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Unlocking financial access in a developing country amidst COVID-19: the impacts of financial literacy and fintech

Dao Ha[a] and Kim Nguyen[b,c]

[a]Graduate Faculty Ho Chi Minh City University of Banking, Ho Chi Minh City, Vietnam; [b]Faculty of Finance, Ho Chi Minh City University of Banking, Ho Chi Minh, Vietnam;Lincoln, UK; [c]Department of Accounting, Finance and Economics University of Lincoln, Lincoln, UK

ABSTRACT

We examine the impacts of financial technology and financial literacy on the development of financial inclusion among the younger generation using data from a survey with 1288 students in Vietnam in the city and rural areas. We employ logistic regression and two-stage instrumental variable regression for our analysis, with location and financial shock caused by COVID-19 serving as the instruments. Vietnam is a fintech hub in Asia with the world-leading adaption of cryptocurrency and a significantly high rate of e-wallet use. The results indicate although there is a gap in access to financial services between urban and rural areas, the access rate is considerably high. Fintech and financial literacy play a significant role in facilitating this high level of financial inclusion development. Women have better access to financial services, showing the effectiveness of women's empowerment programs. Little evidence shows the negative impact of the pandemic on financial inclusion.

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1. Introduction

The World Bank considers financial inclusion a key enabler for achieving seven Sustainable Development Goals (SDGs): reducing poverty (SDG 1) by providing access to savings and credit (Bruhn and Love 2014; Churchill and Marisetty 2020); enhancing food security (SDG 2) by allowing farmers to invest in their crops (Arshad 2022); improving health and well-being (SDG 3) by enabling people to afford healthcare through financial services (Sakyi-Nyarko, Ahmad and Green, 2022); promoting quality education (SDG 4) by facilitating savings and loans for educational expenses (Koomson and Afoakwah 2023); fostering gender equality (SDG 5) by economically empowering women (Swamy 2014; Demir et al. 2022); driving economic growth (SDG 8) by supporting entrepreneurship (Kim, Yu, and Hassan 2018; Ozturk and Ullah 2022); and boosting industry and innovation (SDG 9) by providing businesses with essential financial resources (Levine 2005;

CONTACT Kim Nguyen kimnt@hub.edu.vn; knguyen@lincoln.ac.uk

Ayyagari, Demirgüç-Kunt, and Maksimovic 2008). However, promoting financial inclusion in developing countries remains a challenge. The rate of adults having an account in developing countries is 68% for women and 74% for men compared to 97% and 96%, respectively, in developed countries (World Bank 2021). Among solutions used to boost financial inclusion, fintech, and financial literacy have attracted much attention recently. In a press release by World Bank in 2018, mobile phone is regarded as an acceleration of financial inclusion. The UN 2030 Agenda for Sustainable Development (UN-2030-ASD) and the G20 High-Level Principles for Digital Financial Inclusion (G20-HLP-DFI) also, underline the use of fintech to promote financial inclusion and income inequality.

Financial literacy is considered another solution to boost access to financial services (Grohmann, Klühs, and Menkhoff 2018; Adetunji and David-West 2019; Morgan and Trinh 2019), especially in developing countries (Xu and Zia 2012; Klapper, Lusardi, and Panos 2013; Bongomin et al. 2017; Grohmann, Klühs, and Menkhoff 2018; Morgan and Long 2020). Most of the current literature focuses on the level of financial inclusion among adults, households, and firms, leaving the gap in examining this issue among the younger generation, such as students.

Global Findex, developed by the World Bank, has served as the primary data source since 2011 and is updated every three years, providing comprehensive information on worldwide access to financial services, including payments, savings, and borrowing. The 2021 edition, derived from surveys of approximately 128,000 adults in 123 economies conducted during the COVID-19 pandemic, presents updated metrics on the utilization of both formal and informal financial services, digital payments, and sheds light on behaviours fostering financial resilience. Unfortunately, Mexico and Vietnam were excluded from this Global Findex database due to challenges in collecting samples by phone. In the (World Bank 2018), Vietnam is among the countries with relatively low account ownership, like Nigeria, Indonesia, and Bangladesh. More interestingly, there is no gap in account ownership between younger adults (15–24 years old) and old adults (age 25+) in Vietnam. At the same time, most agricultural payments, utility payments, and online purchasing are made in cash.

The 15-year report from the World Bank, focusing on Vietnam's progress in achieving Millennium Development Goals (MDG) from 2001 to 2015, highlights the nation's commitment since the signing of the Millennium Declaration. Throughout this period, Vietnam has consistently prioritized the pursuit of these goals, facing numerous challenges yet making significant strides. Despite encountering economic hardships on a global scale, Vietnam has demonstrated resilience and ingenuity, maintaining positive momentum in areas such as socio-economic development, poverty alleviation, and environmental preservation. Through collaborative efforts involving the government, citizens, civil society, and development partners, Vietnam has emerged as a genuine success story in development, notably in reducing poverty and enhancing economic performance. Transitioning from one of the world's poorest nations to a middle-income country by 2010, Vietnam has achieved several MDG targets, including the eradication of extreme poverty and hunger, attainment of universal primary education, and promotion of gender equality.

In recent years, Vietnam has made significant strides in enhancing financial inclusion. In 2014, Vietnamese fintech company FPT Wallet launched the e-wallet V-FPT,

aiming to provide a user-friendly and dependable platform for paying monthly bills and conducting e-commerce transactions. Subsequently, in 2018, the introduction of the U-Money e-wallet by Unitel, a collaboration between Lao PDR and Vietnam, further facilitated convenient money transfers and ensured transaction security through a mobile digital platform. Looking ahead, Vietnam's commitment to advancing financial inclusion is evident as it prepares to join ASEAN's cross-border payment connectivity initiative in 2023, aligning with other regional leaders such as Indonesia, Malaysia, The Philippines, and Thailand. Meanwhile, neighbouring countries like Brunei Darussalam, Lao PDR, and Cambodia are actively developing their instant payment systems, reflecting the broader regional efforts towards financial integration and accessibility.

In 2020 the Prime Minister endorsed a national financial inclusion strategy extending to 2025, with a vision to 2030.[1] The objective is to ensure that by 2025, at least 80% of adults in the nation have bank accounts. This strategy aims to provide easy and affordable access to essential financial products and services, including payment methods, money transfers, savings, credit facilities, and insurance. It specifically targets individuals and businesses, especially those with low income and vulnerable groups, as well as medium, small, and micro-sized enterprises. To achieve these objectives, the strategy proposes various measures, such as simplifying the legal framework to facilitate financial inclusion, diversifying financial service providers and support channels to broaden the accessibility of financial services and products, and enhancing financial infrastructures while reducing transaction costs. This strategy aligns with the global financial inclusion agenda outlined by the World Bank."

In the last few years, Vietnam has been one of the fintech hubs in Asia, which ranked number 1 for cryptocurrency adaption in 2021 (Wheatley and Klasa 2021). While 69% of the total population does not have access to traditional banking, there are 19.2 million active mobile wallet users in 2020, which accounts for approximately 19% of the population (Alpuerto 2022). This number is predicted to be 50 million by July 2024 (VNS. 2003). An e-wallet is an electronic financial service enabling users to store financial, credit card, and cash information online on mobile devices or computers. One notable feature of e-wallets is their capacity to facilitate payment transactions and swift money transfers conveniently, eliminating the need for physical transactions. Vietnam is an interesting case for examining e-wallets as a measure of fintech since e-wallets are provided by fintech companies (not banks) licensed by the State Bank to offer payment intermediary services. As of January 2024, there are 50 companies authorised to provide e-wallet services (SBV 2024). The top three e-wallets, MoMo, ZaloPay, and ViettelPay (Decision Lab 2023), include the former as a Fintech company and the latter two as Telecommunications companies. Combining e-wallets with internet banking and mobile banking as measures of Fintech in Vietnam provides a comprehensive overview of technology to access financial services. Also, the e-wallet market in Vietnam is substantial. In 2022, about 57% of the adult population actively utilizes e-wallets, and projections indicate that the e-wallet market in Vietnam is expected to include 50 million users by 2024 (Vietnamnet 2023).

Given the missing data in the recent Global Findex 2021 and the increasing use of e-wallets, Vietnam presents an intriguing case study for investigating fintech and

financial inclusion. We are among the pioneers who include e-wallets as a metric for fintech, particularly in the context of their impacts on financial inclusion.

Additionally, the educational system in Vietnam, which State-owned institutions dominate, is still young and has much room to develop. Overall, Vietnam becomes an excellent case study investigating the interactive impacts of fintech and financial literacy on financial inclusion in urban and rural areas. We want to test whether the financial inclusion rate would be boosted by a higher level of fintech and financial literacy and whether financial knowledge could promote using fintech to access official financial services.

We choose three provinces in Vietnam, which are Ho Chi Minh City, Vinh Long, and Lai Chau, to distribute the survey. While Ho Chi Minh City is the economic hub of the whole country with the highest economic growth and GDP per capita, Vinh Long is a city in Mekong Delta, and Lai Chau locates in the Northwest region of Vietnam, which has a low level of development and receives much support from the central government. The choice of these three cities and provinces is based on the bank's distribution density in Vietnam, representing the highest (Ho Chi Minh City), lowest (Lai Chau), and median distribution (Vinh Long).

We focus on high school and university students (generally from 16 to 22 years old) since this is the new generation with better access to and knowledge of technology. This choice also differentiates our dataset from PISA[2] since that survey concentrates on younger pupils. Students are more likely to be equipped with smartphones and are independent enough to make financial decisions. The results from this survey would provide insights into how the younger generation in a developing country uses fintech and financial literacy to access financial services, both in urban and rural areas. Our research makes four main contributions to the literature. First, this dataset's uniqueness was collected from urban and rural students in a developing country with low financial inclusion. The current literature on this topic focuses mainly on households, with little address on the young generation. The presence of technology and fintech could narrow the gap in financial inclusion between developed and underdeveloped areas. Second, the interaction between financial literacy and using fintech to access financial services is added to this study. While the current literature focuses on these factors separately, we would like to look at these parameters as a package for promoting financial inclusion in urban and rural areas. Third, we also include new measures of fintech, which are e-wallets and the use of e-wallets for payment, checking balances, and transferring money. Given that Vietnam is a country that experienced an evolution of using e-wallets recently and is expected to have nearly 50% of the population using them in 2024, the use of e-wallets as a measure of fintech in Vietnam is interesting. Finally, this survey was conducted during the COVID-19 period when all provinces in Vietnam needed to live under strict quarantine. This timeframe's uniqueness helps us shed light on the usefulness of fintech in enabling financial access.

This article is structured as follows: Section 2 discusses related literature. The data collection and methodology are addressed in Section 3. Section 4 presents the results and discussion, and section 5 concludes the study.

2. Literature review

2.1. Introduction to financial inclusion

Financial inclusion refers to the use of formal financial services by individuals and firms or a process that ensures the availability, accessibility, and use of financial services by all members of society (Sarma and Pais 2011; Amidžić, Massara, and Mialou 2014; Allen et al. 2016). Marcelin et al. (2022) indicate that access to financial services could positively impact economic performance in developing countries. More particularly, access to financial services results in higher growth within firms (Beck et al. 2012), promoting innovation, creating jobs, and boosting growth (Levine 2005; Ayyagari, Demirgüç-Kunt, and Maksimovic 2008; Kim, Yu, and Hassan 2018; Ozturk and Ullah 2022), reducing poverty and income inequality (Bruhn and Love 2014; Omar and Inaba 2020), increasing children's learning outcomes and reducing late school enrolment (Koomson and Afoakwah 2023). Khan (2024) demonstrates that financial inclusion reduces poverty and income inequality in developing countries, thereby facilitating the achievement of SDG01 (End poverty in all its forms everywhere) and SDG10 (Reduced Inequalities).

Financial inclusion could be measured using country-level and individual-level data. For country-level data, a financial inclusion index is normally constructed to address the use (the proportion of people have a bank account), the access (physical point of financial services), and the depth (volume of loans and deposits) (Sha'ban, Girardone, and Sarkisyan 2020). The number of depositors, household depositors, household deposit accounts, borrowers, household borrowers, loan accounts, and household loan accounts (all measures are stated per 1000 adults) is used to capture the first dimension (Owen and Pereira 2018). Automated teller machines (ATM) and the number of commercial bank branches per 100,000 adults are used to measure the outreach of the access (Sarma 2008; Park and Mercado 2015) and outstanding deposits with commercial banks (% of GDP); and outstanding loans with commercial banks (% of GDP) are also employed as a part of the indicator (Amidžić, Mascara and Mialou 2014; Le, Chuc, and Taghizadeh-Hesary 2019). World Bank Global Financial Development, Global Findex, and the International Monetary Fund's Financial Access Survey are the primary sources of country-level data. The composite index of financial inclusion could be constructed using a non-parametric approach or parametric approach where the weights of the components are assigned exogenously based on a judgement element (Chakravarty and Pal 2013) and endogenously based on structure of the data (Cámara and Tuesta 2014; Park and Mercado 2018).

For the individual-level data, financial inclusion is measured by three main dimensions, account ownership, savings, and credit. More particularly, Demirgüç-Kunt, Klapper, and Singer (2013) use ownership of an account at a formal financial institution, savings in the past 12 months, and credit in the past 12 months as three main dimensions of financial inclusion. Similarly, Baber (2020) employ formal accounts, formal savings, and credit. Apart from account and savings, Allen et al. (2016) utilize the frequency of formal account use as an inclusion measure. In Xu (2020), the measure of financial inclusion is constructed based on four variables, financial inclusion score (access to essential financial services and intensity of the use of such service),

the intensity of using transactional accounts (making deposits or withdrawals), the use of technology in financial transactions (mobile phone or made internet payments) and formal credit (if the respondent borrowed in the past 12 months or has a loan from financial institutions). This individual approach is extensive in the financial inclusion literature, mainly based on the Global Findex data collected with the annual Gallup World Poll Survey. This database is published every three years, with 148 countries and at least 1000 participants per country.

Besides the Global Findex database, several studies have developed a customized survey to collect individual data. Specifically, Tambunlertchai (2018) examine the determinants of financial inclusion in Myanmar by surveying 5100 participants. Amoah, Korle, and Asiama (2020) analyze the impact of mobile money by collecting primary data from 733 households in Ghana. Sayed and Shusha (2019) evaluate the supply side of financial services by approaching 470 bank managers in Egypt. The motivation for conducting an independent questionnaire rather than using data from Global Findex is having a unique viewpoint on financial inclusion and research questions. We follow this approach by developing a survey to collect data from students in Vietnam during the COVID-19 period in both urban and rural areas. The nature of this survey is relevant to differentiate the access to formal financial services in different locations in a developing country. Kirmani et al. (2023) indicate that individuals' preferences are shifted toward cashless payment during the COVID-19 period in India and stays the same afterwards. In this study, the impacts of COVID-19 on financial inclusion are examined alongside fintech and financial literacy.

2.2. The impacts of fintech on financial inclusion

Fintech has been considered one of the main drivers of financial inclusion (Mbiti and Weil 2015; Tchamyou, Erreygers, and Cassimon 2019). With fintech innovation, many unbanked areas worldwide have access to financial services, primarily *via* mobile or digital devices (Ozili 2018; Yermack 2018; Senyo and Osabutey 2020; Young and Young 2022). Fintech services, based on digital applications and platforms, are also relatively cheaper to use than traditional banking (Feyen et al. 2021). Financial institutions and fintech providers provide these applications and platforms. For example, commercial banks apply technology to develop Internet banking and mobile banking services, while mobile network operators provide mobile money. Mobile money is widely used in developing countries and is among the most popular proxies of fintech. There is strong evidence of a positive correlation between the use of mobile money and financial inclusion in households (Ouma, Odongo, and Were 2017; Salampasis and Mention 2018; Senyo and Osabutey 2020; Senyo et al. 2022, Coffie and Hongjiang 2023) and firms (Gosavi 2018). These studies show that mobile technology has contributed to access to formal banking systems. Besides mobile money, having a mobile phone or smartphone is another proxy of fintech. With a mobile device, unbanked individuals can access financial services such as opening an account, making payments, receiving, and saving money (Salampasis and Mention 2018). Demir et al. (2022) measure fintech by examining whether mobile phones are used to pay bills. This information is included in the Global Findex database in 2011,

2014, 2017, and 2020. More importantly, there are many fintech questions in the Global Findex survey in 2020, such as Internet banking and mobile banking. Unfortunately, Vietnam is left out of this survey due to telephone challenges. Since the concept of mobile money has just been introduced in Vietnam in 2021 as a pilot project, we do not take this variable as a measure of fintech. Instead, we follow the Global Findex survey by using mobile banking and internet banking as the two measures of fintech. Besides, consisting of the evolution of e-wallets in Vietnam, we employ this application as another proxy of fintech.

2.3. The impacts of financial literacy on financial inclusion

Financial literacy has long been confirmed as a determining factor facilitating financial inclusion. The initial evidence from Cole, Sampson, and Zia (2011, 2012) concludes the positive correlation between financial literacy and demand for financial services. Doi, McKenzie, and Zia (2014) show a positive relationship between financial training, consuming behaviour, and savings. Jamison, Karlan, and Zinman (2014) show a similar correlation between financial education and access to saving accounts. Grohmann, Klühs, and Menkhoff (2018) indicate the critical role of financial literacy in promoting financial inclusion using data from 4 survey concepts collected from Gallup, the World Bank, and the Global Financial Literacy Centre. These concepts include risk diversification, inflation, interest rate, and interest compounding. Financial literacy is a dummy variable that equals one if an individual scores 3 out of 4 concepts and 0 otherwise (Klapper, Lusardi, and Van Oudheusden 2015). Bongomin et al. (2017) reveal that only the attitude element of financial literacy predicts access to financial services in rural Uganda. Zhang, Lu, and Xiao (2023) utilize individual survey data in China to illustrate that financial education provided by financial institutions helps to promote investors' welfare and optimize financial asset allocation by encouraging the use of professional investment advisors and mitigating investment biases. Similarly, Huang et al. (2023) indicate that financial literacy promotes financial participation in China. In this study, financial literacy is measured by ten questions on the knowledge, attitude, skills, and behaviour of households toward financial issues such as personal budgeting, interest rate computing, and dealing with banks.

Similarly, Adetunji and David-West (2019) use ten questions on financial terms and services in a survey conducted with 22,000 participants in Nigeria and show that financial literacy plays a determining factor in facilitating savings with formal and informal financial institutions. Financial training, including contents such as financial goals, financial management, and business finance and business management, is found to have a positive impact on financial inclusion using data collected from a randomized controlled trial (Koomson, Villano, and Hadley 2020). Morgan and Long (2020) develop a comprehensive measure of financial literacy, including three separate components, financial knowledge, financial behaviour, and attitudes toward financial planning, and conclude that these aspects of financial concepts positively affect financial inclusion and savings in Laos. We follow the approach of Grohmann, Klühs, and Menkhoff (2018) by introducing seven questions to measure financial knowledge in

our survey. These questions include different aspects of finance, such as interest, inflation, time value of money, purchasing power, risk and return, and diversification. Also, we add one question to test whether the participants learn financial concepts at school.

Recent studies have extensively explored the critical role of financial literacy in enhancing financial inclusion, particularly in developing countries. Mutamimah and Indriastuti (2023) highlight that financial literacy moderates the impact of fintech on financial inclusion in Indonesia. Zahid et al. (2023) demonstrate that various aspects of financial literacy, including savings, debt, investment, and financial planning practices, significantly improve financial inclusion among women. Jamil et al. (2023) find a linear relationship between financial literacy and financial inclusion, with the impact being more pronounced at higher levels of inclusion. Okello Candiya Bongomin, Munene, and Yourougou (2020) reveal that social networks mediate the relationship between financial literacy and financial inclusion among the poor, while Khan, Siddiqui, and Imtiaz (2022) provide a comprehensive analysis of the literature on this intersection. Finally, Hasan et al. (2023) show that higher digital financial literacy among women entrepreneurs increases their engagement with formal banking channels. These findings collectively underscore the pivotal role of financial literacy in promoting financial inclusion across various demographics and regions.

Although the literature on the impacts of financial literacy and fintech on financial inclusion is extensive, there are limited studies that collect primary data on pupils and students in urban and rural areas of a developing country to demonstrate the vital role of fintech and financial literacy and the interactive effects of these two variables on financial inclusion. With the support of fintech and financial literacy, students in the most rural areas of Vietnam can still access financial services *via* mobile banking, internet banking, and especially e-wallets, making Vietnam an ideal case study since this country is a hub for e-wallets in Asia (Alpuerto 2022). More importantly, this survey was conducted during the COVID-19 period, which can be considered a market shock, making access to financial services even more difficult without technical support. We believe this is a rare dataset collected during this special time.

3. Data and methodology

3.1. Data

Data is collected by conducting a semi-structured questionnaire using Google online survey tool. Convenient sampling is applied to approach students at different high schools and universities. More than 1300 participants were involved, with 1288 questionnaires being accepted for analysis. The regions selected for the study were Ho Chi Minh City, Vinh Long, and Lai Chau. We selected three regions based on the bank's distribution density for comparison. Specifically, Ho Chi Minh City is home to the highest distribution of banks (1953), the median is Vinh Long (104), and the lowest is Lai Chau (31).

Kock, Berbekova, and Assaf (2021) indicate that common method bias can appear with both the independent and dependent variables if they are collected by the same response method. To prevent method bias in collecting primary data, we provide

clear instructions to pupils and students before asking them to complete the survey (Podsakoff et al. 2003). We also apply the temporal separation approach, which separates data collection at different time points (MacKenzie and Podsakoff 2012), and methodological separation, which applies different measures for the independent and dependent variables (IV and DV) (Podsakoff et al. 2003). For example, having an account, savings, and loans (DV) are used for financial inclusion, while mobile banking, internet banking, and e-wallets are used for fintech. Financial literacy is measured by a set of questions (IV). Additionally, for statistical controls, we apply the correlation marker technique (Williams, Hartman, and Cavazotte 2010; Simmering et al. 2015) and regression-based marker techniques (Siemsen, Roth, and Oliveira 2010) such as logistic regression and two-stage instrumental variable regression models to maintain the validity of the results.

This study measures financial inclusion by posing three specific questions to participants, inquiring whether they have an account, savings, or loans (Zins and Weill 2016; Allen et al. 2016; Demirgüç-Kunt, Klapper, and Singer 2017; Demirgüç-Kunt et al. 2020; and Demir et al. 2022). Following the PISA survey and Lusardi and Mitchell (2008), adopted by the U.S. National Financial Capability Study, we measure financial literacy by using seven questions to test their understanding of interest, inflation, time value of money, purchasing power, risk and return, diversification and a general question asking whether they study finance at school. For fintech, a range of questions is used to check whether participants use Internet banking, mobile banking, and e-wallets and whether they use these tools to make payments, check balances, and transfer money. While the literature on fintech in the correlation of financial inclusion usually uses mobile money (Senyo and Osabutey 2020; Senyo et al. 2022) and smartphones, internet banking, and mobile banking (Demirgüç-Kunt, Klapper, and Singer 2017; Gai et al. 2018; Demir et al. 2022) as the measures of fintech, we make the first attempt to use e-wallets as a proxy for fintech. Mobile money is not a good proxy in Vietnam since this concept was launched as a pilot program in March 2021. Meanwhile, Vietnam is an innovation hub in Asia where e-wallets are considerably popular; we believe these are a good proxy of fintech in Vietnam, which potentially could boost financial inclusion without depending on the traditional banking system. Besides, we include selected questions to measure individual characteristics such as age, gender, risk preferences, and whether they are affected by COVID-19.

3.2. Model specification

We conduct the logistic regression to investigate the impacts of financial literacy, fintech, and other individual characteristics on financial inclusion. The model is as follows:

$$Y = \alpha + \beta_1 FL + \beta_2 Fintech + \beta_3 FL{*}Fintech + \beta_4 Covid + \beta_5 X + \varepsilon$$

where: Y denotes financial inclusion, which equals one if the person has an account, savings, or loans and zero otherwise. FL is financial literacy ranging from zero to seven, the number of correct answers over seven financial literacy questions. Fintech indicates whether the person says yes with one of the following: using internet

banking, using mobile banking, using e-wallets, using one of the three previous tools for payments, checking balances, and transferring money. This is a dummy variable that equals 1 if the individual uses either internet banking, mobile banking, or e-wallets for payment activities and 0 if the individual does not use any of the mentioned services. FL*Fintech is an interaction variable indicating the combined effect of financial literacy and fintech on financial inclusion. COVID-19 is a dummy variable that equals one if the person is negatively affected by COVID-19 and zero otherwise. X is the individual characteristics, including gender, age, primary, part-time job, scholarship, and risk preferences.

We choose logistic regression since we have a binary dependent variable (Hosmer, Lemeshow, and Sturdivant 2013). Additionally, we run the two-stage instrumental variable regression as a robustness test to address any potential endogeneity issues (Stock and Watson 2020). Interaction variables between financial literacy and fintech, financial literacy and location, and fintech and location are added to the regressions to test for the interactive impacts. We expect fintech and financial literacy stimulate the level of financial inclusion in Vietnam (Hypothesis 1). Additionally, financial literacy could boost the use of fintech to access financial services. Mathews and Hu (2007) indicate that universities could promote national innovative capacity in Asia, which is demonstrated in the case of Taiwan. This could also be the case in Vietnam with financial literacy and fintech (Hypothesis 2). We expand the analysis by testing the role of e-wallets in the development of financial inclusion. With the significantly high level of e-wallet adoption in Vietnam, it could be a game changer for the prospect of financial inclusion (Hypothesis 3).

Hypothesis 1: Financial literacy and fintech increase financial inclusion in Vietnam's urban and rural areas during the Covid-19 period.

Hypothesis 2: Financial literacy enables people using fintech to access financial services.

Hypothesis 3: The use of e-wallets facilitates the level of financial inclusion in Vietnam.

We use Mann–Whitney *U*-test to examine the differences in financial inclusion, financial literacy, and fintech in urban and rural areas. We run robustness tests where accounts, savings, and loans represent financial inclusion separately and separate internet banking, mobile banking and e-wallets as metrics for fintech.

4. Results and discussion

4.1. Descriptive statistics

Table 1 shows the level of fintech, financial literacy, and other characteristics of the subject pool in urban and rural areas. The results show that 78.96% of participants are equipped with fintech, and they have, on average, 3.88 correct answers over seven financial literacy questions. 34.01% of participants are male, the average age is 18.92 years old, 42.73% of them study natural sciences, 47.74% have part-time jobs, and 2.87% have scholarships. Regarding risk, they address the average preference of 5.69 on a scale of 10, which is the maximum willingness to take risks. Half of the participants (43.16%) are negatively affected by the pandemic. We differentiate the characteristics of the participants in Ho Chi Minh City (52.64%) and from Vinh

Table 1. Characteristics of the participants.

Characteristics	All	Urban	Rural	P-value
Fintech	78.96%	87.76%	69.18%	0.000***
Financial literacy	3.88	4.30	3.41	0.000***
Male	34.01%	31.71%	36.56%	0.066*
Age	18.92	19.84	17.90	0.000***
Risk	5.69	5.85	5.51	0.385
Natural science	42.73%	37.46%	48.43%	0.000***
Part-time job	47.74%	57.67%	36.72%	0.000***
Scholarship	2.87%	3.39%	2.30%	0.239
COVID effect	43.16%	40.96%	45.57%	0.096*
N	1288	678	610	

The *p*-value is taken from the Mann–Whitney *U* test.
***$p < 0.01$
**$p < 0.05$
*$p < 0.1$.

Long and Lai Chau (47.36%). Accordingly, Ho Chi Minh City participants address a significantly higher level of fintech use and financial literacy. The proportion of male and natural science students in Ho Chi Minh City is also lower, with a slightly higher average age. Interestingly, although Ho Chi Minh City is heavily affected by strict lockdowns during the COVID-19 period, students in this city are less likely to be affected by COVID-19.

Table 1 reports the characteristics of all participants. We have 1288 participants, of which 52.64% are from Ho Chi Minh City, and 47.36% are from Vinh Long and Lai Chau. The characteristics included in this study are gender, age, risk preferences, major, part-time job and scholarship. Also, we measure the level of fintech and financial literacy of the two groups and whether they are affected by the pandemic.

We include the descriptive statistics of financial inclusion, financial literacy, and fintech in Table 2. The results show that 62.03% of students have an account, 22.52% have savings, and 6.52% have loans, resulting in a level of financial inclusion of 65.30%. Unsurprisingly, Ho Chi Minh City expresses a higher level of financial inclusion across all variables. We asked the participants the reasons behind their financial exclusion, and most of them indicated that lack of demand, cash use, no document, and family already had accounts/savings/loans are among the most popular explanations, which is consistent between urban and rural areas (Figure 1).

Table 2 reports the level of financial inclusion, financial literacy and fintech of the subject pool and compares these levels in urban and rural areas. In Table 2, 54.19% of students indicate that they study finance at school, and most answer the risk and return questions correctly (89.05%). For other questions, the proportion of accuracy is approximately 50% leaving the average level of financial literacy is 3.88 over seven questions. Similar to the level of financial inclusion, students in Ho Chi Minh City address a better level of financial literacy in most questions. Although they access the same education system, 65.49% of Ho Chi Minh City students indicate that they have studied financial concepts compared to only 41.65% of students in rural areas. For fintech, we ask participants whether they use Internet banking, mobile banking, and e-wallet in general and use these tools for payment, checking balances, and transferring money.

Table 2. Financial inclusion, financial literacy and fintech by location.

A – Financial inclusion of the subject Pool

	All	Urban	Rural	*p*-value
Account	62.03%	79.94%	42.13%	**0.000*****
Savings	22.52%	29.79%	14.43%	**0.000*****
Loans	6.52%	9.73%	2.95%	**0.000*****
Financial inclusion	65.30%	83.48%	45.08%	**0.000*****
N	1288	678	610	

Note: The *p*-value is taken from the Mann–Whitney *U* test.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

B – Financial literacy of the subject pool.

	All	Urban	Rural	*p*-value
Study at school	54.19%	65.49%	41.64%	**0.000*****
Interest	66.23%	72.57%	59.18%	**0.000*****
Inflation	32.84%	38.94%	26.07%	**0.000*****
Time value	43.09%	52.51%	32.62%	**0.000*****
Purchasing power	51.94%	53.54%	50.16%	0.226
Risk and return	89.05%	91.30%	86.56%	**0.006*****
Diversification	50.85%	56.05%	45.08%	**0.000*****
Financial literacy	3.88	4.30	3.41	**0.000*****
N	1288	678	610	

Note: The *p*-value is taken from the Mann–Whitney *U* test.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

C – fintech of the subject pool

	All	Urban	Rural	*p*-value
Internet banking	44.95%	60.03%	28.20%	**0.000*****
Mobile banking	30.90%	37.76%	23.28%	**0.000*****
E-wallet	56.83%	69.32%	42.95%	**0.000*****
Payment (Internet banking)	32.14%	43.36%	19.67%	**0.000*****
Payment (Mobile banking)	17.78%	19.32%	16.07	0.127
Payment (Ewallet)	53.42%	66.22%	39.18%	**0.000*****
Balance (Internet banking)	40.14%	54.28%	24.43%	**0.000*****
Balance (Mobile banking)	27.33%	33.48%	20.49%	**0.000*****
Balance (Ewallet)	30.51%	31.56%	29.34%	0.388
Transfer (Internet banking)	39.52%	53.24%	24.26%	**0.000*****
Transfer (Mobile banking)	20.26%	23.60%	16.56%	**0.001*****
Transfer (Ewallet)	47.20%	56.78%	36.56%	**0.000*****
Fintech	78.96%	87.76%	69.18%	**0.000*****
N	1288	678	610	

Note: The *p*-value is taken from the Mann–Whitney *U* test.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

Interestingly, the proportion of people using e-wallets is the highest (56.83%) compared to Internet banking (44.95%) and mobile banking (30.90%). The application of e-wallets surpasses the most innovative tools of traditional banking services, promising a better rate of financial access in Vietnam. This result confirms our justification

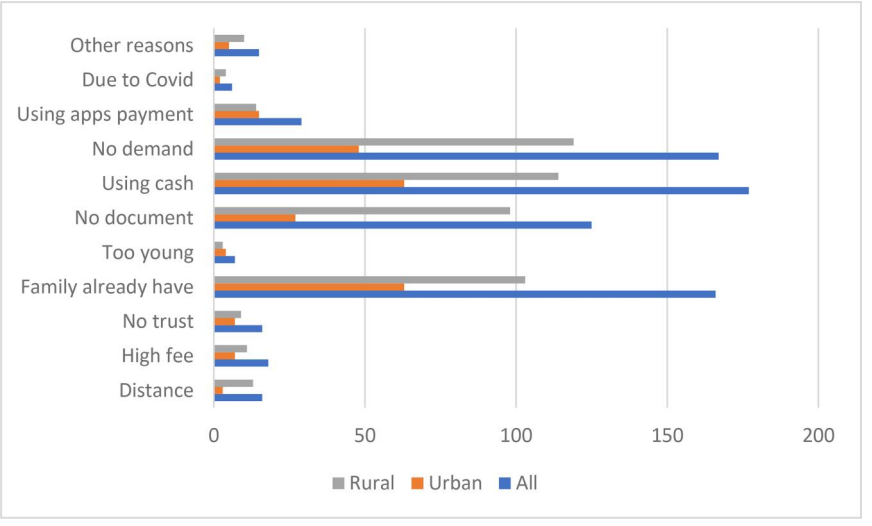

Figure 1. The reasons behind financial exclusion.

at the beginning that e-wallets become substantially popular in this country, which makes examining fintech and financial inclusion in Vietnam interesting. The use of e-wallets is more prevalent in Ho Chi Minh (69.32%) compared to rural provinces (42.95%). The dummy fintech variable equals one if the participants use one of the listing services and zero if they do not use any. Overall, 78.96% of students use one of the services for payment, checking balances, and transferring money, and the use rate is significantly higher in Ho Chi Minh (87.76% compared to 69.18%).

We also test the level of financial inclusion, financial literacy, and fintech between men and women (Appendix 5). The results show that the account ownership of women is significantly higher. Interestingly, while there is no gender gap in financial literacy, the level of using fintech is significantly higher with women in most fintech measures except e-wallets. Specifically, women are more likely to use the Internet and mobile banking for payment, checking balances, and transferring money. However, the rate of using e-wallets is primarily identical between men and women.

This table reports the level of financial inclusion, financial literacy and fintech with all data and data from urban and rural areas.

4.2. The impacts of fintech and financial literacy on financial inclusion

Table 3 shows the impacts of fintech and financial literacy on financial inclusion, controlled by individual characteristics. As the literature suggests, financial literacy and fintech facilitate financial inclusion in Vietnam in urban and rural areas (Grohmann, Klühs, and Menkhoff 2018; Senyo and Osabutey 2020; Demir et al. 2022). The significant interaction effect of these two variables shows that the impacts of financial knowledge on inclusion are relatively higher when participants are equipped with fintech, with all data and rural data. Improved financial literacy and fintech accessibility positively impact people's access to financial services, particularly in rural areas. The Spearman correlation of these two variables indicates a significant

and positive relationship, meaning that participants with a higher level of financial literacy are more likely to use fintech and vice versa. This insight benefits policymakers since they need to consider these two variables as a package to promote access to finance in developing countries such as Vietnam.

Individual characteristics also affect the level of financial inclusion. Specifically, women and urban citizens have better access to financial services, while younger individuals and students without part-time jobs do not. The higher level of financial inclusion among women is an exciting finding, which contradicts most of the literature (Demirgüç-Kunt, Klapper, and Singer 2013; Ghosh and Vinod 2017). This result could be explained by the commendable progress in the gender gap in Vietnam recently. Vietnam has made some progress in promoting women's rights and gender equality, particularly in education, employment, and political participation (VNA. 2022). Besides, the proportion of women with access to fintech is significantly higher (81.76% compared to 73.52%), and 54.47% live in Ho Chi Minh City. Eventually, financial inclusion could be improved with fintech and location, regardless the gender.

We include the interaction terms between fintech and urban and financial literacy and urban in the regression to examine the interactive effects of location and fintech

Table 3. The impacts of fintech and financial literacy on financial inclusion.

A – All data						
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	FI	FI	FI	FI	FI	FI
FL	**0.323*** **	0.138	−0.151	−0.0994	−0.209	−0.0761
	(0.043)	(0.108)	(0.127)	(0.122)	(0.128)	(0.125)
Fintech	**2.965*** **	**2.167*** **	**1.592*** **	**1.358*** **	**1.650*** **	**1.304*** **
	(0.190)	**(0.456)**	**(0.506)**	**(0.498)**	**(0.498)**	**(0.504)**
FL*Fintech		**0.218***	**0.304****	**0.247***	**0.289****	**0.245***
		(0.118)	**(0.138)**	**(0.134)**	**(0.137)**	**(0.134)**
Gender			**−0.321***	−0.284	**−0.348****	−0.277
			(0.176)	(0.177)	**(0.175)**	(0.178)
Age			**0.593*** **	**0.590*** **	**0.606*** **	**0.595*** **
			(0.061)	**(0.062)**	**(0.061)**	**(0.062)**
Major			−0.0481	−0.033	−0.0243	−0.031
			(0.172)	(0.172)	(0.170)	(0.172)
Urban			**1.075*** **			
			(0.181)			
Job			**0.373****	**0.370****	**0.387****	**0.371****
			(0.176)	**(0.176)**	**(0.174)**	**(0.176)**
Scholarship			−0.0308	−0.058	0.0422	−0.059
			(0.512)	(0.520)	(0.508)	(0.522)
Risk			−0.0322	−0.033	−0.0269	−0.034
			(0.0273)	(0.027)	(0.0271)	(0.027)
Covid effect			−0.146	−0.136	−0.172	−0.138
			(0.171)	(0.171)	(0.169)	(0.171)
Fintech*location				**1.267*** **		**1.499*** **
				(0.205)		**(0.367)**
FL*location					**0.223*** **	−0.064
					(0.046)	(0.084)
Constant	−2.876***	−2.197***	−11.95***	−11.72***	−11.92***	−11.82***
	(0.239)	(0.417)	(1.143)	(1.155)	(1.146)	(1.165)
Observations	1288	1288	1254	1254	1254	1254

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

B – Urban

VARIABLES	(1) FI (Urban)	(2) FI (Urban)	(3) FI (Urban)
FL	**0.192****	0.188	−0.262
	(0.078)	(0.181)	(0.256)
Fintech	**3.569*****	**3.552*****	**2.312****
	(0.303)	**(0.836)**	**(1.061)**
FL*Fintech		0.004	0.297
		(0.201)	(0.271)
Gender			−0.342
			(0.341)
Age			**0.662*****
			(0.099)
Major			−0.103
			(0.327)
Job			**0.585***
			(0.330)
Scholarship			−0.417
			(0.717)
Risk			0.0804
			(0.0649)
COVID effect			**−0.590***
			(0.323)
Constant	−1.932***	−1.919**	−12.78***
	(0.402)	(0.746)	(1.930)
Observations	678	678	649

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$
*$p < 0.1$.

C – Rural

VARIABLES	(1) FI (Rural)	(2) FI (Rural)	(3) FI (Rural)
FL	**0.268*****	0.058	−0.074
	(0.058)	(0.141)	(0.144)
Fintech	**2.409*****	**1.542*****	**1.273****
	(0.251)	**(0.565)**	**(0.577)**
FL*Fintech		0.252	**0.291***
		(0.155)	**(0.160)**
Gender			−0.251
			(0.211)
Age			**0.539*****
			(0.084)
Major			−0.066
			(0.206)
Job			0.229
			(0.212)
Scholarship			0.416
			(0.715)
Risk			**−0.062****
			(0.030)
Covid effect			0.043
			(0.204)
Constant	−2.932***	−2.208***	−10.84***
	(0.312)	(0.511)	(1.540)
Observations	610	610	605
			−0.0745

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

and financial literacy on financial inclusion. The results show that fintech substantially impacts urban financial literacy more than rural areas. The same results are found with financial literacy. We further the analysis by running similar regressions separately for Ho Chi Minh City and other areas. Similar results are found with fintech, financial literacy, age, and a part-time job. However, the gender effect disappears. It is consistent with our previous explanation that the location could dominate the gender effect. Comparing the magnitude of the financial literacy and fintech effects on financial inclusion in the two areas, we find that financial literacy boosts financial inclusion more in rural areas (0.268 compared to 0.192). In contrast, fintech uplifts financial inclusion more in Ho Chi Minh City (3.569 compared to 2.409).

In recent years, financial literacy and financial technology have emerged as crucial elements in promoting financial inclusion and overall well-being (Panos and Wilson 2020). Philippas and Avdoulas (2020) highlight the role of financial literacy in the financial well-being and decisions of Greek university students under unexpected financial shocks. Their study reveals that male students generally possess higher financial literacy than female students and that parental education and income significantly correlate with student financial literacy. Importantly, they find that students with higher financial literacy are better equipped to handle unexpected financial shocks. While the setup and results of their study are relatively similar to ours, the gender effect does not align with our findings. The gender effect questions the dominant findings of several earlier studies (for example, Ghosh and Vinod 2017; Lotto 2020) that have regularly emphasized the unequal financial exclusion of women due to factors like education and wage discrimination. The apparent lack of such gender-based discrepancies in financial access within the ASEAN region goes against common beliefs. It's worth noting that ASEAN is often depicted as a notable model of gender equality, a perception supported by reports from UNDP (2021), The ASEAN (2021), and cited references in UNCDF (2023). For Vietnam, the government has implemented the National Strategy on Gender Equality for the period from 2021 to 2030 to boost female involvement in the workforce and enhance gender equality in the country. The gender effect result in this study demonstrates the effectiveness of these policies.

Lusardi, Michaud, and Mitchell (2015) emphasize the need for financial literacy research to focus on making financial education more effective by improving its design and delivery. They argue that in the fintech era, visualization and user-friendliness are vital for financial inclusion. The effects of financial literacy and fintech on financial inclusion are also supported by Hastings and Tejeda-Ashton (2008) and Hastings and Mitchell (2020) by showing that leveraging fintech to present financial information in an accessible and user-friendly manner can significantly boost financial literacy and inclusion; McKillop et al. (2020) by providing empirical evidence of how fintech can directly enhance financial literacy and capability. In their randomized control trial, they assess the impact of four smartphone apps. This study demonstrates that fintech tools can effectively enhance financial literacy and, consequently, financial inclusion and resilience. The results of our study are in line with the previous findings. More specifically, the app we refer to in this study is the e-wallets which people can use to pay bills, transfer money, pay credit, top up, buy airline and train tickets. This is a good measure of fintech and how this innovation enables the ability to

access financial services. The evolution of e-wallet users in Vietnam has stimulated the level of financial inclusion in the country among younger individuals, even in rural areas.

Interestingly, while the COVID-19 pandemic does not affect the level of financial inclusion in the overall dataset and rural areas, it exhibits a significant effect in Ho Chi Minh City. Specifically, students in Ho Chi Minh City are negatively and significantly impacted by the COVID-19 pandemic. This is understandable, given that the city experienced stringent lockdown measures during the pandemic, coupled with the highest death rate (WHO 2021). In our survey, we inquired about how participants were affected by the pandemic, and the majority indicated that COVID-19 prevented them from attending schools/universities, negatively impacted their income/family income, and the lockdown affected their mental health and daily activities. Kirmani et al. (2023) indicate that the COVID-19 pandemic has made payments more difficult in India, prompting the government to encourage cashless payments. Despite the higher level of fintech adoption in urban areas, the pandemic still has negative effects on financial inclusion in our study. Urban areas are more severely affected by lockdowns because all food must depend on supplies from rural areas (cannot be self-sufficient), and lockdowns cause almost the entire supply chain to be disrupted. The results in Appendix 6 show that a significant majority of participants in the urban area (43.07%) experienced financial difficulties due to the pandemic, which is notably higher than participants in rural areas (23.02%). These financial challenges contribute to explaining the negative impacts of COVID-19 on financial inclusion in urban areas.

To address the potential endogeneity of the main regression in Table 3A using logistic model, we run the two-stage instrumental variable regression to test the validity of our results using location as the instrument variable (Ahamed and Mallick 2019; Demir et al. 2022). The results in Appendix 7 confirm the validity of our main results at a relatively lower marginal effects.

Also, we conducted another robustness test using the COVID-19 effect on financial aspects as an instrument. In the studies by Van Rooij, Lusardi, and Alessie (2011) and Morgan and Long (2020), the financial shock experienced by respondents' parents or siblings in the past year was used as an instrument since it may influence the decision to become financially included and improve financial literacy. Similarly, the COVID-19 effect on financial ability can be considered a financial shock and serves as an ideal instrument in this case. The results presented in Appendix 8 indicate that the impact of financial literacy on financial inclusion remains robust with the incorporation of this instrument, as demonstrated by the two-stage instrumental variable regression.

In the investigation with data from participants living in rural areas, risk preferences negatively affect financial literacy. Accordingly, risk-averse individuals have better access to financial services. We run the robustness tests for different measures of financial literacy, including having an account, savings, and loans. The results stay the same with the two main variables, financial literacy, and fintech, and the interaction variables between the two and the location (urban area) (See Appendices 2–4). The impacts of individual characteristics on having an account, savings, and loans are also similar, except for the mixed results of risk preferences and the gender effect on

having accounts and accessing loans. Specifically, risk aversion is negatively correlated with having an account in rural areas but positively correlated with account access in urban areas. More importantly, men are likelier to get loans in Ho Chi Minh City. Consistent with the literature on gender effect and financial inclusion at last, especially after we exclude the location difference and use loans as a measure of financial inclusion, men still have the privilege of access to financial services. Interestingly, men in Ho Chi Minh City do not have a better level of financial literacy and even lower access to fintech (80.93% of men have access to fintech while 90.93% of women do). The only difference between these two genders is that the proportion of men having scholarships is significantly higher (6.05% compared to 2.16%), and they are more willing to take risks.

Another robustness test is conducted with different measures of fintech, namely Internet banking, mobile banking and e-wallet. The results from Table 4 show that these three measures significantly affect financial inclusion, with similar findings on individual characteristics. The impact of e-wallet use is comparable with the two traditional innovation banking services: Internet banking and mobile banking. The

Table 4. The impacts of different measures of fintech on financial inclusion.

A – All data			
	(1)	(2)	(3)
VARIABLES	FI	FI	FI
Internet banking	**2.652*****	**1.538*****	**1.589*****
	(0.192)	**(0.386)**	**(0.449)**
Mobile banking	**2.172*****	**1.491*****	**2.066*****
	(0.212)	**(0.456)**	**(0.524)**
E-wallet	**2.012*****	**1.474*****	**1.522*****
	(0.166)	**(0.306)**	**(0.348)**
FL*Internet banking		**0.295*****	0.158
		(0.099)	(0.117)
FL* Mobile		0.175	−0.076
		(0.112)	(0.130)
FL*E-wallet		**0.144***	0.089
		(0.075)	(0.084)
Gender			−0.181
			(0.187)
Age			**0.504*****
			(0.063)
Major			−0.157
			(0.183)
Urban			**0.844*****
			(0.193)
Job			**0.358***
			(0.188)
Scholarship			−0.220
			(0.523)
Risk			−0.028
			(0.028)
Covid effect			−0.116
			(0.183)
Constant	−1.697***	−1.671***	−10.65***
	(0.141)	(0.141)	(1.141)
Observations	1288	1288	1254

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$
*$p < 0.1$.

B – Urban

Variables	(1) FI (Urban)	(2) FI (Urban)	(3) FI (Urban)
Internet banking	**3.394*****	**3.584*****	**3.816*****
	(0.396)	**(0.970)**	**(1.077)**
Mobile banking	**2.783*****	**3.368*****	**3.712*****
	(0.421)	**(1.076)**	**(1.215)**
Ewallet	**2.337*****	**2.127*****	**2.233*****
	(0.305)	**(0.606)**	**(0.696)**
FL*Internet banking		−0.044	−0.171
		(0.200)	(0.224)
FL*Mobile banking		−0.141	−0.264
		(0.229)	(0.255)
FL*Ewallet		0.055	0.053
		(0.134)	(0.148)
Gender			−0.152
			(0.364)
Age			**0.532*****
			(0.103)
Major			0.014
			(0.355)
Job			0.508
			(0.360)
Scholarship			−0.318
			(0.776)
Risk			0.081
			(0.069)
COVID effect			−0.491
			(0.357)
Constant	−1.291***	−1.292***	−11.57***
	(0.242)	(0.243)	(1.987)
Observations	678	678	649

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

C – rural

VARIABLES	(1) FI	(2) FI	(3) FI
Internet banking	**2.652*****	**1.538*****	**1.589*****
	(0.192)	**(0.386)**	**(0.449)**
Mobile banking	**2.172*****	**1.491*****	**2.066*****
	(0.212)	**(0.456)**	**(0.524)**
Ewallet	**2.012*****	**1.474*****	**1.522*****
	(0.166)	**(0.306)**	**(0.348)**
FL*Internet banking		**0.295*****	0.158
		(0.099)	(0.117)
FL* Mobile banking		0.175	−0.076
		(0.112)	(0.130)
FL*Ewallet		**0.144***	0.089
		(0.075)	(0.084)
Gender			−0.181
			(0.187)
Age			**0.504*****
			(0.063)
Major			−0.157
			(0.183)
Job			**0.358***
			(0.188)

(*continued*)

Continued.

C – rural			
	(1)	(2)	(3)
VARIABLES	FI	FI	FI
Scholarship			−0.220
			(0.523)
Risk			−0.028
			(0.028)
Covid effect			−0.116
			(0.183)
Constant	−1.697***	−1.671***	−10.65***
	(0.141)	(0.141)	(1.141)
Observations	1288	1288	1254

Note: This table reports the impacts of internet banking, mobile banking and e-wallets on financial inclusion, with all data and the separation of urban and rural data. Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

availability of e-wallets in developing countries could be a significant contribution to accessing official financial services.

This table reports the logistic regressions of the impacts of fintech and financial literacy on financial inclusion.

5. Conclusion, policy recommendations and limitations

5.1. Conclusion

This study uses binary logistic regression to examine comprehensive financial literacy, fintech, and financial inclusion on 1288 high school and university students. With the evolution of technology and the awareness of financial literacy, the issue of financial inclusion in developing countries, both in urban and rural areas, could be improved considerably. Individuals with higher education and financial literacy levels frequently use fintech and are more likely to have complete financial access. Other factors such as part-time work, place of residence, and age are statistically significant in increasing comprehensive financial access.

5.2. Policy recommendations

From the findings, we make four main suggestions to the policy-maker. First, research shows that financial literacy strongly and positively impacts complete financial access. Therefore, initiatives for comprehensive financial access should be accompanied by financial literacy programs to ensure desired results. Financial courses should also be provided in educational programs to help students handle their finances better and improve their financial literacy. Second, fintech positively impacts complete financial access, accounting for approximately 1% of all regression models. Thus, the government can promote comprehensive financial access by encouraging efficient payment practices through mobile payments for bills (especially for essential services like electricity and water). Additionally, the government should provide incentives and discounts for convenient payments to expand services and strengthen

comprehensive financial access. Thirdly, the significant interaction effect of financial literacy and fintech shows that the impacts of financial literacy on financial inclusion are relatively higher when participants are equipped with fintech. This insight benefits policymakers since they need to consider these two variables to promote access to finance in developing countries such as Vietnam. Fourthly, individual characteristics such as age, location, and part-time job positively correlate with financial inclusion. The interaction results showed that financial literacy boosts financial inclusion more in rural areas, while fintech has a more significant effect in urban. There is no gender gap in financial inclusion in Vietnam, showing the effectiveness of women's empowerment programs. Even though data is collected during the heat of the COVID-19 pandemic, little evidence shows the negative impact of the pandemic on financial inclusion due to the availability of fintech. Therefore, schools should encourage students to work part-time to increase their experience and real-world connections and help students have easier access to comprehensive financial services through payment and shopping services. It is necessary to continue implementing policies to enhance women's capacities and pay more attention to rural areas to promote comprehensive finance.

5.3. Limitations and further research

Despite the contributions, this study has a few limitations. This research has only used closed questionnaires so far. In the future, open or semi-structured questionnaires, if used, will allow for more in-depth qualitative data analysis. Besides, although online questionnaires have a wider reach, they are voluntary and take more time to get desired feedback than face-to-face interviews. This can also cater better to the characteristics of students (not just limited to scholarships or grouping according to two social sciences and natural sciences), thus increasing the generalizability of research results. Additionally, this study could be expanded to other countries with the different levels of income (lower, middle, and high-income) to provide more comprehensive insights into increasing financial inclusion.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1. https://mof.gov.vn/webcenter/portal/tttpen/pages_r/l/detail?dDocName=MOFUCM171877.
2. PISA stands for the Programme for International Student Assessment, an initiative by the OECD. It assesses the proficiency of 15-year-olds in applying their knowledge and skills in reading, mathematics, and science to address real-world challenges. PISA releases measures for financial literacy among 15-year-old students worldwide every three years.

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ORCID

Kim Nguyen http://orcid.org/0000-0002-5892-5917

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Appendix 1: The description of variables included in the model

Variables	Measure	Literature
Financial inclusion	Binary variable: set to 1 if there is one of the three specified accesses below, and 0 if none of the following accesses are present. One of the three following cases: (1) Has a bank account; (2) Has a debit card; (3) Has a credit card.	Zins and Weill (2016); Allen et al. (2016); Demirgüç-Kunt, Klapper, and Singer (2017); Demirgüç-Kunt et al. (2020)
Financial literacy	Discrete variable: set from 0 to 7, indicating the number of correct answers out of 7 questions on financial literacy. Study at school; Interest; Inflation; Time value; Purchasing power; Risk and return; Diversification	Lusardi and Mitchell (2008); Klapper, Lusardi, and Van Oudheusden (2015); Grohmann, Klühs, and Menkhoff (2018)
Fintech	Binary variable: equals 1 if the individual uses internet banking, mobile banking, or e-wallets for payment-related activities, and 0 if the individual does not use any of the mentioned services. Using internet banking, mobile banking, e-wallets and using these tools to make payments, check balance and transfer money.	Durai and Stella (2019); Kumar, Sharma, and Vyas (2019)
Gender	Binary variable: equals 1 if the individual is male and 0 if the individual is female.	Zins and Weill (2016); Allen et al. (2016)
Age	Age of the interviewee	Zins and Weill (2016); Allen et al. (2016)
Risk preferences	Discrete variable: set from 0 to 10, indicating the willingness to take risk of individuals.	Dohmen et al. (2011)
Major	Binary variable: equals 1 if the individual studies natural sciences and 0 if the individual studies social sciences.	Incorporated newly into the study with student participants.
Part-time job	Binary variable: equals 1 if the individual has a part-time job and 0 if the individual does not have a part-time job.	Incorporated newly into the study with student participants.
Scholarship	Binary variable: equals 1 if the individual has a scholarship and 0 if the individual does not have a scholarship.	Incorporated newly into the study with student participants.
COVID effect	Binary variable: equals 1 if the individual experienced difficulties during the Covid-19 period (such as challenges with studies, financial situations, daily activities, and mental health), and 0 if the individual did not face any difficulties.	Incorporated newly into the study with student participants.

Appendix 2: The impacts of fintech and financial literacy on having an account

A – All data						
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Account	Account	Account	Account	Account	Account
FL	**0.333*****	0.175	−0.183	−0.133	−0.215	−0.056
	(0.0425)	(0.122)	(0.149)	(0.144)	(0.148)	(0.145)
Fintech	**3.112*****	**2.438*****	**1.813*****	**1.655*****	**1.895*****	**1.443****
	(0.208)	**(0.514)**	**(0.583)**	**(0.576)**	**(0.575)**	**(0.588)**
FL*Fintech		0.180	**0.321****	**0.265***	**0.302***	**0.268***
		(0.130)	**(0.157)**	**(0.153)**	**(0.155)**	**(0.153)**
Gender			−0.147	−0.117	−0.178	−0.0956
			(0.180)	(0.181)	(0.178)	(0.182)
Age			**0.711*****	**0.707*****	**0.728*****	**0.727*****
			(0.064)	**(0.064)**	**(0.064)**	**(0.065)**

(*continued*)

Continued.

A – All data

VARIABLES	(1) Account	(2) Account	(3) Account	(4) Account	(5) Account	(6) Account
Major			0.000	0.004	0.021	0.007
			(0.174)	(0.174)	(0.173)	(0.176)
Urban			**0.794*****			
			(0.181)			
Job			**0.399****	**0.396****	**0.417****	**0.402****
			(0.176)	**(0.177)**	**(0.175)**	**(0.178)**
Scholarship			−0.718	−0.771	−0.641	−0.813
			(0.522)	(0.523)	(0.521)	(0.530)
Risk			**−0.048***	**−0.049***	−0.043	**−0.053***
			(0.027)	**(0.028)**	(0.027)	**(0.028)**
COVID effect			−0.211	−0.194	−0.235	−0.200
			(0.173)	(0.174)	(0.172)	(0.174)
Fintech*urban				**1.002*****		**1.796*****
				(0.195)		**(0.391)**
FL*urban					**0.143*****	**−0.218****
					(0.045)	**(0.091)**
Constant	−3.249***	−2.651***	−14.32***	−14.15***	−14.46***	−14.53***
	(0.255)	(0.482)	(1.221)	(1.229)	(1.230)	(1.258)
Observations	1,288	1,288	1,254	1,254	1,254	1,254

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

B – Urban

VARIABLES	(1) Account	(2) Account	(3) Account
FL	**0.204*****	0.336	−0.0746
	(0.0717)	(0.216)	(0.384)
Fintech	**3.688*****	**4.288*****	**4.170****
	(0.331)	**(0.995)**	**(1.711)**
FL*Fintech		−0.150	0.0617
		(0.229)	(0.392)
Gender			−0.0570
			(0.341)
Age			**0.768*****
			(0.100)
Major			−0.110
			(0.319)
Job			**0.784****
			(0.314)
Scholarship			−0.853
			(0.719)
Risk			**0.123***
			(0.063)
COVID effect			**−0.515***
			(0.313)
Constant	−2.455***	−2.987***	−17.22***
	(0.415)	(0.939)	(2.476)
Observations	678	678	649

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

C – rural

VARIABLES	(1) Account	(2) Account	(3) Account
FL	**0.297*****	0.0593	−0.101
	(0.058)	(0.154)	(0.158)
Fintech	**2.503*****	**1.533****	**1.235****
	(0.271)	**(0.610)**	**(0.627)**
FL*Fintech		**0.277***	**0.337***
		(0.167)	**(0.174)**
Gender			−0.113
			(0.220)
Age			**0.689*****
			(0.092)
Major			−0.007
			(0.214)
Job			0.188
			(0.220)
Scholarship			−0.474
			(0.796)
Risk			**−0.097*****
			(0.031)
Covid effect			−0.0171
			(0.212)
Constant	−3.268***	−2.435***	−13.50***
	(0.334)	(0.559)	(1.684)
Observations	610	610	605

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

Appendix 3: the impacts of fintech and financial literacy on having savings

A – All data

VARIABLES	(1) Savings	(2) Savings	(3) Savings	(4) Savings	(5) Savings	(6) Savings
FL	**0.141*****	0.101	−0.018	−0.002	−0.043	−0.034
	(0.040)	(0.150)	(0.165)	(0.164)	(0.165)	(0.168)
Fintech	**1.474*****	**1.318****	0.946	0.868	**1.071***	1.028
	(0.250)	**(0.610)**	(0.638)	(0.636)	**(0.633)**	(0.654)
FL*Fintech		0.0435	0.0899	0.0758	0.0567	0.0584
		(0.156)	(0.171)	(0.170)	(0.170)	(0.170)
Gender			−0.024	−0.021	−0.033	−0.0300
			(0.155)	(0.155)	(0.155)	(0.155)
Age			**0.110*****	**0.111*****	**0.112*****	**0.111*****
			(0.028)	**(0.028)**	**(0.028)**	**(0.028)**
Major			0.061	0.060	0.061	0.062
			(0.150)	(0.150)	(0.150)	(0.150)
Urban			**0.418****			
			(0.163)			
Job			0.247	0.249	**0.252***	0.250
			(0.152)	(0.152)	**(0.152)**	(0.152)
Scholarship			**1.053*****	**1.062*****	**1.064*****	**1.063*****
			(0.374)	**(0.374)**	**(0.373)**	**(0.374)**

(*continued*)

Continued.

A – All data

VARIABLES	(1) Savings	(2) Savings	(3) Savings	(4) Savings	(5) Savings	(6) Savings
Risk			−0.005	−0.004	−0.002	−0.002
			(0.025)	(0.025)	(0.025)	(0.025)
Covid effect			−0.140	−0.145	−0.150	−0.147
			(0.148)	(0.148)	(0.148)	(0.148)
Fintech*urban				**0.391****		0.094
				(0.170)		(0.355)
FL*urban					**0.093****	0.074
					(0.038)	(0.079)
Constant	−3.070***	−2.927***	−4.782***	−4.719***	−4.715***	−4.706***
	(0.278)	(0.579)	(0.786)	(0.789)	(0.788)	(0.788)
Observations	1,288	1,288	1,254	1,254	1,254	1,254

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

B – Urban.

VARIABLES	(1) Savings	(2) Savings	(3) Savings
FL	**0.109****	0.192	0.110
	(0.0511)	(0.233)	(0.276)
Fintech	**1.168*****	1.511	1.210
	(0.351)	(1.01)	(1.132)
FL*Fintech		−0.087	−0.008
		(0.239)	(0.280)
Gender			−0.067
			(0.198)
Age			**0.067****
			(0.030)
Major			0.238
			(0.192)
Job			**0.483****
			(0.195)
Scholarship			**1.379*****
			(0.480)
Risk			−0.043
			(0.036)
COVID effect			−0.239
			(0.188)
Constant	−2.393***	−2.717***	−3.867***
	(0.390)	(0.979)	(1.225)
Observations	678	678	649

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

C – rural			
	(1)	(2)	(3)
VARIABLES	Savings	Savings	Savings
FL	0.081	−0.056	−0.118
	(0.070)	(0.213)	(0.214)
Fintech	**1.491*****	0.991	0.894
	(0.365)	(0.787)	(0.794)
FL*Fintech		0.155	0.119
		(0.226)	(0.228)
Gender			0.087
			(0.257)
Age			**0.237*****
			(0.054)
Major			−0.298
			(0.251)
Job			−0.085
			(0.254)
Scholarship			0.312
			(0.719)
Risk			0.038
			(0.038)
COVID effect			0.046
			(0.247)
Constant	−3.255***	−2.818***	−6.849***
	(0.415)	(0.726)	(1.215)
Observations	610	610	605

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

Appendix 4: The impacts of fintech and financial literacy on having loans

A – All data						
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Loans	Loans	Loans	Loans	Loans	Loans
FL	**0.282*****	**0.634***	0.486	0.502	0.456	0.544
	(0.069)	**(0.356)**	(0.499)	(0.498)	(0.496)	(0.504)
Fintech	**1.527*****	**3.133***	2.925	2.781	3.045	2.459
	(0.521)	**(1.790)**	(2.378)	(2.379)	(2.358)	(2.453)
FL*Fintech		−0.367	−0.330	−0.347	−0.352	−0.302
		(0.363)	(0.505)	(0.504)	(0.501)	(0.514)
Gender			0.312	0.315	0.303	0.324
			(0.259)	(0.259)	(0.259)	(0.260)
Age			**0.158*****	**0.159*****	**0.162*****	**0.159*****
			(0.036)	**(0.036)**	**(0.036)**	**(0.036)**
Major			0.348	0.348	0.330	0.346
			(0.258)	(0.258)	(0.258)	(0.258)
Urban			**0.550***			
			(0.310)			
Job			**0.716****	**0.715****	**0.740*****	**0.715****
			(0.285)	**(0.285)**	**(0.285)**	**(0.285)**
Scholarship			**1.117****	**1.114****	**1.133****	**1.102****
			(0.525)	**(0.525)**	**(0.522)**	**(0.526)**

(*continued*)

Continued.

A – All data

VARIABLES	(1) Loans	(2) Loans	(3) Loans	(4) Loans	(5) Loans	(6) Loans
Risk			−0.023	−0.023	−0.020	−0.025
			(0.046)	(0.046)	(0.045)	(0.046)
COVID effect			0.227	0.225	0.206	0.230
			(0.254)	(0.254)	(0.253)	(0.254)
Fintech*urban				**0.544***		1.037
				(0.317)		(0.785)
FL*urban					0.085	−0.114
					(0.066)	(0.164)
Constant	−5.226***	−6.759***	−10.38***	−10.25***	−10.26***	−10.28***
	(0.576)	(1.755)	(2.445)	(2.444)	(2.429)	(2.463)
Observations	1,288	1,288	1,254	1,254	1,254	1,254

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

B – Urban

VARIABLES	(1) Loans	(2) Loans	(3) Loans
FL	**0.179****	0.340	−0.384
	(0.080)	(0.411)	(0.765)
Fintech	**1.010***	1.708	−0.314
	(0.607)	(1.910)	(2.560)
FL*Fintech		−0.167	0.506
		(0.419)	(0.769)
Gender			**0.682****
			(0.295)
Age			**0.161*****
			(0.041)
Major			0.308
			(0.304)
Job			**1.099*****
			(0.370)
Scholarship			0.702
			(0.653)
Risk			0.006
			(0.059)
COVID effect			0.0353
			(0.296)
Constant	−3.967***	−4.633**	−6.980***
	(0.671)	(1.864)	(2.635)
Observations	678	678	649

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

C – rural.

VARIABLES	(1) Loans	(2) Loans	(3) Loans
FL	**0.397*****	1.498	1.655
	(0.151)	(0.995)	(1.038)
Fintech	**1.904***	7.799	8.646
	(1.036)	(6.051)	(6.280)
FL*Fintech		−1.145	−1.330
		(1.007)	(1.047)
Gender			−1.002
			(0.664)
Age			**0.142****
			(0.062)
Major			0.551
			(0.532)
Job			−0.205
			(0.541)
Scholarship			**2.317****
			(0.906)
Risk			−0.102
			(0.082)
COVID effect			0.889
			(0.566)
Constant	−6.680***	−12.38**	−15.89**
	(1.182)	(6.008)	(6.413)
Observations	610	610	605

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

Appendix 5: The gender gap in financial inclusion, financial literacy and fintech

A – Financial inclusion

	All	Men	Women	*p*-value
Account	62.03%	56.85%	64.71%	**0.005*****
Savings	22.52%	21.69%	22.94%	0.610
Loans	6.52%)	7.76%	5.88%	0.195
Financial inclusion	65.30%	58.68%	68.71%	**0.000*****
N	1288	438	850	

Note: *p*-value is taken from the Mann–Whitney *U* test.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

B – Financial literacy

	All	Men	Women	*p*-value
Study at school	54.19%	51.37%	55.65%	0.144
Interest	66.23%	69.18%	64.71%	0.108
Inflation	32.84%	33.11%	32.71%	0.885
Time value	43.09%	41.10%	44.12%	0.299
Purchasing power	51.94%	50.00%	52.94%	0.317
Risk and return	89.05%	87.90%	89.65%	0.341
Diversification	50.85%	50.23%	51.18%	0.747
Financial literacy	3.88	3.82	3.90	0.464
N	1288	438	850	

Note: *p*-value is taken from the Mann–Whitney *U* test.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

C – fintech

	All	Men	Women	*p*-value
Internet banking	44.95%	35.84%	49.65%	**0.001*****
Mobile banking	30.90%	32.88%	29.88%	**0.000*****
E-wallet	56.83%	50.46%	60.12%	0.270
Payment (Internet banking)	32.14%	25.11%	35.76%	**0.000*****
Payment (Mobile banking)	17.78%	21.92%	15.65%	**0.000*****
Payment (Ewallet)	53.42%	46.12%	57.18%	**0.005*****
Balance (Internet banking)	40.14%	30.82%	44.94%	**0.000*****
Balance (Mobile banking)	27.33%	29.68%	26.12%	0.174
Balance (Ewallet)	30.51%	31.28%	30.12%	0.668
Transfer (Internet banking)	39.52%	31.51%	43.65%	**0.000*****
Transfer (Mobile banking)	20.26%	26.48%	17.06%	**0.000*****
Transfer (Ewallet)	47.20%	42.92%	49.41%	**0.027****
Fintech	78.96%	73.52%	81.76%	**0.000*****
N	1288	438	850	

Note: *p*-value is taken from the Mann–Whitney U test.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

Appendix 6: The impacts of the COVID-19 pandemic

The appendix details the impacts of the COVID-19 pandemic on participants' studies, finances, and mental health/daily life. We specifically present results for participants who indicated being affected by the pandemic (those who answered 'Yes' to the question regarding whether they were affected).

COVID effects	Their studies	Financial situations	Mental health/personal life	*N*
All data	12.14%	32.97%	17.03%	552
Urban	9.85%	43.07%	14.60%	274
Rural	**14.39**%**	**23.02**%***	**19.42**%**	278

Note: *p*-value is taken from the Mann–Whitney *U* test (Compare Urban and Rural data).
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

Appendix 7: The impacts of fintech and financial literacy on financial inclusion (two-stage instrumental variable regression)

This table presents the results of a two-stage instrumental variable regression, aiming to investigate the effects of fintech and financial literacy on financial inclusion. This approach is employed to address the potential endogeneity of financial inclusion.

All data (2SLS-IV)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	FI	FI	FI	FI	FI	FI
FL	**0.049*****	0.017	−0.003	0.003	−0.009	0.011
	(0.006)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Fintech	**0.598*****	**0.463*****	**0.393*****	**0.351*****	**0.442*****	**0.314*****
	(0.027)	**(0.062)**	**(0.058)**	**(0.058)**	**(0.059)**	**(0.060)**
FL*Fintech		**0.039****	**0.031****	0.022	0.019	**0.026***
		(0.016)	**(0.015)**	(0.015)	(0.015)	**(0.015)**

(*continued*)

Continued.

All data (2SLS-IV)						
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	FI	FI	FI	FI	FI	FI
Gender			**−0.040***	−0.035	**−0.045****	−0.032
			(0.021)	(0.021)	**(0.021)**	(0.021)
Age			**0.026*****	**0.025*****	**0.027*****	**0.025*****
			(0.003)	**(0.003)**	**(0.003)**	**(0.003)**
Major			−0.028	−0.024	−0.029	−0.024
			(0.021)	(0.021)	(0.021)	(0.020)
Urban			**0.196*****			
			(0.022)			
Job			**0.077*****	**0.071*****	**0.084*****	**0.071*****
			(0.021)	**(0.021)**	**(0.021)**	**(0.021)**
Scholarship			−0.011	−0.005	−0.000	−0.004
			(0.060)	(0.060)	(0.061)	(0.060)
Risk			−0.005	−0.005	−0.004	−0.005
			(0.003)	(0.003)	(0.003)	(0.003)
COVID effect			−0.024	−0.023	−0.031	−0.023
			(0.020)	(0.020)	(0.021)	(0.020)
Fintech*location				**0.232*****		**0.310*****
				(0.024)		**(0.044)**
FL*location					**0.034*****	**−0.020****
					(0.005)	**(0.009)**
Constant	−0.012	0.0931*	−0.313***	−0.269***	−0.306***	−0.273***
	(0.031)	(0.054)	(0.080)	(0.080)	(0.082)	(0.080)
Observations	1,288	1,288	1,254	1,254	1,254	1,254

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.

Appendix 8: The impacts of fintech and financial literacy on financial inclusion (two-stage instrumental variable regression)

This table presents the results of a two-stage instrumental variable regression, aiming to investigate the effects of fintech and financial literacy on financial inclusion. This approach is employed to address the potential endogeneity of financial inclusion. In this regression, we use the financial impact of COVID-19 (a financial shock) as the instrument.

All data (2SLS-IV)			
	(1)	(2)	(3)
VARIABLES	FI	FI	FI
FL	**0.270***	0.017	−0.002
	(0.140)	(0.014)	(0.014)
Fintech	**0.433*****	**0.463*****	**0.396*****
	(0.111)	**(0.062)**	**(0.058)**
FL*Fintech		**0.039****	**0.029***
		(0.016)	**(0.015)**
Gender			**−0.041***
			(0.021)
Age			**0.025*****
			(0.003)
Major			−0.026
			(0.021)
Urban			**0.200*****
			(0.022)
Job			**0.076*****
			(0.021)

(*continued*)

Continued.

All data (2SLS-IV)			
	(1)	(2)	(3)
VARIABLES	FI	FI	FI
Scholarship			−0.015
			(0.060)
Risk			−0.005
			(0.003)
Constant	−0.737	0.0931*	−0.320***
	(0.462)	(0.054)	(0.080)
Observations	1,288	1,288	1,257

Note: Standard errors in parentheses.
***$p < 0.01$;
**$p < 0.05$;
*$p < 0.1$.