Does FinTech Promote Entrepreneurship?

Evidence from China

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ABSTRACT

The rise of financial technology (FinTech) in China over the past decade has changed the traditional financial landscape in the country. We provide evidence on the role of digital financial services in promoting self-employment. We construct an indicator of relative FinTech adoption at the provincial-level in China. We show that the digitalization of financial services at an aggregated level is associated with a higher share of self-employed individuals in the total population. In rural areas, coverage breadth of digitalized financial services drives the positive impact on the share of self-employment, while in urban areas, digitalized insurance services appear to be more influential. We also show that the shift to self-employment is not at the expense of employment in private firms in the country.

Keywords: Fintech, Financial Inclusion, Digitalization, China, Entrepreneurship

JEL classification: G23, J21, O33

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NON-TECHNICAL SUMMARY

Financial technology (FinTech) has developed rapidly in China, and on a large scale. The annual volume of mobile payments was equivalent to 38 percent of GDP in 2018, compared to less than 2 percent of GDP in the USA (FSB, 2020). This trend is linked to several key factors. The first is the shortcomings of the existing financial system (Arner et al., 2015). Financial repression in China has channelled capital to large state-owned enterprises at preferential rates (Lardy, 2015). This allocation of finance has been at the expense of households and SMEs, particularly in rural areas. Second, the rise of smartphones and the low agility of the traditional banking sector have paved the way for the mass adoption of mobile payments. In addition to inefficiencies in the traditional financial system, a fragmented network of local merchants, for example, has created a huge opportunity for e-commerce.

Literature has been abundant on the impact of FinTech on financial inclusion of firms and households. Several studies show a positive impact of FinTech development on financial inclusion, in particular in emerging and developing economies where financial needs are not met by traditional lenders (Bazarbash et al., 2020; Demirguc-Kunt et al., 2018; Shrader and Duflos, 2014). We investigate the impact of these developments on entrepreneurship.

Because FinTech firms in China have long been exempted from banking regulation requirements and reporting standards, granular data on their different business lines were not fully captured by policymakers and academics. Unless data is made available by FinTech firms themselves, it remains scarce. We overcame this challenge by exploiting a dataset of Peking University Digital Finance Inclusion Index, built on data provided by a major Chinese FinTech player: Ant Group, which operates Alipay, one of the two dominant digital financial platforms in China. The index compiles information collected at the provincial level on different dimensions of FinTech penetration (coverage breadth, usage depth, and digitalization level), as well as on different product lines (credit, insurance, payments). We construct a relative FinTech adoption indicator, showing the degree of Fintech penetration in each province, relative to the national average on a given year.

We show that the digitalization of financial services at an aggregated level is associated with a higher share of self-employed individuals in the total population. In rural areas, coverage breadth of digitalized financial services drives the positive impact on the share of self-employment. We argue that this result illustrates the underlying hypothesis that the digital finance infrastructure created by FinTech firms allows entrepreneurs to draw from a wider network of formal and informal contacts to address unmet financing needs, especially in rural areas. In urban areas, digitalized insurance services appear to have more influence. We argue that insurance can help entrepreneurs better manage and balance both their personal and business risks. Traditional services may be not well suited for the needs of the financially underserved, especially in developing economies (Raithatha & Priebe 2020, Benami & Carter 2021), whereas digitalised services might meet these needs. We also show that the shift to self-employment does not come at the expense of employment in private firms in the country.

Figure 1. Relative Fintech Adoption Indicator, 2018
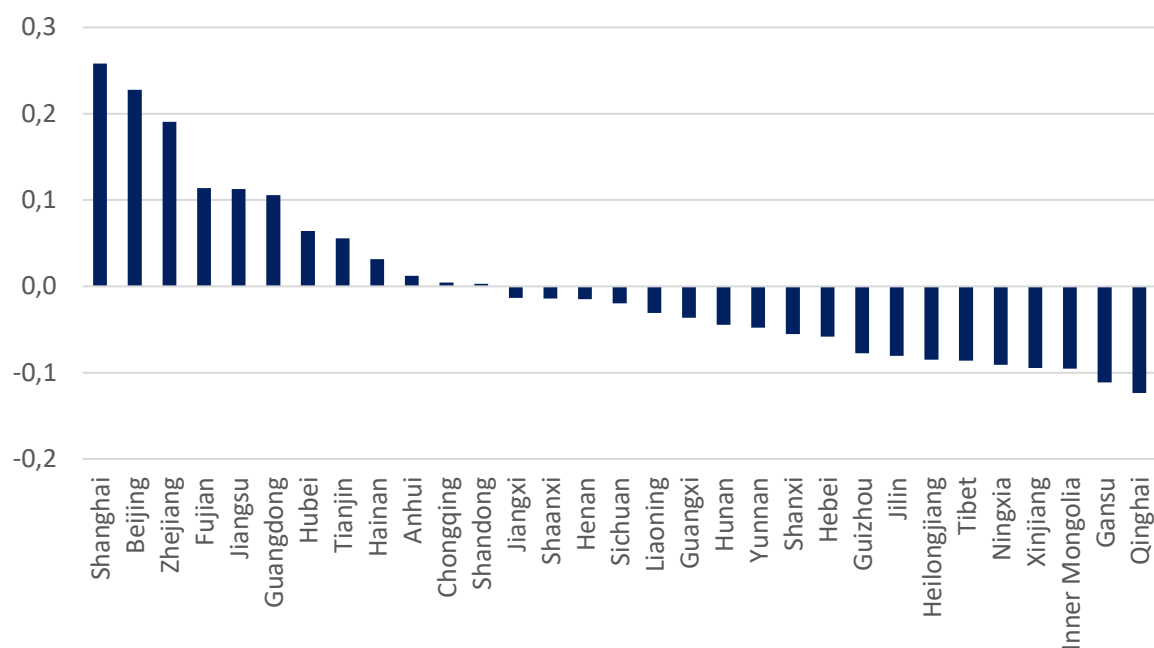
Sources: Peking University, Ant Group, Authors' calculations

Note: We construct the relative Fintech adoption indicator by dividing the aggregate index for each province by the national average for a given year. The graph shows the relative index, from which we have subtracted 1.

L'adoption des Fintech favorise-t-elle l'entreprenariat ?
Le cas de la Chine

RÉSUMÉ

L'essor des technologies financières (FinTech) en Chine au cours de la dernière décennie a modifié le paysage financier traditionnel du pays. Nous étudions la relation entre l'adoption de ces services et la part de l'entreprenariat dans la population totale. Nous construisons un indicateur de l'adoption relative des FinTech au niveau provincial dans le pays, et montrons que la numérisation des services financiers est associée à une part plus élevée d'autoentrepreneurs dans la population totale. Dans les zones rurales, l'étendue de la couverture des services financiers numérisés est à l'origine de cet impact positif, tandis que dans les zones urbaines, les services d'assurance numérisés semblent avoir plus d'influence. Nous montrons également que le passage à l'emploi indépendant ne se fait pas au détriment de l'emploi au sein des entreprises privées dans le pays.

Mots-clés : Fintech, inclusion financière, digitalisation, Chine, entreprenariat.

1 Introduction

In 2015, China Premier Li Keqiang announced the "Internet Plus" action plan, encouraging a deep integration of the internet with traditional industries to create a new development ecosystem. This plan was designed to support a modernization of the economic model, as well as to provide new opportunities to address small and medium-sized enterprises' (SMEs) financing and promote innovation and entrepreneurship (Wang et al., 2016). Through the integration of internet technology and the financial sector, digital finance supported by information technology ought to reduce information asymmetry, lower transaction costs and optimize resources.

China is an interesting case study since financial technology (FinTech) has expanded rapidly, at a large scale. The yearly volume of mobile payments is equivalent to 38 percent of GDP in 2018, compared to less than 2 percent of GDP in the USA (FSB, 2020). Why and how did FinTech firms expand rapidly in China? And what effect does it have on small businesses and individuals, especially those who have been poorly served by traditional financial institutions?

Because FinTech firms in China have long been exempted from banking regulation requirements and reporting standards, data on their activities were not fully captured by policymakers and academia. Unless the data is made available by FinTech firms themselves, data on FinTech development is scarce. We overcame this challenge by exploiting a dataset of Peking University Digital Finance Inclusion Index, built on data provided by a major Chinese FinTech player: Ant Group[1], which operates Alipay, one of the two dominant digital financial platforms in China. The data is uniquely suited to analyze digital finance development in China on multiple levels. It contains information at the provincial level on the breadth of coverage of digital financial service and the depth of usage. Further, the data allows us to distinguish between different digital services such as payment, insurance and credit. We append it with publicly available macroeconomic data such as employment data to study the effect of financial digitalization on entrepreneurial activity.

We construct a relative FinTech adoption indicator, showing the state of FinTech adoption in each province, relative to the national average on a given year. We show that the digitalisation of financial services at an aggregated level is associated with a higher share of self-employed individuals in the total population. In rural areas, coverage breadth of digitalised financial services drives the positive impact on the share of self-employment, while in urban areas, digitalised insurance services appear to be more influential. We also show that the shift to self-employment is not at the expense of private employment in the country.

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[1] Ant Group was renamed in 2020. From 2014 until 2020 it was known as Ant Financial.

The remainder of the paper is organized as follows. Section 2 presents the literature review. In Section 3, we describe the development of digital finance in China and its impact on the socio-economic model of the country. We provide a detailed background on Ant Group, one of China's largest FinTech provider. Section 4 presents the unique data comprehensively. In Section 5, we firstly lay out hypotheses on the impact of digital finance on entrepreneurship that are then tested empirically with a regression analysis. Finally, Section 6 concludes.

2 The Literature: Digital versus Traditional Finance

Literature has been abundant on the impact of FinTech on financial inclusion of firms and households. Several studies show a positive impact of FinTech development on financial inclusion, in particular in emerging and developing economies where financial needs are not met by traditional lenders (Bazarbash et al., 2020; Demirguc-Kunt et al., 2018; Shrader and Duflos, 2014). Digital finance can make up for the shortcomings of traditional finance by making financial services easily accessible in underdeveloped areas. Philippon's (2015) seminal paper shows that the traditional banking system still includes high costs of financial intermediation and FinTech lending emerged due to the financing gap of SMEs (Ahmed et al. 2016; Jagtiani et al., 2018). In turn, financial inclusion is a catalyst for the development of small private firms and support entrepreneurship (Aghion et al., 2007).

Traditional financial institutions are often reluctant to serve remote and poor populations (Armendariz and Morduch, 2005). Using firm-level data and bank surveys, Ayyagari et al. (2017) identify the lack of reliable credit information as one of the most important constraints that impede access to finance by SMEs. The lack of business records indeed increases information asymmetry (Stiglitz and Weiss, 1981), making traditional financial institutions reluctant to engage with them. The small size of micro and small enterprises makes traditional risk assessment models cost-ineffective. The World Economic Forum (WEF, 2015) also cites regulatory pressures to reduce banks' exposure to risky loans, as a factor behind banks' reduced lending to SMEs. A growing number of studies in recent years shows that digital credit can overcome some of these constraints, widening access to finance for entrepreneurs especially at the early stages (Hau et al., 2021, Berg et al., 2020, Frost et al., 2019, Huang et al., 2020).

The development of FinTech can have a disruptive effect on the incumbent actors. New financial service providers are emerging outside the traditional banking sector, e.g. small startups (Arner et al., 2015; Greenwood and Scharfstein, 2013) or BigTech[2] like Alibaba, which owns Ant Group, or Amazon (Frost

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[2] BigTech refers to technology companies that provide financial services or products as part of their broader business model and are characterized by extensive established customer networks (FSB, 2019). Some BigTech companies use their existing large platforms to provide financial services (e.g., accessible consumer data can be used for credit analysis). FinTech companies on the other hand primarily operate financial services.BigTech firms that further facilitate financial services can be seen as a subset of FinTech firms. In the following, we also distinguish between FinTech and BigTech. We use primarily the term FinTech since we are focusing on Ant

et al., 2019). FinTech development brings new regulatory issues, risks to financial stability and data protection, and new challenges to the well-established banking systems (Carney, 2017; Lagarde, 2018; Frost et al., 2019). For the latter, the core research question is whether these new technologies are substituting or complementing traditional banking services. The findings are mixed. Some studies find that FinTech substitutes traditional lending (e.g., Vallée and Zang, 2019). Wang et al. (2021) who study the impact of FinTech on 113 commercial banks in China conclude that FinTech firms have an advantage over banks as they are not subject to banking regulations, allowing them to implement advanced technologies and improve their operating efficiency. On the contrary, FinTech is found to be complementary to the banking system in that it helps expand the customer base (Cole et al., 2019) and provides information spill-overs (Balyuk, 2016). FinTech firms have the potential to expand the existing credit markets to vendors previously excluded from bank credit due to low credit scores (Hau et al., 2019). Sheng (2021) shows that FinTech simplifies and supports banks when providing credit to SME in China, and that it is more important to utilize FinTech than to develop many small banks for SME finance. Erel and Liebersohn (2020) specifically show that financial services expand to small businesses, districts with fewer bank branches and population groups characterized by lower income and higher minority shares.

Other studies find mixed results. Tang (2019) shows that FinTech substitutes traditional lending as it hinders bank-lending channels but with respect to small loans, FinTech services are complementing bank services. Regarding payments, FinTech may harm consumers with strong bank affinity but benefits those with weaker banking connections (Parlour et al., 2020). Lastly, studies that analyze the impact of FinTech on banking show that the increased competitive challenge lead to more efficient financial services provision and expand the range of users (Navaretti et al., 2018) at the same time nudge banks to change their old business strategies (Vives, 2019).

3 FinTech Landscape in China

FinTech services have disrupted traditional finance over the latest decades. China is an interesting case study in that this financial development has been large and rapid. Non-bank mobile payments grew from a value of RMB 10.4 trillion in 2013 (USD 1.7 trillion) to a value of RMB 335.5 trillion in 2021 (USD 55.1 trillion), according to the PBoC. Online lending increased from USD 4 billion in 2013 to USD 156 billion in 2016 and USD 515 billion in 2019 (Cornelli et al, 2020). It is estimated to be around USD 764 billion by 2020 (Goldman Sachs Global Investment Research, 2017).

Group. In particular, we will highlight the key characteristics of financial service providers that emerged from technology companies such as Ant Group that was founded by Alibaba.

Behind these numbers are predominantly two FinTech companies that spur the rise of digital finance in China, namely Ant Group and Tencent.

3.1 Drivers of the FinTech Rise in China

The expansion of the FinTech industry in China is linked to several key factors. The first is related to the shortcomings of the existing financial system (Arner et al., 2015). Financial repression in China has channeled capital at below-market interest rates through the formal banking system mainly to large, state-owned enterprises (Lardy, 2015). The consequences of financial repression can be summarized as the "two abundances and two difficulties" (两多两难): private savings are abundant but attractive investment channels are difficult to access, and smaller, private companies in need of financing are abundant but they struggle to obtain credit (Xie, 2013). Despite having a bank-based financial system with high dependency on bank funding for a majority of firms and households, some areas remain quite remote from funding sources due to geographical obstacles, stringent collateral and credit history requirements or high account expenses (Demirguc-Kunt et al., 2018). This left individuals, households and SMEs with financial needs underserved, in particular in rural areas.

Over the past decade, the country has embraced digital technologies on a massive scale, addressing the shortcomings of financial repression and skipping stages of development ("leapfrogging") in the process. In addition to inefficiencies in the traditional financial system, a fragmented network of local merchants, for example, created a huge opportunity for e-commerce even before the Western-style supermarket model became widespread. The rise of smartphones and the low agility of the traditional banking sector paved the way for the mass adoption of mobile payments. By 2017, 75% of the Chinese population did not hold a bank card (World Bank Group, 2017). A comparison of 79 countries finds that FinTech credit is larger where there are fewer bank branches per capita (Cornelli et al, 2020).

The second element is a diversification strategy that allows for powerful synergies. In 2004, Alibaba set up a new company, Alipay, as a response to a payment problem for Alibaba's e-commerce site (Taobao 淘宝). It served as an escrow account, allowing secure transfers between buyers and sellers, a service traditional banks were unwilling to offer at the time. Alipay was then transformed into a new company Ant Financial, renamed Ant Group in 2020. The digital platform and services kept the name Alipay. In 2011, Alipay developed into a mobile payment app using QR codes. In 2018, Ant Group created its own physical marketplace chain, Hema, expanding Alipay's reach into online and offline retail. And more than just synergies on the customer base, this cross-functional approach allows for the collection of fine-grained cross-sectional data on consumer habits. For example, more than 3,000 variables from payment, shopping and other activities have been integrated into Ant Group's credit risk models, Sesame Credit (Zhima Credit, 芝麻信用). This technology allows it to provide automated loans with interest adjusted to the risk profile, and offers a "three-one-zero" service - three minutes to apply,

one second to get a credit decision and no one involved in the decision process. In addition to its agility, this service provides a financial inclusion opportunity for people with no bank credit history in China.

The horizontal development of Ant Group, which offers a variety of services, also creates synergies: in 2020, more than 70% (almost 730 million) of Ant's users transacted in one or more of the digital finance services offered by the group (payments, asset management, credit or insurance).

Figure 1: Ant Group Eco-System

Source: Ant Group (2020)

A third success factor is the conciliatory stance of the Chinese government (Zhou, Arner and Buckley, 2018). It is only recently that the authorities created an encompassing regulatory framework for FinTechs, close to twenty years after the launch of Alipay. Regarding the protection of private data and respect for intellectual property, relative freedom has again been a major asset. And it is not only through inaction that the Chinese government is accompanying the digital transition, but also through its investments. Its "Internet Plus" action plan, unveiled in 2015, provides for the integration of the Internet into all sectors of the economy.

On the other hand, while a protectionist policy has sheltered Chinese FinTech companies from international competition, the horizontal extension of these real ecosystems and domestic competition in the race for new markets are fuelling a major effort to innovate and gain competitiveness. Ant's main competitor is Tencent, which has developed a widely adopted payment system, WeChat Pay, around its messaging application WeChat. It has almost 40% of the market share and thus forms a veritable duopoly with Alipay in the mobile payments sector[3]. Other companies also have significant financial ambitions. In particular, Lufax, an asset management platform partly owned by Ping An, China's largest insurer, which went public on the New York Stock Exchange in 2020 (valuation of USD 32.9 billion in

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[3] According to "2020 Q1 Chinese Third-party Mobile Payments Market Report" published by the iResearch Consulting Group: https://www.iresearch.com.cn/Detail/report?id=3601&isfree=0

2020[4]). Ant Group's agility, its affiliation with Alibaba, which gives it access to large amounts of data, and its dynamic revenues ensure that it remains well positioned in the country's highly competitive environment.

Lastly, telecommunication infrastructure developed rapidly in the country, supported by public investments. By end-2019, China had more than half of the world's total 4G base stations (Chui, 2021). Low-cost smartphones produced in China led to widespread adoption in the country.

Bazarbash et al. (2020) show that, in 52 countries studied, the development of digital technologies has strengthened financial inclusion, even compensating in some cases (8 countries) for a decline in banking inclusion through traditional channels. The authors also show a significantly positive impact of the development of digital financial inclusion on the GDP of the countries studied, highlighting the impact on transaction costs, liquidity and solvency. Finally, the report indicates that the development of FinTechs increases competition for the banking sector, but also provides new opportunities for banks in terms of broadening their customer base and allows for important complementarity effects.

More specifically, digital technologies brought new forms of inclusion through a geographical spread of e-commerce. In particular, the e-commerce platform Alibaba supported the development of 'Taobao villages' (Taobao being the Chinese name of a major e-commerce platform operated by Alibaba). This means the transformation of semi-rural industrial areas into clusters for e-commerce, and is depicted as a factor for rural development (Wei, Lin and Zhang, 2020), fostering entrepreneurship and creating flexible and inclusive employment opportunities (Luo and Niu, 2019).

3.2 Ant Group as the Reflection of FinTech Business Trends in China

Our study uses a dataset on FinTech penetration and adoption provided by Ant Group. In November 2020, China's financial supervisory authorities rejected the company's plan to list publicly and instead subjected Ant Group to a rectification campaign. Nevertheless, the company continues to play a dominant role in the Chinese FinTech ecosystem. Its wide user base and sophisticated data collection efforts make Ant Group a credible source of information to detect trends and patterns, not only in the digital payment space, but also for China's digital economy at large. This section reviews the main characteristics of the group before and after the rectification campaign.

Ant Group's deployment and profitability make it one of the world's largest FinTechs. Between January and September 2020, Ant Group reported a gross profit of RMB 69.5 billion (USD 10.4 billion), up

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[4] According to Reuters: https://www.reuters.com/article/us-lufax-ipo-idUSKBN27F12C

74.3% year-on-year. Its operating revenue was USD 118.2 billion, up 42.6%. Ant Group had 16,660 employees at the end of June 2020. And over 500 million users utilize its services in 2020.[5]

Ant Group's business model is divided into four main components, namely payments, lending, asset management, and insurance.

The first concerns mobile payments via Alipay (支付宝). Created in 2004，the platform generates revenue via fees charged to merchants as a percentage of transaction volumes made (0.55%), as well as on any movement of funds in and out (0.1%), for example to or from a bank account. Initially, customers could only use Alipay for online purchases and transfers. In 2017, Ant Group promoted a campaign to offer to offline vendors a QR code technology for payments, widening access to its network. Alipay's market share was reduced when Tencent introduced WeChat Pay in August 2013. Alipay generated nearly RMB 52 billion (USD 7.8 billion) in revenue in 2019. Admittedly, this business segment tends to decrease in total revenues (55% in 2017 compared to 36% in H1 2020), but mobile payments are also a loss leader that allows the group to strengthen its customer base for its ancillary services (Ant Group, 2020)[6].

Ant Group's second line of business is small loans. It offers two consumer loan products in-house and lends to SMEs via an associated online bank (see below). The company launched Huabei (花呗), also known as CreditPay, in 2014, which operates like a virtual credit card. Huabei allows users to defer or reschedule payments for products purchased on Alibaba-owned platforms such as Tmall. Due to low credit card penetration in China, this service has met strong demand.

One year after Huabei, Ant Group launched Cash Now or Jiebei (借呗), a feature that allows Alipay users to borrow larger amounts in cash (minimum amount: RMB 1,000 or about USD 150). This business line is geared towards consumer finance but also offers loans to small businesses, at annualized rates of between 7% and 14%. Jiebei's loans were largely financed by securitization. The overall consumer lending segment, which represents 20% of the market in China, generated 39% of the group's revenue in H1 2020 (USD 29 billion), a share that has been growing strongly in recent years (25% in 2017)[7].

In addition to consumer loans, Ant Group offers business loans to SMEs in cooperation with an online bank, MYBank, where it holds a 30% stake. Credit risk assessment is undertaken in a digital and automated fashion, incorporating a vast amount of data including payments over Alipay. This approach has allowed MYBank to cut the average cost of loan assessment for SMEs from an industry average of

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[5] The numbers are taken from Ant Group (2020), an IPO filing prospectus which was available before the planned IPO in November 2020. The prospectus can still be accessed online here: https://www1.hkexnews.hk/listedco/listconews/sehk/2020/1026/2020102600165.pdf

[6] The numbers are taken from the financial information stated in the Ant Group (2020). For more details and numbers see 315ff.

[7] Ibid.

RMB 2000 (USD 300) to around RMB 3 (Ren, 2020). The median loan size is ca. RMB 10000 (USD 1500) (Beck et al., 2022). Since its creation in 2015, MYBank has served over 20 million Chinese SMEs. At around 7%, MYBank's market share is smaller than that of Ant Group in the consumer loan market (13.3%), but all three lending products saw rapid growth in assets and profit until 2020. As an online bank, MYBank is not authorized to accept deposits, it relies mostly on funding from the interbank market and certificates of deposit instead (Xu, 2020).

Figure 2: SMB Credit Performance Metrics
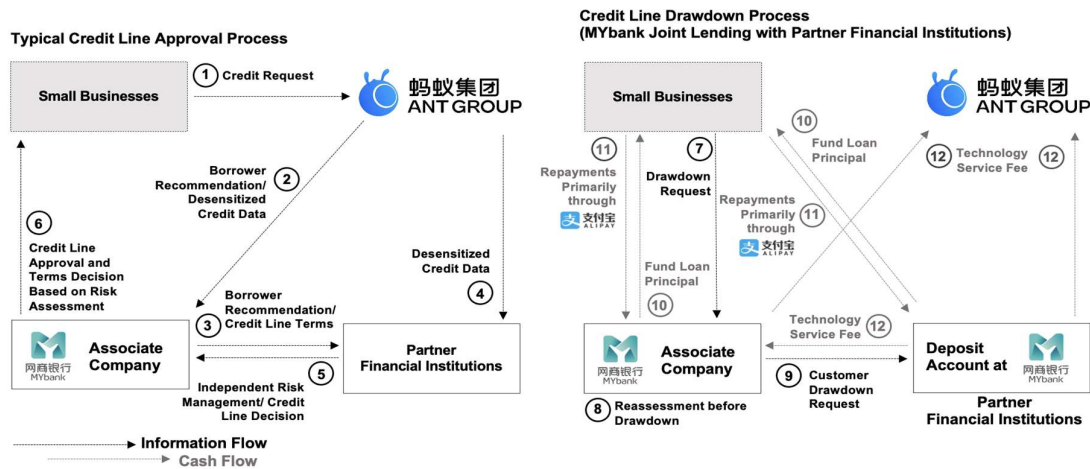
Source: Ant Group (2020)

Financial supervisors were particularly concerned with the consumer loan business of Ant Group. Jiebei credit grew at triple-digit rates in the mid-2010s, and even though the loans were booked off balance sheet, the company had high implied leverage and an estimated capital adequacy ratio of about 2%, as compared to the ca. 8% Chinese regulators require for banks under Basel III (Global Source Partners, 2020). Moreover, Ant Group was marketing consumer loans to students and low-income households, raising debt sustainability and consumer protection concerns. In response to the rectification requirements made by the authorities in late 2020, Ant Group split both Huabei and Jiebei in two sub-products, re-branding loans that are underwritten by third parties (Liao 2021). It shares Huabei loan data directly with the PBoC (Zhu 2021). And the company has introduced higher requirements in screening consumer loan applicants, following new national regulations for microlenders (Yue & Jia 2021).

Ant Group's third business line is asset management. In June 2013 the company launched Yu'eBao (余额宝), or "leftover treasure". Merchants or shoppers can simply place leftover cash from their Alipay wallets in a money market fund (with a minimum of 1 RMB), whose yield (3.5% on average between 2014 and 2019) is attractive compared to bank deposits. One year after its launch, Yu'eBao had 81 million investors, more than China's equity markets (Orient Capital Research 2014). Yu'eBao became

the world's largest money market fund, with USD 268 billion under management in March 2018. It has since shrunk to USD 122 billion under management as of March 2020, mainly due to tighter regulation and greater competition from wealth management products (Detrixhe 2020). Other services, such as Yulibao (余利宝, asset management) and Dalicai (大理财, a marketplace for investment products), complete the offering. More than 500 million users have subscribed to an Ant Group InvestmentTech service, for an outstanding amount of over RMB 4,000 billion (USD 600 billion).

Insurance is Ant Group's fourth business line. Insurance services (InsureTech) cover a wide range of services (health, pension, life, motor etc.) and serve over 570 million people by June 2020 (Ant Group, 2020). As with other services, Ant Group receives commissions from partner insurance institutions based on a percentage of insurance premiums and contributions generated via its platform. Ant launched a mutual aid healthcare insurance platform (Xianghubao 相互宝）in October 2019, but had to take down the service two years later due to adverse selection and regulatory shortcomings (Ran & Jia 2021). Together, asset management and insurance accounted for 24% of the group's revenues in H1 2020.

Since 2017, Ant Group has also been promoting new services such as blockchain, artificial intelligence, security or the Internet of Things. Although they represent a minor share of revenues, these product lines position Ant Group among the pioneers in digital finance. In July 2020, the group announced the launch of AntChain, a blockchain-based solution, which is said to have the capacity to handle one billion transactions each day according to official statements by the group. Ant Group has signed a strategic agreement with Intel, Dell, Hewlett-Packard and Lenovo to make IT leasing services more accessible to SMEs through the use of AntChain. The group also created Ant Forest in 2016 to encourage Alipay users to reduce their carbon footprint through their activities and purchases. The "winnings" are materialized by planting trees in desert regions. The programme received the 2019 UN Champions of the Earth award, the highest environmental honor of the United Nations.

In November 2020, financial authorities suspended the company's IPO citing multiple regulatory infractions. One month later, representatives from the central bank, the banking, foreign exchange, and securities regulatory authorities accused Ant Financial of unsound corporate governance mechanisms, scant awareness of the law, defiance of regulatory compliance requirements, regulatory arbitrage, infringement of customer rights, and abuse of its dominant market position to exclude peer operators, among other things. Alibaba, Ant's parent company, was fined a record RMB 18.2 billion (USD 2.8 billion) for anti-competitive behavior in April 2021 (Walsh, 2021).

In response, Ant Group applied to obtain a license as a financial holding company, which entails holding RMB 200 billion (USD 31 billion) in registered capital and more extensive scrutiny by central bank supervisors. Ant Group is also required to cut links between Alipay and its consumer lending businesses, improve its data governance, and apply for an additional license as a personal credit reporting company (Munroe 2021).

4 Data

4.1 Digital Financial Inclusion Index

To assess FinTech penetration and adoption, we use a dataset launched by the Institute of Digital Finance of Peking University. The dataset offers multiple indexes on aggregate and disaggregate level. The final aggregated indicator is the Digital Finance Inclusion Index, which is constructed by three main characteristics: coverage breadth, usage depth, and digitalization level. Additional sub-sector indexes such as usage depth distinguish FinTech penetration by product category (payments, insurance, purchase of monetary funds, investment, credit, credit investigation)[8]. We use annual data of 31 provinces of China[9] for the years 2011 to 2018.

Figure 3 illustrates the dataset. The index consists of three main dimensions which further consist of several indicators, respectively[10], as presented in Hasan, Kwak and Li (2020) and shown in the Appendix. In the following we discuss the content of each dimension and key indicators. A more detailed and methodological description of the index construction can be found in Guo et al. (2019).

Figure 3: The Index System of the Peking University Digital Finance Inclusion Index
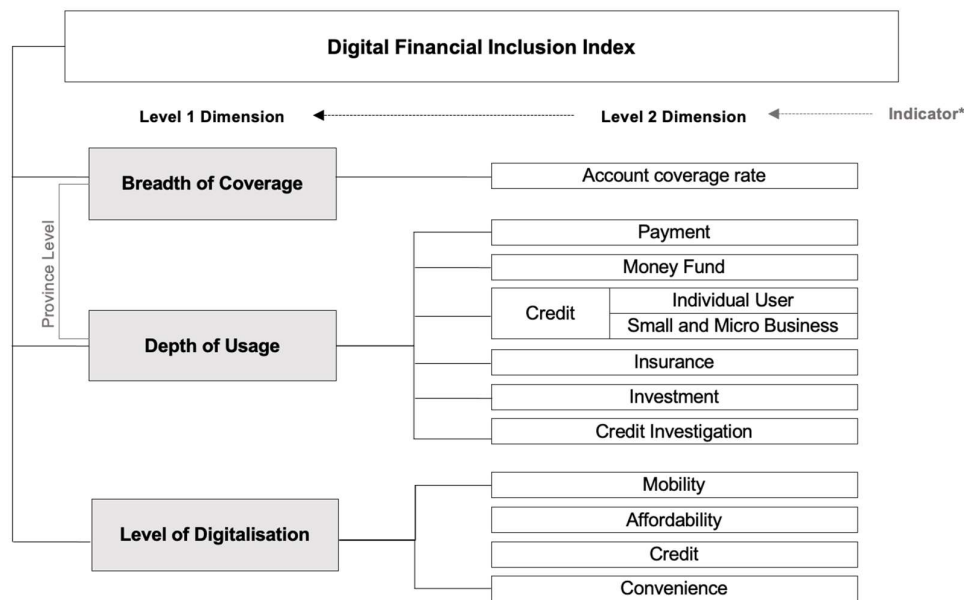
Source: Guo et al. (2019)

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[8] For our study, we exclude data on purchases of monetary funds, investment and credit investigation since the dataset for these subcategories is available after 2014 only.

[9] The 31 entities include 22 provinces (Anhui, Fujian, Gansu, Guangdong, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Qinghai, Shaanxi, Shandong,Shanxi, Sichuan, Yunnan, and Zhejiang), 5 autonomous regions (Guangxi, Inner Mongolia, Ningxia, Tibet and Xinjiang), and 4 municipalities (Beijing, Chongqing, Shanghai, and Tianjin). Data on Hong Kong, Macau and Taiwan are not available.

[10] The full dataset consists of 33 specific indicators (see Appendix).

Coverage breadth. To measure the degree of accessibility of traditional financial institutions, indicators such as "number of branches" or "number of service personnel" are used. Contrary to financial institutions, digital finance cannot be captured by location. Hence, to reflect the reach of digital finance services, an account coverage rate is built by aggregating indicators such as the number of e-accounts owned or bank accounts customers are bound to. Table 1 in the Appendix states in detail which indicators are included in our data.

Usage depth. Owning Internet payment accounts does not imply actually using them. Hence, the depth of usage index captures the actual use of digital financial services. Specifically, digital finance services are classified into six products offered by Alipay: payment, money funds, credit, insurance, investment, and credit investigation. Each classification group contains several indicators. For instance, payment includes information such as the number of payments made as well as the amount of payments made per capita. The credit service distinguishes between individual users as well as small and micro businesses[11].

Digitalization level. Key features of FinTech are convenience and costs. Compared to traditional financial services, digital finance is more convenient and less expensive for potential customers. Given Internet connection is available customers are offered financial access anywhere at any time. Hence, the level of digitalisation accounts for the facilitation of FinTech services which are categorized in four dimensions: mobility, affordability, credit and convenience. For instance, the latter captures the proportion of number of QR code payments by users.

Finally, all 33 indicators are consolidated to different levels. At the top is the aggregated "digital financial inclusion index" consisting of all 33 indicators. A level further down are the three dimensions: coverage breadth, usage depth and digitalization level. To ease comparison between the different regions and years, each index is given an efficacy score between 0 and 100 starting in 2011 as the benchmark year. The higher the score, the higher the level of FinTech development. Scores after 2011 may be less than 0 or higher than 100, which reflect a worsening or improvement in the indicator value compared to 2011. An increase in the score the following year indicates growth, while a decrease in score indicates a drop in the indicator.

The FinTech index displays a strong time trend in the sampled period, reflecting the momentum of FinTech development in China. To mitigate the concern of nonstationary, we follow Guo and al (2019) and divide the raw index by the national average in each period. By doing so, we construct a relative FinTech adoption indicator, showing the state of FinTech adoption in each province, relative to the national average on a given year.

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[11] The data is only available on the aggregate level. We are not able to use the disaggregated indicators (e.g., distinguishing between "individual user" and "small and medium business") in our regression analysis.

4.2 Additional Data Sources

Statistics for self-employment and employment at private firms are retrieved from the China statistical yearbook published yearly by the National Bureau of Statistics of China. The dataset provides the number of self-employed individuals at the provincial level, with a distinction between urban and rural areas. Again, to mitigate the problem of non-stationarity and to capture national trends that may be related to exogenous factors, we normalize the self-employment share series. We divide each data point by the national average for each period, at the aggregate, rural and urban level.

A potential concern is reverse causality between the penetration of FinTech services and entrepreneurship. We build on the literature and present our main hypotheses described below to address this concern. Another source of bias could stem from other variables that jointly influence FinTech penetration and self-employment. To address this concern, we include a set of controls. We use socio-demographic measures at the provincial level as control variables, as described in Table 1. The marketization index is from Fan et al. (2018); it is constructed by aggregating eighteen indicators covering the relationship between government and markets, the non-state-owned economy, the development of product markets, the development of factor markets (i.e., labor), and the development of market organizations. Since we have a complete set of data for the overall size of the population at the provincial level, but not for employed individuals only, we control for the working age population as a percentage of total population, which is the 2020 figure replicated for all years due to data limitations. To account for specificity at the provincial level, we include Province fixed effects in all models. To account for potential time trends in the control variables, we add time fixed effects.

Table 1. Control variables

Name	Description
GDP per capita	GDP per capita (log)
Working age population	Working age population as % of total population, year 2020
Higher education graduates	Higher education graduates per year as % of total population
GDP Growth	GDP real YoY growth
Marketization index	Index of marketization level of the province (NERI Index) (log)

Note: Data source is the National Bureau of Statistics of China.

5 The Impact of FinTech on Entrepreneurship

5.1 Conceptual Framework

To analyze how FinTech penetration is associated with entrepreneurship, we first develop a set of six hypotheses based on relevant literature covering digital finance in general and China's digital financial system in particular.

Hypothesis 1: *The digital finance infrastructure created by FinTech firms allows entrepreneurs to draw from a wider network of formal and informal contacts to address unmet financing needs.*

For the case of Kenya, Jack et al. (2013) show that households use digital payments (mobile money) to weave networks of diffuse reciprocity with family and friends. Such interpersonal remittances can be thought of as zero-interest loans with contingent repayment terms, a quintessential informal financial service for many entrepreneurs, especially in developing countries. In a follow-up study, Jack & Suri (2014) show that mobile money allows families to draw from a wider and more diverse network of contacts than they would otherwise. This safety net allows individuals to move away from smallholder farming and adopt occupational strategies with higher risks and returns, such as opening a business (Jack & Suri, 2016). The more people adopt mobile money, the wider and denser this network becomes. Thus, we expect the penetration rate (breadth) of a retail digital payment network to have a positive influence on self-employment and entrepreneurship.

Hypothesis 2*: The integration of diverse financial services in one digital platform facilitates business creation.*

One of the chief distinguishing features of FinTech is the integration of complementary financial services using a customer's digital data trail. Unlike traditional financial services providers, FinTech firms can leverage what the BIS (2019) calls the DNA (data, network, activities) feedback loop: business clients create a continuously growing record of transaction data with their suppliers and end customers, along with reputational data such as reviews and claims ratio, at zero marginal cost. FinTech firms can also exploit network externalities, where the digital platform becomes more attractive with every additional user. Finally, FinTech firms can sell interwoven activities, such as supply chain management and logistics services along with a wide spectrum of financial services ranging from payments to insurance (BIS, 2019). A more encompassing use of services in turn generates richer data for the FinTech firm, and so on. All of the above can be beneficial for would-be and early stage entrepreneurs. Thus, we expect entrepreneurs to thrive the more services offered by the digital platform are being used (depth).

Hypothesis 3*: FinTech firms facilitate digital retail payments (both online and offline using QR codes) that benefit entrepreneurs.*

Prospective and early-stage entrepreneurs in developing countries often struggle with payments. How can small firms ensure that they get paid reliably and on time by clients, especially those that are far away? Setting up a merchant account at a traditional bank and obtaining a point of service terminal to process debit and credit cards can be clumsy and costly. Cash payments in turn can be unreliable or impossible beyond a narrow geographic range. Here, digital retail payments can make a difference. They allow entrepreneurs to sell their products and services to a much wider range of prospective clients and get paid reliably. Ding et al (2018) document Ant Group's efforts to financially include small vendors by providing them with QR codes they can simply print for customers to scan with their cell phone. Smallholder farmers for example can use this method to sell their produce and create a data trail that then informs their credit assessment. Beck et al (2022) study 475'000 small firms in China that use QR codes for payments in return for goods purchased both online and offline. The authors find that such firms have better access to digital credit, benefit from improved processing of payments, and record a faster recovery of transactions after the economic shock caused by Covid-19 lockdowns. Along the lines of these findings, we expect the use of digital retail payments to benefit entrepreneurship, especially in rural areas.

Hypothesis 4*: FinTech firms offer risk management services (insurance) that enables individuals to start, run, and scale a business.*

Starting and running a business is a risky endeavor. When unforeseen events such as a weather shock or illness happen, entrepreneurs may have to close down and lose their investment. They may struggle to repay credit (formal or informal) and may lose their savings. The prospects of having to do so might dissuade prospective entrepreneurs from trying to open a business. Insurance can help entrepreneurs manage such risks better, but traditional services may be too expensive or not well suited for the needs of the financially underserved, especially in developing economies (Raithatha & Priebe 2020, Benami & Carter 2021). There is little research available to date on how formal insurance can spur business creation in emerging markets. But FinTech firms deliver a range of insurance products such as health, life, and agricultural insurance that can, in principle, offer risk management services that match the needs of prospective and current small business owners. We thus expect entrepreneurs to thrive the more insurance products by FinTech firms are used.

Hypothesis 5*: BigTech firms offer non-collateralized credit based on data that allows entrepreneurs to obtain financing to start a business.*

Unlike traditional finance, which focuses on traditional information such as financial statements, digital finance tends to use a wide spectrum of information ranging from behavioral to cash flow data to build

credit assessment models for small firms (Duarte et al, 2012). Gopal and Schnabl (2020) show that FinTech lenders play a crucial role during the recovery from the global financial crisis in 2008 by providing financial access to small businesses. Erel and Lieberson (2019) show that customers in areas with fewer bank branches tend to borrow from FinTech loans, with a focus on the US. Indeed, the impact of FinTech to date is largely studied through credit data (e.g., Balyuk et al., 2020; Cheng and Qu, 2020; Fuster et al., 2019).

Machine learning models are, in principle, able to identify patterns in the data that standard econometric models fail to capture (Bazarbash, 2019). In fact, several empirical studies suggest that credit risk assessment models of FinTech firms outperform traditional ones (Frost et al. 2019, Jagtiani & Lemieux, 2018a, Berg et al., 2020). With credit assessment at low cost and more accurate risk pricing, FinTech lenders can offer credit to firms (especially upstarts) that would not have access otherwise (Jagtiani & Lemieux 2018b). A review of impact studies conducted in eight developing countries shows a robust demand for digital credit (Robinson et al., 2021). And a 2016 survey of businesses operating on MercadoLibre, a Latin American digital platform, revealed that 70% of merchants were interested in obtaining credit whereas only 25% had access to bank loans (Frost et al., 2019).

In China, SMEs have long struggled to obtain loans from banks. Only half of SME loans are collateralized because small business owners often lack the required documentation and work far away from bank branches (Gambacorta et al., 2020). FinTech firms are able to perform better predictions of loan defaults, even after unanticipated regulatory shocks and covid-19 (Huang et al., 2020, Gambacorta et al., 2019, 2020). Using credit data from the same source, Hau et al. (2021) show that digital credit spurs entrepreneurial growth of small e-commerce firms. We thus expect digital credit to be a predictor of entrepreneurship.

Hypothesis 6*: FinTech firms digitalise financial management, making it more convenient for small firms.*

FinTech firms make financial flows digitally readable. This function makes life easier for entrepreneurs in a variety of ways. Their clients can pay either online or offline using a QR code, FinTech firms can analyze the resulting cash flows, and they can offer related products or credit at more affordable rates than traditional providers. Thus, we expect entrepreneurship to grow with increasing digitalisation of financial flows. The Digital Finance Inclusion Index includes one sub-index (*level of digitalization*) that seeks to cover this phenomenon. It aggregates a number of indicators, such as the share of mobile and QR payments among users, frequency of small loan use, and the average loan interest rate.

5.2 Empirical Analysis

In this section, we exploit the panel structure of our data and examine the effects of FinTech penetration through a panel regression analysis. In particular, we analyze the impact of digital finance on the share of self-employed people in the total population for the rural and urban areas respectively. The detailed data on different FinTech characteristics and services allow us to assess whether these affect entrepreneurship.

Specifically, the baseline panel regression model is as follows:

$$Y_{sit} = \beta_0 + \beta_1 DigitalFinanceIndex_{di(t-1)} + \beta_2 X_{i(t-1)} + \beta_3 Z_{si(t-1)} + FE + \varepsilon_{sit} \ ,$$

where Y is the share of self-employment or private employment in the total population. The subscript s denotes the type of region (aggregate, urban or rural), i represents the province, and t represents the year. Lastly, d in $DigitalFinanceIndex$ represents the type of variable tested. The set is composed of the aggregated index, the coverage breadth and usage depth of digital payments, the penetration index of digital payment, insurance, and credit services, as well as the digitalization level for each province at time t. The X vector includes control variables for the provinces, Z is the vector for control variables that depend on the s factor (urban or rural). Finally, FE are the fixed effects for provinces.

As a first step, we estimate the overall impact of digital finance measured with the aggregate index variable on the share of self-employment in the total population. Further, we regress the dependent variable on the set of digital finance components (coverage breadth and usage depth) as well as product-specific (payment, insurance, credit).

The baseline results presented in Table 2 indicate that, at the aggregate level, the digitalization of financial services positively impacts the share of self-employed individuals in the total population. Going further, results indicate that the coverage breadth of digital financial services is significant, suggesting that the ecosystem allows entrepreneurs to draw from a wider network of formal and informal contacts (*Hypothesis 1*). We also find that the depth of usage is significant. This results suggests that the integration of diverse financial services in one digital platform facilitates business creation (*Hypothesis 2*). Lastly, risk services, captured in insurance (*Hypothesis 4*), are significant.

Table 2 Dependent variable: Self-employed (as a share of population, normalized)

	(1)	(2)	(3)	(4)	(5)	(6)
Index aggregate norm.	0.17** (0.08)					
Coverage breadth norm.		0.09* (0.05)				
Usage depth norm.			0.14* (0.08)			
Payment norm.				0.11 (0.07)		
Insurance norm.					0.15*** (0.06)	
Credit norm.						0.03 (0.07)
Province Fixed Effect	YES	YES	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES	YES	YES
Adjusted R²	0.85	0.85	0.85	0.84	0.85	0.84

*** signifies statistically significant at the 1% level of significance; ** at the 5% level of significance; * at the 10% level of significance. Standard errors are in parentheses.

Note: The sample period covers 2010 – 2018. The normalized index is the ratio of the raw index on the national average for each period.

In the second step, we look at the differentiated impact on rural and urban areas separately. Since we have population data for rural and urban areas at the province level, we can construct the share of self-employed individuals in the rural and urban areas in the total rural and urban population, respectively.

Table 3 and 4 present the two sets of results. The aggregated index for digitalisation of financial services has a positive and significant impact on the share of self-employed in the rural areas but is non-significant in the urban areas (see column (1), respectively). In rural areas, results show that the breadth of coverage (*Hypothesis 1*) has a positive and significant impact on the share of self-employment. In urban areas, although the aggregated index is found to be non-significant, insurance services are found to have a significant and positive effect (*Hypothesis 4*). We argue that individuals in rural areas depend more on the density of the network (coverage breadth) to create new business hubs, as the density of population is potentially lower and can create isolation.

Table 3 Dependent variable: Self-employed in rural area (as a share of rural population, normalized)

	(1)	(2)	(3)	(4)	(5)	(6)
Index aggregate norm.	0.33* (0.19)					
Coverage breadth norm.		0.20* (0.11)				
Usage depth norm.			-0.09 (0.20)			
Payment norm.				-0.06 (0.16)		
Insurance norm.					0.22 (0.13)	
Credit norm.						-0.25 (0.16)
Province Fixed Effect	YES	YES	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES	YES	YES
Adjusted R²	0.79	0.79	0.79	0.79	0.79	0.79

*** signifies statistically significant at the 1% level of significance; ** at the 5% level of significance; * at the 10% level of significance. Standard errors are in parentheses.

Note: The sample period covers 2010 – 2018. The normalized index is the ratio of the raw index on the national average for each period.

Table 4 Dependent variable: Self-employed in urban area (as a share of urban population, normalized)

	(1)	(2)	(3)	(4)	(5)	(6)
Index aggregate norm.	0.02					
	(0.10)					
Coverage breadth norm.		0.02				
		(0.06)				
Usage depth norm.			0.14			
			(0.10)			
Payment norm.				0.09		
				(0.08)		
Insurance norm.					0.15**	
					(0.07)	
Credit norm.						0.07
						(0.08)
Province Fixed Effect	YES	YES	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES	YES	YES
Adjusted R²	0.91	0.91	0.91	0.91	0.91	0.91

*** signifies statistically significant at the 1% level of significance; ** at the 5% level of significance; * at the 10% level of significance. Standard errors are in parentheses.

Note: The sample period covers 2010 – 2018. The normalized index is the ratio of the raw index on the national average for each period.

The NBS publishes data for total employment in urban areas only. We show that the digitalisation of financial services has a non-significant impact on total urban employment as a share of total urban population (Table 5). That is, at least in urban areas, there are no composition effects that would explain the positive impact on the share of self-employed individuals in the total population.

Table 5 Dependent variable: Total urban employment (as a share of total urban population, normalized)

	(1)	(2)	(3)	(4)	(5)	(6)
Index aggregate norm.	-0.06 (0.06)					
Coverage breadth norm.		-0.02 (0.03)				
Usage depth norm.			-0.03 (0.06)			
Payment norm.				0.06 (0.05)		
Insurance norm.					0.03 (0.04)	
Credit norm.						-0.03 (0.04)
Province Fixed Effect	YES	YES	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES	YES	YES
Adjusted R²	0.89	0.89	0.89	0.89	0.89	0.89

*** signifies statistically significant at the 1% level of significance; ** at the 5% level of significance; * at the 10% level of significance. Standard errors are in parentheses.

Note: The sample period covers 2010 – 2018. The normalized index is the ratio of the raw index on the national average for each period.

Lastly, we measure the relation of the relative FinTech index to the share of employed people in private firms. Results presented in Table 6 show that the positive impact of FinTech on the share of self-employment in the total population is not at the expense of the share of private employment in the country. Rather, some components of FinTech services (payment, insurance), have a positive relation to the share of private employment in the total population.

Table 6 Dependent variable: Employment in private firms (as a share of total population, normalized)

	(1)	(2)	(3)	(4)	(5)	(6)
Index aggregate norm.	-0.03 (0.13)					
Coverage breadth norm.		0.00 (0.07)				
Usage depth norm.			0.09 (0.13)			
Payment norm.				0.18* (0.10)		
Insurance norm.					0.18** (0.09)	
Credit norm.						-0.08 (0.11)
Province Fixed Effect	YES	YES	YES	YES	YES	YES
Time Fixed Effects	YES	YES	YES	YES	YES	YES
Adjusted R²	0.96	0.96	0.96	0.96	0.96	0.96

*** signifies statistically significant at the 1% level of significance; ** at the 5% level of significance; * at the 10% level of significance. Standard errors are in parentheses.

Note: The sample period covers 2010 – 2018. The normalized index is the ratio of the raw index on the national average for each period.

As a robustness check, we run the model without any control variables. Results are similar (table 7). Note that we don't need to add time fixed effects in this specification, as both self-employment as a share of population as well as the FinTech indexes are normalized through time.

Table 7 Dependent variable: Self-employed (as a share of population, normalized), no control

	(1)	(2)	(3)	(4)	(5)	(6)
Index aggregate norm.	0.12* (0.08)					
Coverage breadth norm.		0.07* (0.04)				
Usage depth norm.			0.14** (0.07)			
Payment norm.				0.10* (0.06)		
Insurance norm.					0.17*** (0.05)	
Credit norm.						0.06 (0.06)
Province Fixed Effect	YES	YES	YES	YES	YES	YES
Adjusted R²	0.84	0.84	0.84	0.84	0.85	0.84

*** signifies statistically significant at the 1% level of significance; ** at the 5% level of significance; * at the 10% level of significance. Standard errors are in parentheses.

Note: The sample period covers 2010 – 2018. The normalized index is the ratio of the raw index on the national average for each period.

6 Conclusion

Existing literature documents how digital finance is spurring financial inclusion. In this paper we ask if digital finance promotes self-employment. Exploiting a unique dataset that is built on Ant Group, one of China's leading FinTech firms, we show that digital finance supports an increase in the share of self-employment in the country. The unique dataset allows us to separately identify the impact of FinTech development level and digital services.

Digital finance makes finance convenient and affordable and hence, more likely for entrepreneurs to process financial flows easily and sell their products. FinTech coverage contributes to higher self-employment and business creation, especially in the rural areas. We argue that the digital finance infrastructure created by FinTech firms allows entrepreneurs to draw from a wider network of formal and informal contacts to address unmet financing needs, which are greater in rural areas. We also show that risk management services (insurance) support entrepreneurship in urban areas. Our findings hence contribute to a better understanding of FinTech firms and their impact on the economy. They offer a complementary explanation to the growing literature on FinTech (Goldstein et al., 2019) on FinTech being complementary to traditional banking services.

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Appendix

Table 1. Indicators compiled in the FinTech adoption index.

Aggregate Usage	Payment	Number of payments per user
		Amount of payments per user
		Share of frequent user (have 50+ activities per year) in total user
	Insurance	Number of users with insurance policies purchased in Alipay per 10.000 users
		Number of insurance policies purchased in Alipay per user
		Amount of insurance policies purchased in Alipay per user
	Loan	Number of users that have consumption loans in Alipay per ten thousand users
		Number of consumption loans per user
		Amount of consumption loans per user
		Number of users that have SME business loans in Alipay per ten thousand users
		Number of SME business loans per SME owner
		Amount of SME business loans per SME owner
	Money Market Fund	Number of purchase transaction of Yu'e Bao per user
		Amount of shares purchased of Yu'e Bao per user
		Number of users that have purchased Yu'e Bao per ten thousand users
	Investment	Number of online investment per user
		Amount of online investment per user
		Number of users that have invested online per ten thousand users
	Credit Evaluation	Number of calls for credit evaluation per user
		Number of users that have used credit score-based services per ten thousand users

Source: Guo et al. (2019)

Table 2: Descriptive Statistics

Variable	Mean	St. Dev.	Min	Max
Index aggregate, normalized	1.0	0.2	0.4	2.0
Coverage breadth, normalized	1.0	0.3	0.1	2.9
Usage depth, normalized	1.0	0.2	0.1	2.0
Payment, normalized	1.0	0.3	0.0	2.1
Insurance, normalized	1.0	0.2	0.0	2.1
Credit, normalized	1.0	0.3	0.0	2.0
GDP per capita (log)	10.7	0.0	9.7	11.9
Working age population, as share of population	72.1	3.3	66.6	78.8
Higher education graduates, as share of population	0.5	0.1	0.2	0.9
GDP growth	8.7	2.4	0.5	16.4
Marketization index	6.3	2.1	0.0	10.0
Share of self-employed in total population, normalized	1.0	0.3	0.2	2.1
Share of self-employed in rural population, normalized	1.0	0.7	0.1	4.0
Share of self-employed in urban population, normalized	1.0	0.5	0.1	3.6
Share of employees in private firms in the total population, normalized	1.0	1.0	4.7	0.1

Note: Sample period is from 2010 to 2018; Observations for each variable=248; Number of provinces=31.