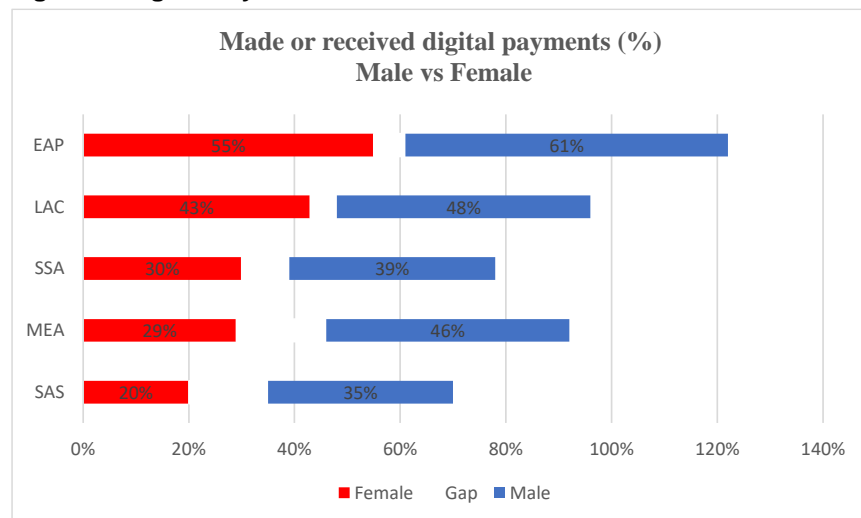
Using data from World Bank's Findex survey (2017), we illustrate the gender gap as the white space between the female (red bar) and the male (blue bar) below. The most striking message from the charts is that the gender gap exists across all regions. This fact is well-documented in the literature (BIS 2021, IMF 2020b). The gap is persistently largest across the three measures (accounts, used internet to pay bills, and made or received digital payments) and across the Middle East and North Africa (MEA), Sub-Saharan Africa (SSA), and South Asia. For instance, in MEA the gender gap as measured by the number of accounts is 19 percent points (Figure 2). In general, the gender gap narrows when we move from the accounts measure of inclusion to the two digital measures. **The average gender gap across all regions, using the accounts measure, is 11 percent points.**

**Figure 2: Number of Accounts**

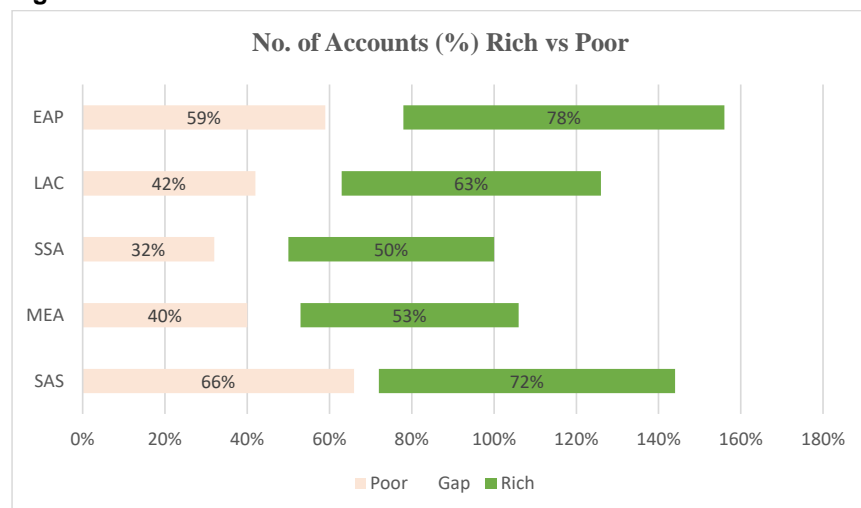


**Figure 3: Used Internet to Pay Bills**

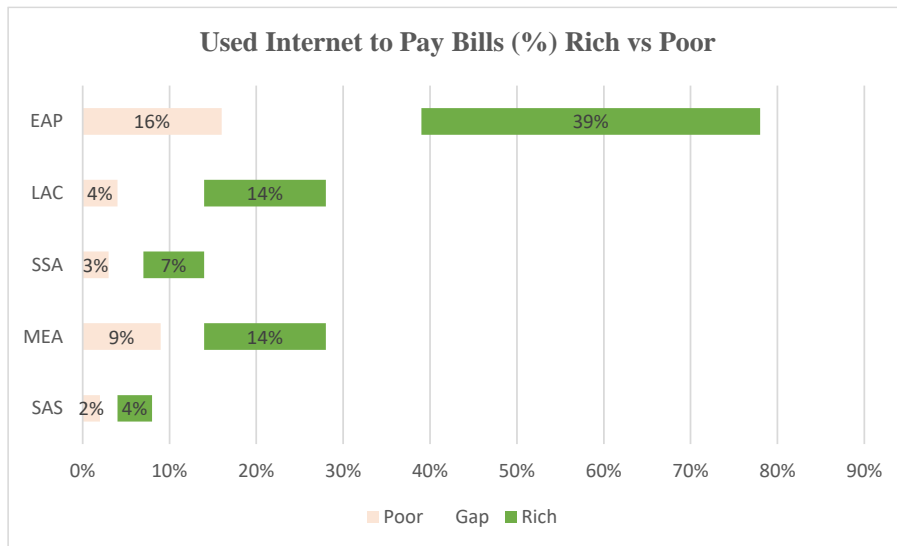


**Figure 4: Digital Payments**

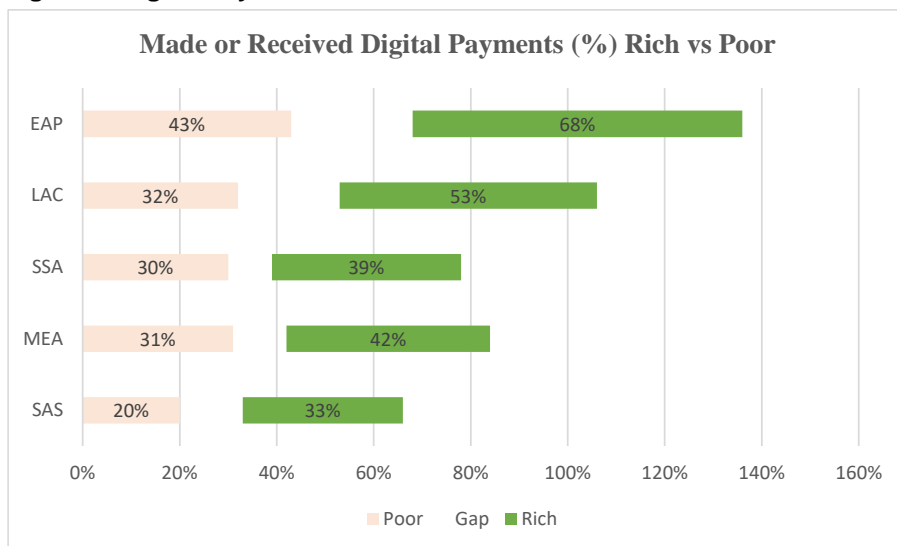
**The average rich-poor gap is 15 percent points across all regions.** The gap between the rich and poor is most pronounced in Latin America and Caribbean (LAC, 21 percent points) and East Asia and Pacific (EAP, 19 percent points) using the accounts measure. They did not narrow when the digital measures were used (Figures 3 and 4). By contrast, the rich-poor gap is smaller in SSA, MEA and SAS, and even smaller when digital measures are used (Figures 5 to 7).

**Figure 5: Number of Accounts**

**Figure 6: Internet Usage**



**Figure 7: Digital Payment**



## IV. Data and Empirical Approach

In this paper we use three digital financial inclusion indicators, two traditional financial inclusion indicators, and four Fintech proxies. They are described in Table 1 below. The three digital financial indicators were chosen because to our knowledge they are the only ones available and to which we have access. The four Fintech proxies are: (1) leapfrog; (2) venture capital raised for Fintech businesses; (3) business volume raised from crowdfunding platforms; and (4) mobile money accounts. Table 1 below lists the variables used in this study. More details about definitions and sources may be found in Appendix A.

**Table 1: Summary of Indicators Used in Regression**

Fintech Proxies	Digital Financial Inclusion Indicators	Traditional Financial Inclusion Indicators	Measures of Digital Divide
Leapfrog (proxied by mobile phones/fixed line subscriptions)	Digital Financial Inclusion Index	Traditional Financial Inclusion Index	Gender divide: the deviation of female digital usage from male. The higher the number, the better, i.e., less divide.
Venture capital raised for Fintech companies (as % of GDP)	Digital Intelligence Index (DII)	Number of bank branches	Rural divide: the deviation of rural digital usage from the average. The higher the number, the better.
Total amount of funds raised through P2P lending platforms (as % of GDP)	Digital Adoption Index (DAI)		Class divide: the deviation of the bottom 40% from the top 60%.
Mobile money accounts			

### Review of Digital Financial Inclusion Indicators

In this paper, we focus on the following three digital financial inclusion indices:

**Digital Financial Inclusion Index** (Sahay et al. 2020): Based on the principal component analysis, the index aggregates digital payment services through mobile phone and internet usage. The index covers 52 EMDEs for 2014 and 2017. Sahay et al. 2020 also constructed “traditional” financial inclusion index for financial services provided by traditional financial institutions. With these two indices, a comprehensive financial inclusion index was constructed using a three-stage principal component analysis. The first stage combined various indicators to compute measures of “access” to and “usage” of payment services separately for both traditional and digital financial inclusion. The second stage computed “traditional financial inclusion” and “digital financial inclusion” indices combining the respective access and usage indicators from the first stage. The third and final stage combined traditional and digital financial inclusion indices to build a comprehensive financial inclusion index of a country.

**Fletcher School's Digital Intelligence Index (DII)**<sup>6</sup>: This index takes a comprehensive approach to measure the digitalization of an economy within a framework. Digitalization is driven by four key drivers of equal importance: supply conditions, demand conditions, institutional environment, and innovation and change. It covers 90 economies from 2008 to 2019 and uses a total of 160 indicators. (For more details see the methodology in Appendix B.)

**World Bank's Digital Adoption Index (DAI)** is a composite index that measures the depth and breadth of the adoption of digital technologies in 171 countries. It uses 16 indicators of sectoral sub-indices covering businesses, people and governments, with each sub-index assigned an equal weight. It covers the period from 2014 to 2016. It is meant to provide a comprehensive picture of technology diffusion in an economy and not just in the financial services sector. As a result, it is a broader measure than the other two indices used in this study. The DAI was constructed using data on coverage and usage, often from the World Bank's internal databases, and therefore is likely to be more robust than those based on perception surveys.

The correlation between these three indices and their descriptive statistics is as follows:

**Table 2: Correlation Matrix**

	No. of accounts	Branches	Traditional Financial Inclusion	Digital Financial Inclusion Index	Digital Intelligence Index	World Bank Digital Adoption Index
No. of accounts	X	0.56	0.89	0.35	0.87	0.86
Branches		X	0.67	-0.04	0.38	0.50
Traditional Financial Inclusion Index			X	0.22	0.76	0.82
Digital Financial Inclusion Index				X	0.33	0.42
Digital Intelligence Index					X	0.88
World Bank Digital Adoption Index						X

<sup>6</sup> <https://digitalintelligence.fletcher.tufts.edu/methodology>



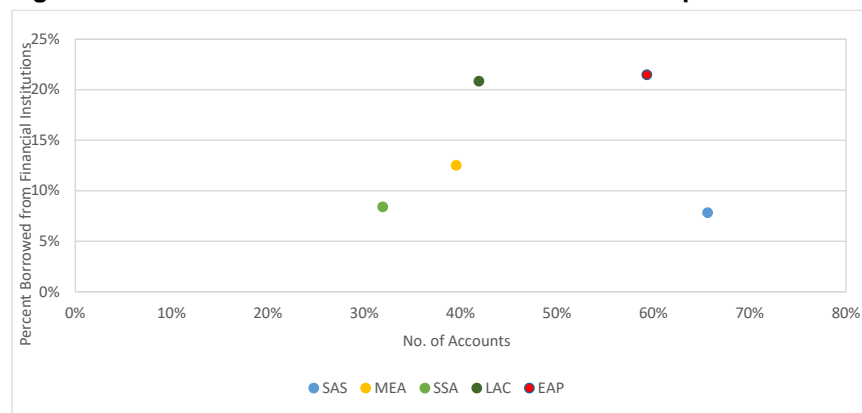
	Traditional Financial Inclusion Index	Digital Financial Inclusion Index	Digital Intelligence Index	WB Digital Adoption Index
Mean	0.33	0.36	0.51	0.5
Standard deviation	0.22	0.20	0.19	0.19
Min-Max	0.0-1.0	0.0-1.0	0.1-1.0	0.1-0.8

Table 2 shows the correlation among these key indices. The highest correlation is between the Digital Intelligence Index and the World Bank Digital Adoption Index. The lowest correlation (0.2) is to be expected between the IMF traditional Financial Inclusion Index and the IMF-Fintech Driven Index because the two indices were constructed to be distinct. The IMF-Fintech Driven Index has only a 0.3 and 0.4 correlation with the Digital Intelligence Index and the Digital Adoption Index respectively. Notably, the correlations between the number of accounts and the various financial inclusion indicators are positive, while that between the Fintech financial inclusion indicator and branches is negative. This provides preliminary evidence that Fintech is a substitute for bank branches. We provide more evidence below.

### Traditional vs Digital Fintech Indicators

Financial inclusion is like a huge elephant – it is multi-faceted. Imagine that you are blind and have never seen an elephant. If you touched its ears you would think that the elephant is soft and flappy, but if you touch its legs you would think that it looks like a tree trunk. Similarly, if you were to look at financial inclusion in terms of the number of accounts, it would look relatively high (Figure 8) at 71% for East Asia-Pacific; however, the borrowing is only 21% each for East Asia and Pacific and Latin American countries, and only 8% each for Sub-Saharan Africa and South Asia. This could lead one to conclude that financial inclusion is a problem in the area of borrowing/lending. Indeed, Fintech innovations such as mobile money and peer-to-peer lending exist to fill this lending gap and have been found to be quite successful (Bazarbash, Majid, Beaton, Kimberly (2020), Tok et al. (2020)). As noted in Sahay et al. (2020), across all regions and income levels borrowing activity is much less widespread than account holding. Even in wealthy countries, an adult is over four times as likely to have an account than to borrow from a formal financial institution (Barajas et al. 2020).

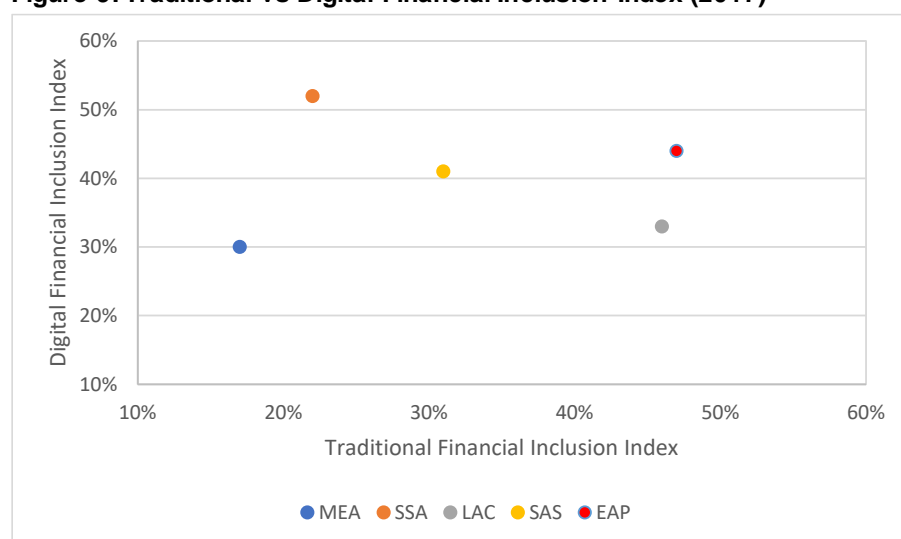
**Figure 8: Traditional Financial Inclusion Indicators Compared**



Source: World Bank Findex. SAS= South Asia, MEA = Middle East and Africa, SSA = Sub-Saharan Africa, LAC=Latin America and Caribbean, EAP = East Asia and Pacific.

To get a more accurate view of the elephant it is useful to look to at the digital index. In Figure 9, we compare traditional and digital financial inclusion index (Sahay et al. 2020). East Asia and Pacific, and Latin America and Caribbean have higher levels of traditional financial inclusion. However, when it comes to digital financial inclusion, Africa and again East Asia are ahead. Notably, nine African countries (including Ghana, Kenya, Senegal and Uganda) have the highest digital financial inclusion indices, while China is only in tenth position. This illustrates how Africa is at the forefront of leading Fintech innovation (see results on leapfrogging in Section V), primarily through the use of mobile money which has reduced the fixed cost of providing financial services to many people in Africa and has boosted financial inclusion. In other words, if we had measured financial inclusion the traditional way, we would have missed this African leapfrogging story.

**Figure 9: Traditional vs Digital Financial Inclusion Index (2017)**



## V. Empirical Assessment

This section sets out our empirical approach and results. First, in equation (1), we examine and compare the correlation of Fintech on financial inclusion using the indicators reviewed in the previous section. Second, in equation (2), we focus on the three digital divides constructed by the Fletcher School, namely, the gender divide (e.g. percent of women’s use of digital payments divided by percent of men’s use of digital payments), class divide (e.g. use of digital payments by the poorest 40% divided by the richest 60%) and the rural divide (rural vs population mean). (See Appendix A for definitions.) In our regressions, we have reversed the signs for the divide variables, so that a lower number (i.e. a smaller gap). means an improvement As we would like to examine the correlation between the fintech and the three divides, we control for other “environment factors” such as the regulatory quality, education levels, trust and gender inequality (structural issues facing women across three dimensions – health, empowerment and the labour market).

The analysis uses fixed-effect model with robust standard errors. The specification is as follows:

$$FI_{it} = c + \beta_1 X_{it} + \beta_2 Fintech_{it} + \alpha_i + \varepsilon_{it} \quad (1)$$

where FI is either digital or traditional financial inclusion as listed in Table 1; ‘Xs’ are the controls, which include per capita income, credit to private sector, education level, regulatory quality, population, internet penetration, and mobile phone penetration; and Fintech is the respective Fintech proxies listed in Table 1. The choice of the independent variables follows the literature (OECD, 2012; Dabla-Norris et al. 2015; ). Education, for instance, has been found to be important in reducing income inequality as it determines occupational choice, access to jobs, and the level of pay, and plays a pivotal role as a signal of ability and productivity in the job market.

### A. Does Fintech Promote Financial Inclusion?

First, we ran panel regressions with fixed effects to examine the effect of Fintech on financial inclusion using various traditional and digital financial inclusion measures and different proxies for Fintech. As shown in Table 3, the coefficient of Fintech proxied by leapfrog and capital raised have positive signs and are statistically significant in most regressions with digital financial inclusion and the Digital Intelligence Index (DII). These results suggest that the two Fintech proxies have a positive effect with digital financial inclusion that is consistent with the emerging literature. (See for example, Sahay et al. 2020.) In contrast, leapfrogging has no significant effect with the traditional financial inclusion indicator (i.e., bank branches), and capital raised has no correlation with the traditional financial inclusion indicator (Eq 2, 5, 8). These results imply that using traditional financial inclusion to measure the role of Fintech could lead to the wrong conclusions. As discussed in the previous section, leapfrogging has a negative correlation with traditional indicators and branches (Eq 2), implying that Fintech is a substitute for bank branches. This is similar to the conclusion in Tahsin et al (2018).

**Overall, the leapfrog variable has the highest positive effect on digital financial inclusion (Digital Inclusion Index).** The leapfrog Fintech proxy has a positive correlation with digital financial inclusion (Eq 1), but a negative correlation with traditional financial inclusion and branches. Taken together, our results suggest that economies with a greater propensity for technological leapfrogging in moving to cellular technologies have also tended to see falling levels of traditional financial infrastructure, particularly in bank branches. The phenomenon of leapfrogging is readily observable in developing countries which have led the way in many innovations such

as mobile payments (Kenya), digital land registration (India), and e-commerce (China). They were able to leapfrog because they were not bogged down by legacy IT systems or antiquated infrastructure. The variable of capital invested has only a 10% significance on digital financial inclusion (Eq 3).

Table 3 also shows results for the amount of funds raised through P2P lending platforms as a percentage of GDP. Like leapfrogging, P2P lending has a negative effect on branches (Eq 1). It has a positive correlation with the Digital Intelligence Index (Eq 7), but no significant relationship with the Digital Financial Inclusion Index (Eq 6). This means that P2P lending is complementary to traditional bank lending but a substitute for branches. This result is consistent with previous studies in this area as highlighted in our literature review. As mentioned earlier, lending, as opposed to accounts, is the area with the biggest gap; P2P lending is helping to fill this gap. Experience from many countries shows that P2P lending provides loans at a faster speed and a lower cost, and without collateral requirements that benefit low-income households and SMEs. In some countries, mobile point-of-sale devices or e-payments have helped SMEs collect electronic payments and subsequently use the documented sales as an indicator of creditworthiness to obtain credit. (See, for example, Beck et al. 2018, Sahay et al. 2020).

**Table 3: Leapfrog, Fintech and Digital Financial Inclusion**

VARIABLES	(1) Digital FI	(2) Branch	(3) Digital FI	(4) DII	(5) Branch	(6) Digital FI	(7) DII	(8) Branch
Population	2.551*** (0.731)	-5.835 (5.640)	1.217*** (0.238)	0.709*** (0.093)	2.395 (10.419)	5.090*** (1.356)	0.649*** (0.094)	2.074 (8.027)
Regulatory Quality	-0.077 (0.073)	1.180 (1.865)	-0.046 (0.051)	0.056*** (0.019)	1.539 (2.761)	-0.038 (0.109)	0.050*** (0.017)	-1.806 (1.396)
Credit/GDP	-0.384 (0.243)	8.262*** (2.062)	-0.009 (0.091)	-0.057** (0.022)	8.860 (5.528)	-0.895** (0.357)	-0.051 (0.037)	0.870 (4.265)
Education (secondary)	0.011* (0.006)	-0.112*** (0.032)	0.002 (0.004)	0.001** (0.000)	-0.131** (0.051)	0.014 (0.010)	0.001* (0.000)	-0.043 (0.039)
Cellphone/population	0.003*** (0.001)	0.017 (0.012)	0.003** (0.001)	0.001** (0.000)	0.016 (0.026)	0.004* (0.002)	0.001* (0.000)	0.037** (0.017)
Internet/population	0.074* (0.037)	-0.869 (0.561)	0.149*** (0.032)	0.009*** (0.002)	-1.141*** (0.275)	0.012 (0.066)	0.009*** (0.002)	-0.600*** (0.198)
Leapfrogging (cell/fixed line)	0.037*** (0.011)	-0.172** (0.211)						
Fintech (Capital Invested)			0.013* (0.007)	0.004*** (0.001)	-0.407*** (0.151)			
Fintech (Capital raised, P2P)						-0.014 (0.014)	0.004*** (0.001)	-0.206** (0.082)
Constant	-43.450*** (12.088)	88.174 (87.108)	-21.897*** (4.237)	-11.418*** (1.570)	-47.366 (175.158)	-87.686*** (23.514)	-10.407*** (1.548)	-15.840 (120.189)
Observations	64	950	33	369	332	40	259	307
R-squared	0.786	0.197	0.910	0.692	0.295	0.834	0.678	0.161
Number of ctry	36	152	19	65	71	25	66	85
Adj. R-squared	0.759	0.191	0.884	0.686	0.279	0.797	0.669	0.141

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## B. Does Fintech Bridge the Gender, Class and Rural Divides?

We examine the role played by the various Fintech proxies on the various divides, after controlling for the difference in regulatory quality, education, level of trust in the economy and gender inequality across countries. We ran the regression using the latest Digital Intelligence Index sub-indices of rural divide, class divide, and gender divide:

$$XDIVIDE_{it} = \beta_1 + \beta_2 X_{it} + \beta_3 Fintech_{it} + \alpha_i + \varepsilon_{it} \quad (2)$$

Where  $XDIVIDE$  = rural divide or class divide or gender digital divide, 'X's are the control variables: trust index, regulatory quality, and education. Regulatory quality and education appear again in this empirical analysis as they can affect both the level and the gap in digital financial inclusion. Nonetheless, for the equation on the gender divide regression, we added the gender inequality index, to control for "environmental factors" that could disadvantage women. The gender inequality index is a proxy for human development for women. It measures inequality across the three dimensions of health, empowerment, and the labour market.

As shown in Tables 4, 5 and 6, the Fintech proxies are significant and negatively correlated with the rural divide and the class divide. These results imply that Fintech has the potential to improve the rural divide and class divides. However, Fintech has no significant correlation with the gender divide (Table 6). We also checked the robustness by using the raw gap measure without normalization (e.g., digital payments (female) – digital payments (male)). The results are similar and are set out in Appendix C.

Our results demonstrate evidence of the potential benefits of mobile money accounts in providing much-needed digital financial services to lower-income households and small and medium-sized enterprises (SMEs). In many countries, digital financial services have facilitated the quick and efficient deployment of government support measures to firms and households affected by the COVID-19 pandemic.

**Table 4: Fintech and Rural Divide in Digital Financial Inclusion**

VARIABLES	(1) Rural Divide	(2) Rural Divide	(3) Rural Divide	(4) Rural Divide	(5) Rural Divide
Regulatory quality	-0.019 (0.292)	-0.209 (0.398)	0.222 (0.246)	0.222 (0.209)	-0.190 (0.173)
Education	-0.000 (0.003)	-0.027 (0.067)	0.009 (0.022)	0.002 (0.003)	-0.001 (0.005)
Trust index	-0.382*** (0.076)	-0.024 (0.129)	0.193 (0.201)	-0.040 (0.203)	0.170 (0.253)
Leapfrog	<b>-3.039*</b> (1.754)				
Digital financial inclusion		<b>-4.948**</b> (2.077)			
Digital adoption index			<b>-7.138**</b> (3.054)		
Fintech (Capital invested)				<b>-0.094**</b> (0.045)	
Fintech (Capital raised, P2P)					<b>-0.069**</b> (0.030)
Constant	0.274 (0.283)	4.844 (6.945)	3.409 (3.242)	-1.251** (0.568)	0.363 (0.571)
Observations	147	32	62	137	98
R-squared	0.286	0.511	0.355	0.234	0.219
Number of ctry	23	8	23	23	23
Adj. R-squared	0.266	0.439	0.310	0.211	0.185

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

However, the story is not so rosy for the gender divide (Table 6). There is no significant correlation between the gender divide and the different Fintech proxies. This is consistent with the findings in Cheah et al. (2021) that the gender gap persists in digital payments.

The digital gap could be explained by differences in preferences across genders, for example differences in risk aversion (Croson and Gneezy, 2009), or differences in the costs and benefits that consumers attach to the use of these new products. They could also result from gender-based discrimination (Bartlett et al., 2019), such as women's previous negative experiences with financial institutions (Brock and De Haas, 2021). Finally, the gap could also arise from social norms or laws that affect the cost-benefit trade-off differently across genders (Hyland et al., 2020). Future research focusing on the determinants of these factors could be particularly promising in understanding the Fintech gender gap.

**Table 5: Fintech and Class Divide**

VARIABLES	(1) Class Divide	(2) Class Divide	(3) Class Divide	(4) Class Divide	(5) Class Divide
Regulatory quality	0.202 (0.146)	0.320* (0.165)	0.434*** (0.137)	0.264 (0.248)	0.223 (0.239)
Education	-0.002 (0.002)	0.052*** (0.011)	0.039** (0.016)	0.004 (0.003)	-0.003 (0.004)
Trust index	-0.575*** (0.159)	-0.438*** (0.038)	-0.259*** (0.050)	-0.557** (0.202)	-0.153 (0.129)
Leapfrog	-2.357*** (0.424)				
Digital financial inclusion		-3.857*** (0.365)			
Digital adoption index			-6.282*** (1.138)		
Fintech (Capital invested)				-0.056*** (0.019)	
Fintech (Capital raised, P2P)					-0.060*** (0.015)
Constant	0.196 (0.266)	-2.798** (1.100)	-0.424 (1.575)	-1.023* (0.508)	0.289 (0.439)
Observations	147	32	62	137	98
R-squared	0.450	0.917	0.648	0.307	0.477
Number of ctry	23	8	23	23	23
Adj. R-squared	0.434	0.904	0.624	0.286	0.455

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

**Table 6: Fintech and Gender Digital Divide**

VARIABLES	(1) Gender Digital Divide	(2) Gender Digital Divide	(3) Gender Digital Divide
Regulatory quality	-0.416* (0.211)	-0.443** (0.197)	-0.416** (0.189)
Education	0.043 (0.030)	0.003 (0.002)	-0.002 (0.006)
Trust index	-0.087 (0.096)	-0.155 (0.098)	-0.105 (0.097)
Gender inequality	4.555 (4.250)	3.553 (2.113)	1.561 (3.623)
Digital adoption index	<b>-0.882</b> (1.225)		
Fintech (Capital invested)		<b>0.013</b> (0.012)	
Fintech (Capital raised, P2P)			<b>-0.004</b> (0.008)
Constant	-4.951 (3.410)	-0.977* (0.490)	-0.104 (0.415)
Observations	41	137	98
R-squared	0.325	0.307	0.222
Number of ctry	23	23	23
Adj. R-squared	0.229	0.281	0.180

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

A caveat is that the explanatory powers of these variables are rather low and suggest for further analysis with more variables. This is a topic for further research as new data become available.

## VI. Policy Implications

Our results above show that while fintech is positively correlated with improving digital financial inclusion, and potentially benefitting the poor and rural population, it could not address the gender divide. To identify the policy measures that could help address the gender gap, we approach several central bankers in the region for their take on this issue (See Appendix 6 for the interview questions). Our interviews with the central bankers in Asia suggest that even in countries with a very high level of traditional financial inclusion, digital financial inclusion is still a work in progress. In many countries, digitalization efforts are decentralized, making it challenging to design an overarching strategy to reduce financial exclusion amongst vulnerable groups. Recognizing the need to narrow the digital gap, especially amongst women and the aged, they have taken a two-track approach: to go digital for those who are both willing and able, and to make sure that those who are willing but unable have continued access to cash and personalized help. As one policymaker put it, the aim is to be cash-light but not completely cashless. Many countries have devised innovative ways to encourage and incentivize digital adoption. For example, in Singapore the “Go Digital Campaign” provides funding support to SMEs to digitalize their business, the “Hawkers Go Digital” provides cash incentives for hawkers to adopt digital payments, and the “Seniors Go Digital Campaign” provides one-on-one guidance to seniors on using mobile



phones for digital payments and other digital services. Closing the digital gaps also includes raising financial and digital literacy, addressing infrastructure issues such as broadband and wifi availability, and last-mile challenges.

## VII. Conclusion

A higher level of financial inclusion will be achieved when policies succeed in extending financial services to a broader segment of the population in an efficient and sustainable manner. This paper draws three conclusions. First, Fintech has a positive correlation with financial inclusion, and the correlation is greater when digital financial inclusion measures are used as compared to traditional measures. Second, Fintech has played a positive role in bridging the digital access gap between rural and rich-poor populations. Third, Fintech has no correlation with the gender digital gap.

Our findings highlight the importance of leaving no one behind when promoting Fintech services. While Fintech has delivered some promises in reducing the rural, rich-poor gap, more work needs to be done to close the gender gap in access to financial services. Fintech development may need to be complemented by targeted policy initiatives aimed at improving women's access to internet, addressing differences in attitudes or challenges across demographic groups. These challenges include discrimination or social norms and laws that disadvantage women in many countries.

## Appendix A. Data Definitions and Source

**Leapfrog:** Ratio of mobile phones to fixed lines (Source: GSMA)

**Capital Invested:** Amount of venture capital raised (all stages) for Fintech companies (Source: Pitchbook)

**Business Volume:** Total amount of funds raised through digital lending and digital capital raising activities. It includes both lending to individuals and businesses and other entities that raise funds via an online digital marketplace. (Source: Cambridge Centre for Alternative Finance)

**Gender inequality:** It measures gender inequalities across three aspects: (1) reproductive health, measured by maternal mortality ratio and adolescent birth rates; (2) empowerment, measured by proportion of parliamentary seats occupied by females and (3) proportion of adult females and males aged 25 years and older with at least some secondary education; and economic status, expressed as labour market participation and measured by labour force participation rate of female and male populations aged 15 years and older. (Source: UNDP Human development report)

**Internet Pop:** Per cent of population that has access to the internet (Source: World Bank Findex)

**Cell Pop:** Per cent of population that has cellphones (Source: World Bank)

**Lnpop:** Log (Population) (Source: World Development Indicators)

**Lcreditgdp:** Log (domestic credit by financial institutions/GDP – proxy of financial sector development (Source: IMF)

**Mobile money:** a pay-as-you-go digital medium of exchange and store of value using mobile money accounts which are offered by a mobile network operator or another entity in partnership with a mobile network operator. (Source: GSMA)

**Regulatory quality (req):** perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. One of six dimensions of governance in the Worldwide Governance Indicators. (Source: World Bank)

**Education:** Gross enrollment ratio in secondary school (Source: World Bank World Development Indicators)

**Trust index:** Edelman Trust Barometer (Source: Edelman), based on survey data covering 22 markets (Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Ireland, Italy, Japan, Malaysia, Mexico, Netherlands, Russia, Singapore, South Korea, Spain, the UAE, the UK, and the US) across 16 industries.

**The following are the definitions of the components of the Digital Intelligence Index by the Fletcher School:**

**Digital Inclusion:** The extent to which inequities in digital account ownership, online engagement, and digital payment uptake exists across gender, class, and geography.

**Gender Digital Divide:** The gap between women and men's usage of digital account, online engagement and digital payment. For instance, the use of digital payments by women divided by the use of digital payments by men. The results are then standardized (z-scored). A negative score means a score below the population mean. The higher the score the better. However, for ease of interpretation, we have reversed the signs in our regressions so that a lower number (i.e. a smaller gap).means an improvement

**Class Digital Divide:** The extent to which inequities in digital account ownership, online engagement, and digital payment uptake differs among the poorest 40% of the population as compared to the richest 60%. For example, the use of digital payments by the poorest 40% divided by the use of digital payments by the richest 60%. A higher number means higher inclusion. However, for ease of interpretation, we have reversed the signs in our regressions so that a lower number (i.e. a smaller gap).means an improvement

**Rural Digital Divide:** The extent to which inequities in digital account ownership, online engagement, and digital payment uptake differs between rural consumers vs the average level for a particular country -year. The results are then standardized (z-scored). A negative score means a score below the population mean. The higher the score the better. However, for ease of interpretation, we have reversed the signs in our regressions so that a lower number (i.e. a smaller gap).means an improvement

#### **World Bank Findex Data**

% Used the internet to pay bills or to buy something online in the past year (poorest 40%)

% Received digital payments in the last year (poorest 40%)

% Account (poorest 40%)

% Made digital payments in the last year (poorest 40%)

% Used the internet to pay bills or to buy something online in the past year (richest 60%)

% Received digital payments in the last year (richest 60%)

% Account (richest 60%)

% Made digital payments in the last year (richest 60%)

% Used the internet to pay bills or to buy something online in the past year (Male)

% Received digital payments in the last year (Male)

% Account (Male)

% Made digital payments in the last year (Male)

% Used the internet to pay bills or to buy something online in the past year (Female)

% Received digital payments in the last year (Female)

% Account (Female)

% Made digital payments in the last year (Female)

% Used the internet to pay bills or to buy something online in the past year (Urban)

% Received digital payments in the last year (Urban)

% Account (Urban)

% Made digital payments in the last year (Urban)

% Used the internet to pay bills or to buy something online in the past year (Rural)

% Received digital payments in the last year (Rural)

% Account (Rural)

% Made digital payments in the last year (Rural)

# Appendix B: Methodology Underlying the Compilation of the Indices

## Digital Intelligence Index and the World Bank Digital Adoption Index

### The Digital Intelligence Index

Digital Evolution is a data-driven holistic evaluation of the progress of the digital economy across 90 economies, combining 160 different indicators into four key drivers: supply conditions, demand conditions, institutional environment, and innovation and change.

To create a composite picture of the digital economy, Digital Evolution tracks a total of 160 indicators to measure the current state and pace of digitalization. It is structured at four levels: indicators, clusters, components, and drivers. Indicators are standardized data points that answer a specific question. They are aggregated into clusters which illuminate 35 aspects of digitalization and then rolled into 13 higher-order components which ultimately feed into the four drivers. A visual representation of Digital Evolution's data hierarchy is presented here.

The central hypothesis of Digital Evolution is that digitalization of an economy is governed by four drivers of equal importance: supply conditions, demand conditions, institutional environment, and innovation and change. As such, our model accords equal weight to all four drivers. Indicator, cluster, and component weights are determined according to three factors: data quality, data centrality, and the strength of data collection methods.

After indicators have been aggregated into clusters, components, drivers, and ultimately final scores, the final scores are rescaled to fit a 0 to 100 range. Momentum scores are generated by applying the compound annual growth rate formula (**CAGR**) on final index scores across our time window. After calculating index growth rates for each economy, we rescaled CAGRs on a similar 0 to 100 scale. Momentum scores, like the final index scores, are relative.

Throughout the computation, weighting, standardization and aggregation processes we adopted several quality assurances measures to ensure the validity and robustness of the index. By deploying different statistical tools throughout the process, including data cleaning, variance analysis, regression analysis, and simulations, we stress tested the index scores at multiple levels to produce the most comprehensive and robust numbers possible.

### The World Bank Digital Adoption Index is a supply-side measure:

**The DAI is a worldwide index that measures countries' digital adoption across three dimensions of the economy: people, government, and business.** The index covers 180 countries on a 0–1 scale and emphasizes the “supply-side” of digital adoption to maximize coverage and simplify theoretical linkages. The overall DAI is the simple average of three sub-indices. Each sub-index comprises the technologies necessary for the respective agent to promote development in the digital era: increasing productivity and accelerating broad-based growth for *business*; expanding opportunities and improving welfare for *people*; and increasing the efficiency and accountability of service delivery for *government*. Originally constructed as part of the [World](#)

[Development Report 2016: Digital Dividends](#), the DAI has been updated to reflect new data sources and an improved methodology. Two observations are available for most countries: 2014 (applying the updated data and methodology to the year covered in the original DAI dataset), and 2016 (the most recent year available). By measuring the relative adoption of digital technologies, DAI can assist policymakers to design digital strategy with policies tailored to promote digital adoption across different user groups.

**Methodology:** DAI is a composite index that measures the depth and breadth of adoption of digital technologies in 171 countries, spanning every region and income group. It is based on three sectoral sub-indices covering businesses, people, and governments, with each sub-index assigned an equal weight:

$$\text{DAI (Economy)} = \text{DAI (Businesses)} + \text{DAI (People)} + \text{DAI (Governments)}$$

- **DAI (Business):** The Business cluster is the simple average of four normalized indicators: the percentage of businesses with websites, number of secure servers, download speed, and 3G coverage in the country.
- **DAI (People):** The People cluster is the simple average of two normalized indicators from the Gallup World Poll – mobile access and internet access at home.
- **DAI (Governments):** The Government cluster is the simple average of three sub-indices: core administrative systems, online public services, and digital identification. Data for online public services is provided by the UN's Online Service Index. Data for core administrative systems and digital identification was collected by the World Bank. The sixteen indicators used to develop the three sub-indices of the Government cluster are the most critical advantage offered by DAI.

Much of the data was collected as part of the preparation for the WDR 2016. These indicators need to be updated on a regular basis to remain useful. Additional indicators to capture ministry-specific management information systems, such as education, health, and welfare payments, are also required.

The four indicators used to create the Business cluster, while useful, are not enough. Firm-specific variables, such as enterprise resource planning, cloud computing, supply chain management software, and e-purchases and e-sales, are currently available only for advanced economies. They need to be expanded to include the developing world.

The methodology used to construct the DAI provides considerable flexibility to adjust the index to accommodate new digital technologies such as mobile money or big data, as well as to drill down to more disaggregated level (for example, DAI for e-retail or digital ID) as required in different contexts.

## Appendix C: Robustness Check With Raw Gap Measure

In addition to the Digital Gender Divide produced by the Fletcher School Index, we used the gap in account, “use internet to pay bill”, and “made/received digital payment”, collected by the Findex Survey. We calculated

the gap in accounts as “% of male with account- % of female with account” for the gender digital gap, and “60% richest – 40% poorest” for the class divide. We then used these gap indicators as dependent variables in the panel regression. The results in Table A1 and Table A2 confirm our earlier findings about gender digital gap and class divide. In some cases, we saw a wider gap as a result of Fintech.

**Table A1: Fintech and Gender Digital Divide**

VARIABLES	(1) Account	(2) Internet to pay bill	(3) Made/received digital payment	(4) Account	(5) Internet to pay bill	(6) Made/received digital payment	(7) Account	(8) Internet to pay bill	(9) Made/received digital payment
Regulatory quality	-0.065 (0.065)	-0.009 (0.014)	-0.097 (0.056)	-0.071 (0.065)	0.012 (0.023)	-0.114*** (0.036)	-0.034 (0.035)	-0.068 (0.049)	-0.044 (0.060)
Trust index	-0.056** (0.024)	0.005 (0.013)	-0.050** (0.018)	-0.057*** (0.017)	0.009 (0.009)	-0.050*** (0.013)	-0.031 (0.025)	-0.038 (0.062)	0.014 (0.036)
Gender inequality	1.193 (1.838)	0.228 (0.665)	-0.034 (1.853)	1.266 (1.195)	0.282 (0.396)	-0.380 (1.011)	0.507 (0.774)	-0.445 (0.738)	-0.761 (0.699)
Digital Financial Inclusion	<b>0.042</b> (0.097)	<b>0.149**</b> (0.055)	<b>-0.007</b> (0.229)						
Mobile Money Account				<b>0.114</b> (0.226)	<b>0.462***</b> (0.138)	<b>-0.240</b> (0.457)			
Fintech (Capital raised, P2P)							<b>-0.000</b> (0.002)	<b>-0.001</b> (0.004)	<b>-0.006</b> (0.005)
Constant	-0.417 (0.770)	-0.136 (0.262)	0.109 (0.823)	-0.377 (0.478)	-0.139 (0.155)	0.305 (0.418)	-0.040 (0.190)	0.229 (0.208)	0.302 (0.193)
Observations	22	22	22	24	24	24	51	51	51
R-squared	0.328	0.331	0.130	0.428	0.460	0.192	0.117	0.070	0.102
Number of ctry	11	11	11	12	12	12	27	27	27
Adj. R-squared	0.169	0.173	-0.0750	0.307	0.346	0.0216	0.0405	-0.0112	0.0235

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

**Table A2: Fintech and Class Digital Divide**

VARIABLES	(1) Account	(2) Internet to pay bill	(3) Made/received digital payment	(4) Account	(5) Internet to pay bill	(6) Made/received digital payment	(7) Account	(8) Internet to pay bill	(9) Made/received digital payment
Regulatory quality	0.117** (0.047)	0.069 (0.041)	0.065** (0.028)	0.088* (0.046)	0.058 (0.059)	0.027 (0.030)	0.078** (0.033)	0.049 (0.054)	0.057 (0.054)
Trust index	-0.066** (0.021)	-0.003 (0.021)	-0.013 (0.014)	-0.078*** (0.018)	0.016 (0.039)	-0.041* (0.020)	-0.103*** (0.032)	-0.009 (0.053)	0.021 (0.050)
Gender inequality	1.167 (1.734)	-0.193 (1.108)	-1.590 (1.249)	0.743 (1.142)	0.898 (1.284)	-1.092 (1.095)	0.358 (0.683)	0.047 (0.807)	-1.066 (0.891)
Digital Financial Inclusion	<b>0.020</b> (0.178)	<b>0.393***</b> (0.121)	<b>-0.283</b> (0.161)						
Mobile Money Account				<b>-0.016</b> (0.274)	<b>1.051**</b> (0.445)	<b>-0.301</b> (0.416)			
Fintech (Capital raised, P2P)							<b>0.001</b> (0.003)	<b>0.005</b> (0.006)	<b>-0.007</b> (0.005)
Constant	-0.282 (0.743)	0.024 (0.460)	0.887 (0.549)	-0.115 (0.449)	-0.361 (0.505)	0.571 (0.441)	-0.005 (0.170)	0.050 (0.219)	0.352 (0.234)
Observations	22	22	22	24	24	24	51	51	51
R-squared	0.304	0.610	0.460	0.296	0.279	0.116	0.217	0.048	0.128
Number of ctry	11	11	11	12	12	12	27	27	27
Adj. R-squared	0.140	0.518	0.333	0.148	0.127	-0.0701	0.149	-0.0343	0.0518

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

## Appendix D: Interview Questions with Policymakers

- In the design of the digitalization/fintech national strategy, have you considered the segments of society that might be excluded e.g. the poor, aged, women, those in rural/remote areas?
- Who amongst the “excluded group” do you think are the most excluded and therefore needs most help?
- How do you take into account these gaps and what needs to be done to help those excluded or make sure that they can catch up?
- What are the consequences of ignoring this group?
- Would you consider slowing the pace of fintech development in your country as part of your strategy to “wait” for them to catch up.
- Would additional data initiatives help in the design of policies to mitigate financial exclusion? If so, any specific examples?

## References

- Agur, I., Martinez Peria, S. and Rochon, C. 2020. Digital Financial Services and the Pandemic: Opportunities and Risks for Emerging and Developing Economies. IMF Special Series on COVID-19.
- Alliance for affordable internet. (2021). The costs of exclusion: economic consequences of the digital gender gap.
- Allmen, Eriksson von, U., Khera, P., Ogawa, S., and Sahay, R. 2020. Digital Financial Inclusion in the Times of COVID-19. IMF Blog.
- Arner, Douglas W., Buckley, Ross P., Zetsche, Dirk A. and Veidt, Robin. 2020. Sustainability, fintech and financial inclusion. European Business and Organization Law Review.
- Barajas Adolfo, Thorsten Beck, Belhaj Mohammed and Naceur, B. Sami. Financial Inclusion: What have we learnt so far? What do we have to learn. IMF Working Paper, WP/20/157.
- Bartlett, Robert, Morse Adair, Stanton Richard and Wallace Nancy. (2019). Consumer-lending discrimination in the fintech era. NBER Working Paper.
- Bazarbash, Majid, Beaton, Kimberly (2020). Filling the Gap: Digital Credit and Financial Inclusion. IMF WP/20/150.
- Boot, Arnoud WA, Hoffmann, Peter, Laeven, Luc and Ratnovski, Lev. (2020). Financial intermediation and technology: What's old, what's new? CEPR Discussion Papers.
- Breza, Emily, Kanz, Martin and Klapper, Leora F. (2020). Learning to navigate a new financial technology: Evidence from payroll accounts. NBER Working Paper.
- Brock, J. Michelle and Ralph De Haas. (2021). Discriminatory lending: Evidence from bankers in the lab. Working Paper.
- Burjorjee, Deena M and Yasmin Bin-Humam. 2018. New insights on women's mobile phone ownership, Consultative Group to Assist the Poor, Washington Chakravorti, Bhaskar, Chaturvedi, Ravi Shankar, et al. (2020). The Digital Intelligence Index. Digital Planet, The Fletcher School at Tufts University.
- Cheah, Wen Chong, Ammu George and Taojun Xie. 2021. Gender Divides in the ASEAN Payment Ecosystem., Research Paper #15-2021, Asia Competitiveness Institute Research Paper Series.
- Chen, Sharon, Doerr, Sebastian, Frost, Jon, Gambacorta, Leonardo, Hyun Song Shin. (2021). The fintech gender gap. BIS Working Paper No. 931.
- Croson, Rachel and Gneezy, Uri. (2009). Gender differences in preferences. Journal of Economic Literature 47 (2), pp 448–474.



Dabla-Norris, E., Kochhar, K. Suphaphiphat, N., Ricka, F. Tsounta, E. (2015). Causes and Consequences of Income Inequality: A Global Perspective. IMF Staff Discussion Note. SDN/15/13.

Demirguc-Kunt, Asli, Klapper, Leora, Singer, Dorothy, Ansar, Saniya and Hess, Jake. (2018). The Global Findex Database 2017: Measuring financial Inclusion and the fintech revolution. World Bank.

Dong He, Leckow, Ross, Haksa, Vikram et al. (2017). Fintech and Financial Services: Initial Considerations. IMF Staff Discussion Note.

Espinosa-Vega, M., Shirono, K., Villanova, Carcel, H., Chhabra, E., Das, B., and Fan, Y. 2020. Measuring Financial Access: 10 Years of the IMF Financial Access Survey. IMF Departmental Paper No. 20/08.

Frost, Jon, Leonardo Gambacorta, Yi Huang, Hyun Song Shin, and Pablo Zbinden. (2019). BigTech and the changing structure of financial intermediation. *Economic Policy* 34 (100), pp 761–799.

Fuster, Andreas, Plosser, Matthew, Schnabl, Philipp and Vickery, James. (2019). The role of technology in mortgage lending. *Review of Financial Studies* 32 (5), pp 1854–1899.

Guiso, Luigi and Luana Zaccaria. (2021). From patriarchy to partnership: Gender equality and household finance. Working Paper.

Hau, Harald, Huang, Yi, Shan, Hongzhe, and Sheng, Zixia. (2018). Fintech credit and entrepreneurial growth. Swiss Finance Institute Research Paper.

Heaven, W. Douglas. (2021). Bias isn't the only problem with credit scores – and AI can't help. MIT Technology Review.

Hyland, Marie, Simeon Djankov, and Pinelopi Koujianou Goldberg. (2020). Gendered laws and women in the workforce. *American Economic Review: Insights* 2 (4), pp 475–490.

IMF, Asia-Pacific Department (2019). Financial Inclusion in the Asia-Pacific. Appendix 6.

Julapa, Jagtiani and Lemieux, Catharine. (2018). Do fintech lenders penetrate areas that are underserved by traditional banks? *Journal of Economics and Business* 100, pp 43–54.

Ke, Da. (2020). Who wears the pants? Gender identity norms and intra-household financial decision making. *Journal of Finance*, June 2021, Vol 76, Issue 3.

Naceur, B. Sami, Barajas, Aldofo, Massara, Alexander. (2015). Can Islamic Banking increase Financial Inclusion? IMF/WP/15/31.

OECD. (2018). Financing SMEs and Entrepreneurs 2018: An OECD Scoreboard.

OECD. (2012). Inequality in Labor Income—What Are Its Drivers And How Can It Be Reduced? OECD Economics Department Policy Note 8, Paris.

Ouma, Shem Alfred, Odongo, Teresa Maureen and Were Maureen. (2017). Mobile financial services and financial inclusion: Is it a boon for savings mobilization? *Review of Development Finance* 7 (1), pp 29–35.

Paaso, Mikael, Okat, Deniz, and Pursiainen, Vesa. (2020). Trust in finance and consumer fintech adoption. Available at SSRN.

Philippon, Thomas. (2020). On fintech and financial inclusion. BIS Working Paper, No 841.

Ronit, Ghose, Yafei Tian. (2017). FinTech Around the World. Citi Research.

Sahay, Ratna, Ulric, Ericsson, Lahreche, Amina, Khera, Purava, Ogawa, Sumiko, Bazarbash Majid, and Beaton Kimberly. (2020). The Promise of Fintech: Financial Inclusion in the Post-Covid-19 Era. MCM Paper No. 20/09.

Saadi Sedik, Tahsin, et al. (2018). Impact of Technology on Financial Inclusion. Financial Inclusion in the Asia-Pacific, Chapter 5.

Sumit, Agarwal, Qian, Wenlan, Yeung, Bernard Y and Zou Xin. (2019). Mobile wallet and entrepreneurial growth. AEA Papers and Proceedings 109, pp 48–53.

Talia. Gillis B. (2021). The Input Fallacy. Minnesota Law Review, forthcoming 2022 Tavneet, Suri, and Jack, William. (2016). The long-run poverty and gender impacts of mobile money. Science 354 (6317), pp 1288–1292.

Thakor Anjan V. (2020). Fintech and banking: What do we know? Journal of Financial Intermediation 41, p 100833.

Thorsten, Beck, Ioannidou, T., Vasso and Schäfer, Larissa, (2018). Foreigners vs. Natives: Bank Lending Technologies and Loan Pricing. Management Science 64, 3792-3820

Tok, Tan and Chansrinyom. (2020). Do innovations in lending help SMEs. *ADB-IGF Special Working Paper Series "Fintech to Enable Development, Investment, Financial Inclusion, and Sustainability"*



# PUBLICATIONS

**Fintech: Financial Inclusion or Exclusion?**  
Working Paper No. **WP/2022/080**