General Patterns and Regional Disparity of Internet Finance Development in China:Evidence from the Peking University Internet Finance Development Index

Feng Guo, Sherry Tao Kong, and Jingyi Wang [1]

2016 年 7 月 27 日

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Key words: Internet Finance, Development Index, Financial Development, Local Finance

JEL: G29, O16, R51

1. Introduction

Although the increasing provision of financial services digitally through the Internet has been a global phenomenon, it has particularly thrived in China. The term for the Chinese version, Internet finance (IF)—*hulianwang jinrong* in Chinese—was first coined by the former Vice President of the China Investment Corporation, Ping Xie, in 2012. Xie argued that modern information technology, particularly Internet-enabled technology, such as mobile transactions, cloud computing, social networks, and search engines, would lead to fundamental changes in the ways in which finance is shaped (Xie 2012). As a result, Xie and his colleagues expect a new mode of financing to emerge in the near future, which is radically different from interbank financing or financing directly from the capital market.[2] In contrast to digital finance or Fintech, which generally focuses on the development of traditional financial institutions that expand their services through the availability of the Internet, IF in China primarily refers to financial services provided by Internet-based enterprises that are nonfinancial institutions.

The making of IF in China was inspired by the development of Fintech and digital finance in the West. PayPal, one of the forerunners of digital payment resolution, was founded in 1998. It also set up a money market fund that allowed its customers to earn interest, a model emulated by subsequent cash management products. The world's first peer-to-peer (P2P) lending platform, Zopa.com, appeared in the United Kingdom in 2005, and Lending Club in 2006 in the United States. Similarly, crowdfunding, e-banking and virtually all other major types of business practices in the field of IF can trace their origins back to developments in the United States or Europe before taking root in China.

Nevertheless, it is in China where IF has evolved into a formidable economic force in its own right. By the end of 2015, Alipay and WeChat Pay, China's two largest third-party payment service providers, had more than 270 million and 200 million active users, respectively. In the same year, CreditEase, probably the largest P2P platform worldwide, listed its Yirendai[3] on the New York Stock Exchange. According to information published by Ant Financial Services Group, it issued a sum of 600 billion yuan (US$94 billion) worth of loans to small and medium size enterprises between 2011 and 2015, a far greater value than that of the small loans issued by all the other IF companies combined for the same period. In addition to the staggering volumes of users and capital involved, the IF services available in China are varied in type: from Internet payments, P2P lending, and Internet fund sales, to crowdfunding, Internet insurance, e-banks, and e-money. There is little doubt that China is standing at the global forefront of IF.

Moreover, the most remarkable feature of China's IF industry is its pace of development since its genesis in 2013.[4] The performance of Yu'E Bao, the money market product of the Alibaba Group, is indicative of the growth of IF in China. As a direct result of Yu'E Bao's takeoff, Tianhong Fund, the company that manages Yu'E Bao, expanded its fund base to more

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[2] See Xie et al. (2015) for a more detailed discussion.

[3] Yirendai Ltd. is the consumer finance arm of Chinese P2P lender CreditEase. Information based on CrunchBase, webpage available from https://www.crunchbase.com/organization/yirendai#/entity.

[4] Although the launch of Alipay in 2004 and the establishment of CreditEase in 2005 took place approximately 10 years ago, the start of China's IF era is widely believed to be when Yu'E Bao, the money market product of the Alibaba Group, came online in June 2013.

than 500 billion yuan, transforming from a small, unknown company to the largest of its kind in China over the course of 12 months. This expansion demonstrates the explosive power of IF. As a point of reference, it took China Asset Management Co., Ltd. (China AMC), the largest fund in the country before the emergence of Yu'E Bao, 16 years to develop to a comparable scale.

However, accompanying this rapid development, the IF industry has exposed risks in several areas, caused partly by insufficient supervision and regulation, and partly by the lack of risk awareness of investors. A sizeable number of financial activities, once strictly prohibited by the authorities, came back to life under the guise of IF, and have been subject to limited scrutiny. This has resulted in several individuals and organizations using illegal means to assemble funds in the name of IF, which constitutes financial fraud. A recent high-profile example is E-zubao, a P2P lending company that essentially operated as a Ponzi scheme on its Internet platform. By the end of 2015, when the scheme was closed down and the key personnel involved were arrested, E-zubao had attracted about 74.5 billion yuan (US$11.4 billion) in funds from more than 900,000 investors.[5]

The extraordinary speed of growth and many cases of IF fraud have attracted attention and raised concerns within the Chinese government. It is useful to recount the attitude of the regulators, which, to a significant extent, shaped the ongoing development of IF in China. As early as 2011, the China Banking Regulatory Commission (CBRC) believed P2P lending posed major potential risks, and therefore prohibited all banking institutions under its supervision from participating in P2P lending activities. Because of similar concerns related to the IF industry as a whole, an interdepartmental research group was established by the Chinese government in late 2013, headed by the People's Bank of China (PBC), to conduct a nationwide survey of IF. The findings of this study are expected to inform policy makers as they formulate appropriate regulatory measures. However, not long after the research was commissioned, the new administration under Premier Li Keqiang publicly expressed a significantly more positive attitude toward IF. In March 2014, Premier Li Keqiang made his first official statement about the development of IF in the Report on the Work of the Government, saying: "*We will promote the healthy development of Internet finance.*" In response, senior officials of various ministries made many comments expressing their endorsement and enthusiasm for China to become a global leader in the IF industry.

Although the Premier has embraced the development of IF, until recently the status of IF in the formal financial system had not been clarified. In July 2015, two years after the commencement of the survey led by PBC, 10 ministries and commissions officially released guidelines for the regulation of IF, entitled *Guiding Opinions on Promoting the Healthy Development of Internet Finance* (PBC 2015). According to these guidelines, various IF services were to be regulated by different regulatory authorities. For example, P2P lending would be under the supervision of the CBRC, crowdfunding would be overseen by the China Securities Regulatory Commission, and third-party payments would be regulated by the PBC. More recently, there have been subtle changes in the attitude of the government subsequent to the exposure of several IF fraud cases. Since 2015, the official statement has been revised from *promoting* to *regulating* IF development. In March 2016, The National Internet Finance

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[5] According to the Supreme People's Procuratorate of the People's Republic of China. Webpage available from http://finance.youth.cn/finance_jsxw/201604/t20160427_7919382.htm.

Association of China, a government-backed association, was established by the PBC and several other departments to strengthen the industry's capacity for self-regulation, and a campaign against illegal activities was carried out systemically nationwide. Although opportunities abound, the development of IF in China seems to be confronted with serious regulatory uncertainties.

In addition to the business world and the government, academics have shown enormous interest in the burgeoning IF industry, particularly since 2013. According to the China National Knowledge Infrastructure (cnki.net), the largest online source of academic information in China, there were only approximately 100 papers by Chinese scholars with the theme "Internet finance" by July 2013. By the end of 2014, however, the number had soared to more than 8,200, and subsequently skyrocketed to 17,900 by March 2016. Most scholars agree that, similar to IF development abroad, the main driver of IF growth in China is the reduced cost of financial transactions using the Internet, resulting in enhanced accessibility of financial services.

However, for an explanation of the rapid expansion of Chinese IF, there has not been a unanimous answer. Several studies have attributed the success of IF in China to the development of communications technology and e-commerce (Li 2015; Wu 2015). In contrast, many believe that financial services have been severely undersupplied in China, and that IF has met a societal demand by way of filling the "void." In addition to the financial repression argument, some perceive IF as merely a product of regulatory arbitrage (Zheng 2014; Li 2015; Zhu and Guo 2014; Wang and Zhang 2015).[6]

Although previous studies may be informative, they have been based primarily on case studies or restricted to localized information. To the best of our knowledge, no study has been able to provide a comprehensive picture of this new industry. This is probably because of the lack of firsthand data, as most IF activities have not been integrated into China's official statistical system. This paper sets out to address this gap by utilizing data from Ant Financial Services Group, the largest IF enterprise in the world, in conjunction with a large amount of data from several other key players in the industry.

By way of constructing an IF development index, we intend to offer the first comprehensive description of China's IF industry in an accurate and timely fashion. In addition to the overall IF development index, we also categorize IF businesses (Internet payment, Internet investment, and so forth), and provide indices by these business categories as well as by user characteristics (gender and age) and region (province and prefecture-level city). Based on information that captures the width and depth of the business, we calculate the IF development index of each category. The overall IF development index and indices by business categories are also computed by region and by characteristics to enable regional comparisons and additional factor analysis.

The rest of the paper is organized as follows. The next section introduces the methodology of the index. Section 3 describes the trends in the overall IF development index, followed by a discussion of the patterns of regional IF development and the likely underlying factors that shape regional variation in IF development. Section 4 concludes the paper.

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[6] Dong and Li (2015) provide a comprehensive review of the earlier literature on this topic.

2. Methodology

Structure of the IF Development Index

Fundamentally, the core element of IF is finance. IF supplements and complements the traditional financial sector. By employing Internet technology, IF expands the business of existing financial institutions (banks, securities, insurance, and funds) and offers innovative solutions. For clarity of understanding, we classify the business operations of IF into six categories: Internet payments, Internet money market funds, Internet lending, Internet insurance, Internet investment, and Internet credit investigation. Table 1 provides a brief description of the business categories and lists key players in the respective fields.

Table 1. Business Categories of Internet Finance

Business category	Description	Examples of key players
Payments	Online payments, money transfers	Alipay, Wechat pay
Investment	P2P lending, consumption finance	Yi Rendai, PPmoney
Money market funds	Low-risk online investment	Yu'E Bao
Lending	Unsecured credit for small companies and individuals	Webank, Mybank
Insurance	Online insurance sold by nontraditional insurance companies	Shipping insurance on Taobao.com
Credit investigation	Individual credit collection and evaluation.	Zhima Credit

We developed six indices corresponding to the business categories. The indices have four levels to capture the coverage and intensity of each business. The coverage indicator reflects the overall scope of development of each business, and the intensity represents the volume and frequency. Among the six business categories, with the exception of Internet credit investigation, the other five categories use the rate of transaction penetration in the previous month as the coverage indicator, and the average value and number of transactions per person in the previous month as the intensity indicator. In contrast, Internet credit investigation is somewhat unique. It involves no direct transactions and plays a role that resembles infrastructure. More specifically, it collects information that allows for a baseline assessment of creditworthiness for individuals, which facilitates other businesses and assists them in risk management and pricing. Given its distinctive features, we use the number of people who have made use of the individual credibility information during the past month as the coverage indicator, and the average number of times that this information was used in the last month to capture the intensity of the activity.

Explanations of the individual indicators are as follows:

- *Transaction penetration rate* is used to capture the coverage of a particular category of business. The rate is calculated by the total number of people who made transactions

over the past month divided by the relevant population at the time.

- *Average value of transactions per person* is used to reflect the intensity and quality of a particular category of business. It equals the total transaction value divided by the number of people who made transactions in the last month.

- *Average number of transactions per person* is also used to reflect the intensity and quality of a particular category of business. It equals the total number of transactions divided by the number of people who made transactions in the last month.

We calculate the values of the three indicators at the national and regional levels, and by individual characteristics. For example, the *transaction penetration rate* of a specific characteristic uses the total number of people who possess the specific characteristic and have made transactions over the past month divided by the number of people who share the characteristic. Accordingly, we produce national IF development indices that describe the overall trend of the IF industry as well as regional-level indices and indices by business category and individual characteristics, such as age and gender.

Data

The primary sources of data for producing the IF development indices are Ant Financial Services Group, the PBC, and several key players in the industry, including MiMe Finance, qufenqi.com, 01caijing.com, and Tongbanjie.com. While we acknowledge that the data to which we have access are not exhaustive, we believe they are able to provide a reasonable starting point to capture the current situation of the IF industry. Admittedly, the indices we produce will be somewhat biased because of data limitations. It is our intention to continue searching for complementary data and improve the calculation of the indices. The current methodology is designed to be flexible enough to allow for the inclusion of additional sources of data in the future. The adjustment method is able to accommodate new data while maintaining the continuity and stability of the index series.

To ensure consistency between data from the Ant Finance Group and other institutions, we prioritize the data sources that contain information that can be used to produce the three indicators. When such information is not available, we rely on data from the Ant Finance Group to conduct the necessary estimations.

Weighting Issues

The index consists of four levels. To produce an index that captures the overall development level of the industry as a whole, a weighting strategy was developed involving three steps. First, individual activities characterized by the three indictors need to be integrated into one; second, various data sources need to be merged; and third, there needs to be a system that combines the six business categories into one.

- *Weighting of the coverage and intensity indicators (w).* The weight of the transaction penetration rate is set at 50 percent. The weights of the average transaction value per person and the average number of transactions per person are set at 25 percent each.

- *Weighting of information from Ant Financial Services Group and other data sources*

(p). The weights of various data sources are proportional to the relative total transaction value of the IF enterprises. To reduce the influence of fluctuation in the data on the index, we use the three-month moving average value to generate the weights.

- *Weighting of the six business categories (m).* There is substantial variation in the level of development across the business categories. For example, Internet payments has a much longer history than Internet insurance. Accordingly, based on a consensus developed with the leader of the IF industry, Ant Financial Services Group, we assign weights to the six business categories as follows: Internet payments, 30 percent; Internet money market funds, 25 percent; Internet lending, 15 percent; Internet insurance, 15 percent; Internet investment, 10 percent; and Internet credit investigation, 5 percent.

In anticipation of the rapid progress of IF—and the consequent shifts in relative importance between the various business categories—we allow the weights of the six categories to be adjusted in the first calendar month of every year. To ensure the stability of the resultant indices and that changes in the indices only reflect the actual development of the businesses, we employ the so-called "divider adjustment method" in the adjustment process.

In the case that a new business category emerges in the future, we will include this new category from the second month of its emergence. To avoid introducing major turbulence to the indices, we will limit the weight of the new business category to a value of no greater than 10 percent. We will reweight the existing business categories (*m*) in accordance with their relative shares in the previous month.

Calculation of the Overall Index and Indices by Business Category

Given the weights assigned at the three levels, the calculations of the overall index and the indices by business category are the collection of the weighted averages of each level. We calculate the month-on-month indices first, and then apply chain rule multiplication to produce the indices relative to the base point. The mathematical representation of the calculation is as follows:

- Calculation of the month-on-month indices:

$$i_t = \frac{I_t}{I_{t-1}} = \sum_{i=1}^{6} W_i \frac{L_{i,t}}{L_{i,t-1}} = \sum_{i=1}^{6} W_i \left(\sum_{j=1}^{2} P_{i,j,t} \frac{K_{i,j,t}}{K_{i,j,t-1}} \right)$$

$$= \sum_{i=1}^{6} W_i \sum_{j=1}^{2} P_{i,j,t} \sum_{k=1}^{3} m_k \frac{X_{i,j,k,t}}{X_{i,j,k,t-1}}$$

where $\frac{I_t}{I_{t-1}}$ denote the month-on-month IF development indices for period *t*; $\frac{L_{i,t}}{L_{i,t-1}}$ denote the month-on-month IF development indices for business category *i* for period *t*; $\frac{K_{i,j,t}}{K_{i,j,t-1}}$ denote the month-on-month IF development indices for business category *i* for period

t based on data source j; $\dfrac{X_{i,j,k,t}}{X_{i,j,k,t-1}}$ denote the month-on-month IF development indices for business category i for period t based on data source j of coverage or intensity indicator j. W_i (i = 1, 2, 3, 4, 5, 6) are weights for the ith business category，$P_{i,j,t}$ denote the weight for the ith business category based on data source j for period t，m_j (j = 1, 2, 3）denote the weight of coverage or intensity indicator j.

- Calculation of the indices relative to the base point at various levels:

The relative base points for the indices at various levels are calculated by multiplying the month-on-month indices of period t with that of period t - 1 at the corresponding level.

$$I_t = \left(\sum_{i=1}^{6} W_i \frac{L_{i,t}}{L_{i,t-1}}\right) I_{t-1} = \left[\sum_{i=1}^{6} W_i \sum_{j=1}^{2} P_{i,j,t} \sum_{k=1}^{3} m_k \frac{X_{i,j,k,t}}{X_{i,j,k,t-1}}\right] I_{t-1}$$

where the index relative to the base point of period t - 1 is a result of multiplying the month-on-month indices of previous periods. January 2014 is set as the base month, and the base point is 100. The following formula is used to calculate indices relative to the base point for period t - 1.

$$I_{t-1} = 100 \times i_1 \times i_2 \times \ldots \times i_{t-1}$$
$$= 100 \times \frac{I_1}{I_0} \times \frac{I_2}{I_1} \times \frac{I_3}{I_2} \times \ldots \times \frac{I_{t-2}}{I_{t-3}} \times \frac{I_{t-1}}{I_{t-2}}$$

where i_1, i_2, … i_t denote the month-on-month indices of periods 1, 2, … t.

Calculation of Indices by Region

The regional indices offer a means for comparison across localities. The following procedure is used to ensure the comparability of the regional indices.

- To calculate the relative values of the coverage and intensity indicators by business category of a region to that of the nation:

$$A_{h,i,j,t} = \frac{X_{h,i,j,t}}{X_{i,j,t}}$$

where $x_{h,i,j,t}$ denotes the value of the indicator (transaction penetration, average transaction value, or average number of transactions per person) of business category i based on data source j for period t, region h, $x_{i,j,t}$ denotes the value of the indicator of business category i based on data source j for period t at the national level, and $A_{h,i,j,t}$ the relative value of the indicator of business category i based on data source j for period t, region h.

- To calculate the relative values of business category i for period t, region h:

$$B_{h,i,t} = \sum_{j=1}^{3} m_j A_{h,i,j,t}$$

where $B_{h,i,t}$ denotes the relative value of business category i for period t, region h to the national level. As explained in the weight strategy, the shares of the three indicators are set as follows: $m_1 = 50$ percent, $m_2 = 25$ percent, and $m_3 = 25$ percent.

- To calculate the overall index for period t, region h:

$$I_{h,t} = (\sum_{i=1}^{6} W_i B_{h,i,t}) I_t$$

where $I_{h,t}$ denotes the index relative to the base point for period t, region h; W_i denotes the weight of business category i; and I_t is the index relative to the base point for period t at the national level.

The calculation of the indices by individual characteristics follows the same principles. For succinctness, we omit the detailed calculation here.

3. Results

General Trends Revealed by the IF Development Indices

Finding 1: Rapid Growth of the IF Industry in China

Using the IF development index, we demonstrate (Figure 1) the rapid trend of growth at the national level. By December, 2015, relative to the base month, January 2014, the value of the index increased from 100 to 386, with an average monthly growth rate of 6 percent, which translates into a doubling in size per annum.
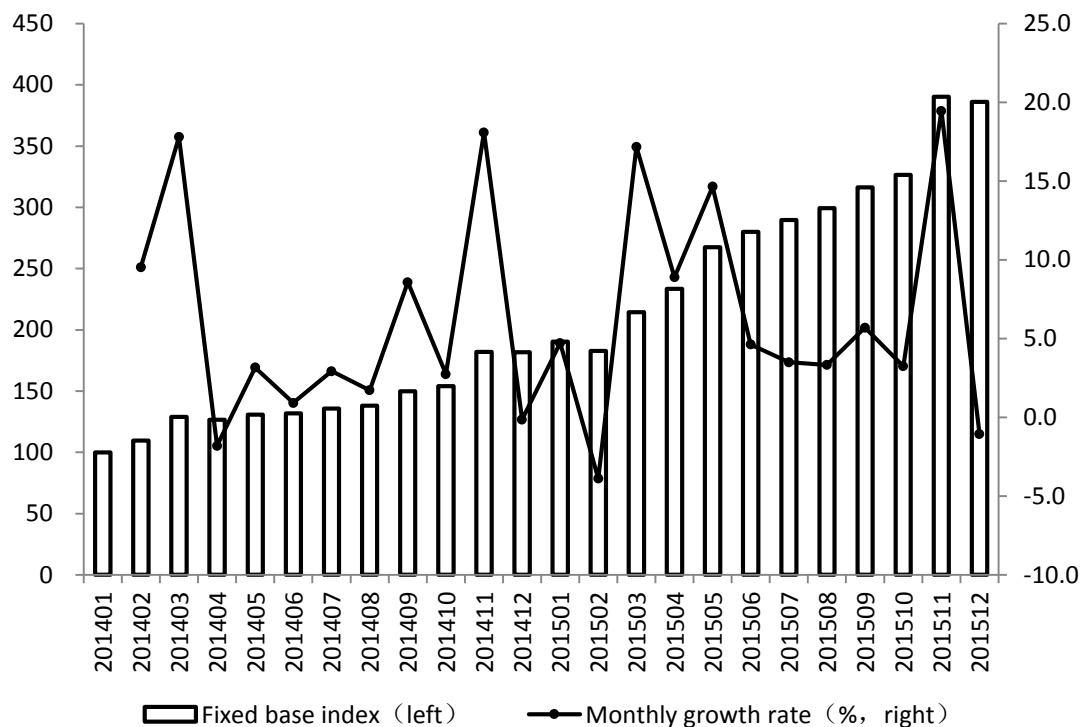
Figure 1. National-Level Internet Finance Development Index (Relative to Base Month and Month-on-Month Growth)

Source: Authors' calculations using the PKUIFDI.

Finding 2: Substantial Variation across Business Categories

As shown in Figure 2, the growth of Internet payments and Internet money market funds is relatively slow. By December 2015, the indices of these two business categories were 208.7 and 209.3, respectively. In contrast, during the same period, the index of Internet investment increased to 385.6, and that of Internet insurance reached as high as 441.5. However, we emphasize that the numerical values of the indices reflect the rate of growth per se without taking into account the relative level of development of various IF business categories. As the base value of all IF business category indices was set uniformly to 100 for January 2014, the indices merely capture the rate of growth over time of each business category, and it is not possible to make comparisons across business categories.

For example, Internet payments was already an established form of business several years before being captured by the index. Consequently, its rate of growth is not as remarkable as that of newly emerging businesses such as Internet insurance and Internet investment. Precisely based on the consideration of the variation in the level of development between IF business categories, when constructing the overall IF development index, we assign greater weight to the relatively well developed Internet payments business and less weight to the less developed Internet investment business.

In addition, the fluctuations in the IF businesses exhibit several Chinese-specific characteristics. There appears to be a decline or slowdown in the indices during the months of February and October. This is likely an outcome of the week-long holidays of the Chinese New Year and National Day celebrations. The surge in IF activity across business categories, particularly Internet insurance, probably reflects the effect of the large-scale promotion of

online shopping on November 11.[7]
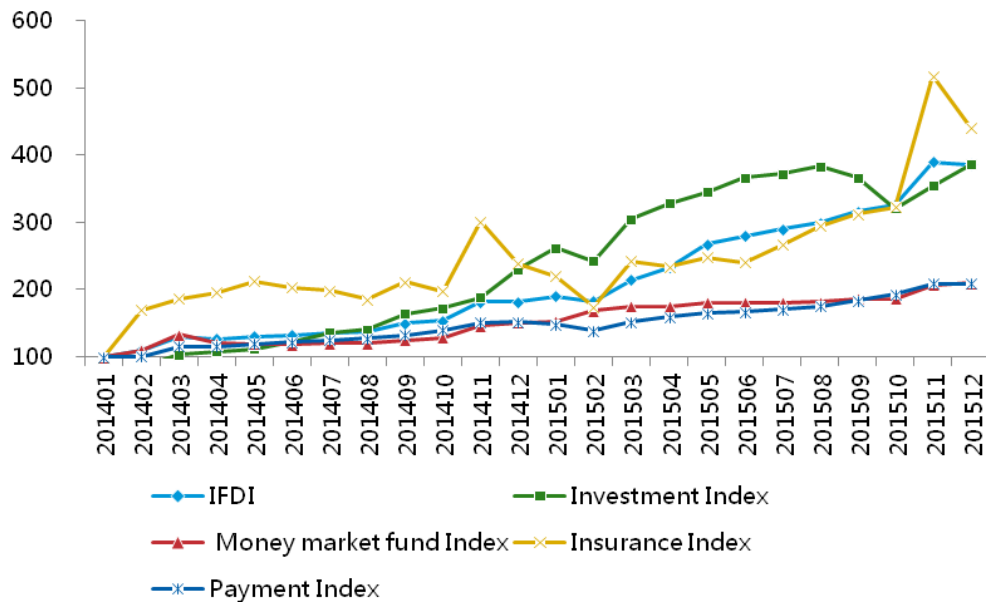
Figure 2. IF development indices by business categories
Source: Authors' calculations using the PKUIFDI.

*Finding 3: 1980s and 1990s Birth Cohorts: Main Drivers of IF Growth*

IF relies on individuals to utilize Internet technology, which in turn implies an age factor. Figures 3 and 4 show overall IF development and IF development by business category, respectively, across various demographic groups. In both cases, the 1980s and 1990s birth cohorts appear to be the main forces of growth for the IF industry. To a large extent, this probably reflects the relationship between IF development and the effects of the lifecycle, labor market participation, and income factors. In addition, Figure 4 demonstrates that between January 2014 and December 2015, the 1960s and 1990s birth cohorts exhibit the strongest growth momentum, indicating rapid penetration of IF into the younger and older subpopulations.

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[7] Several major online shopping platforms organize large-scale promotional activities on November 11 each year. It is the largest sales bonanza on the Internet in China. The one-day event generated 90 billion yuan in sales for taobao.com in 2015.
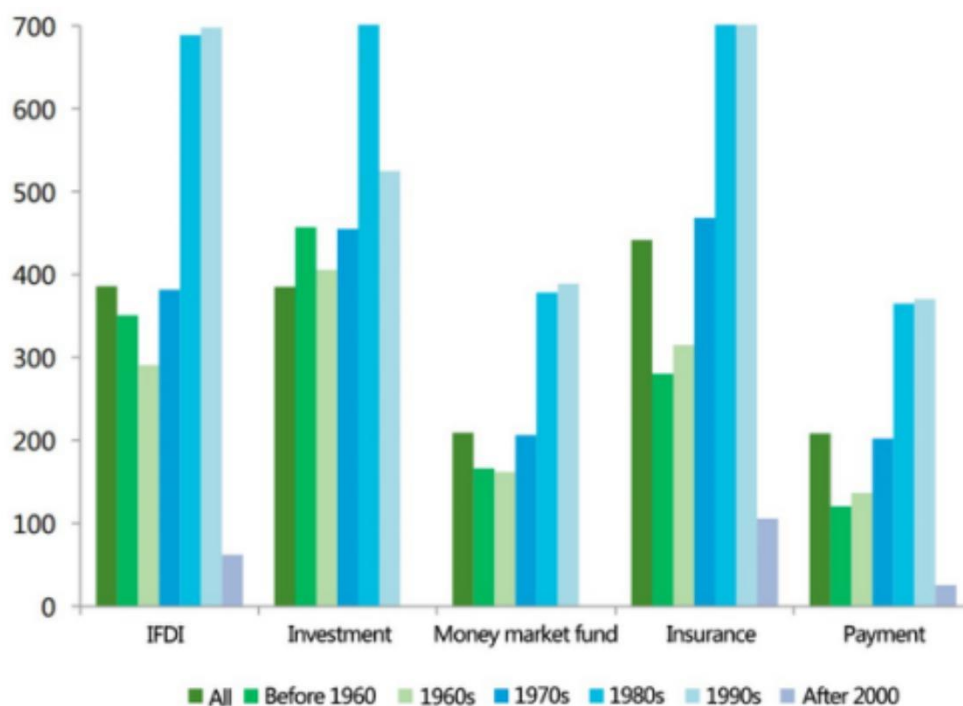
Figure 3. Internet Finance Development Indices by Business Category across Birth Cohorts, December 2015

Source: Authors' calculations using the PKUIFDI.
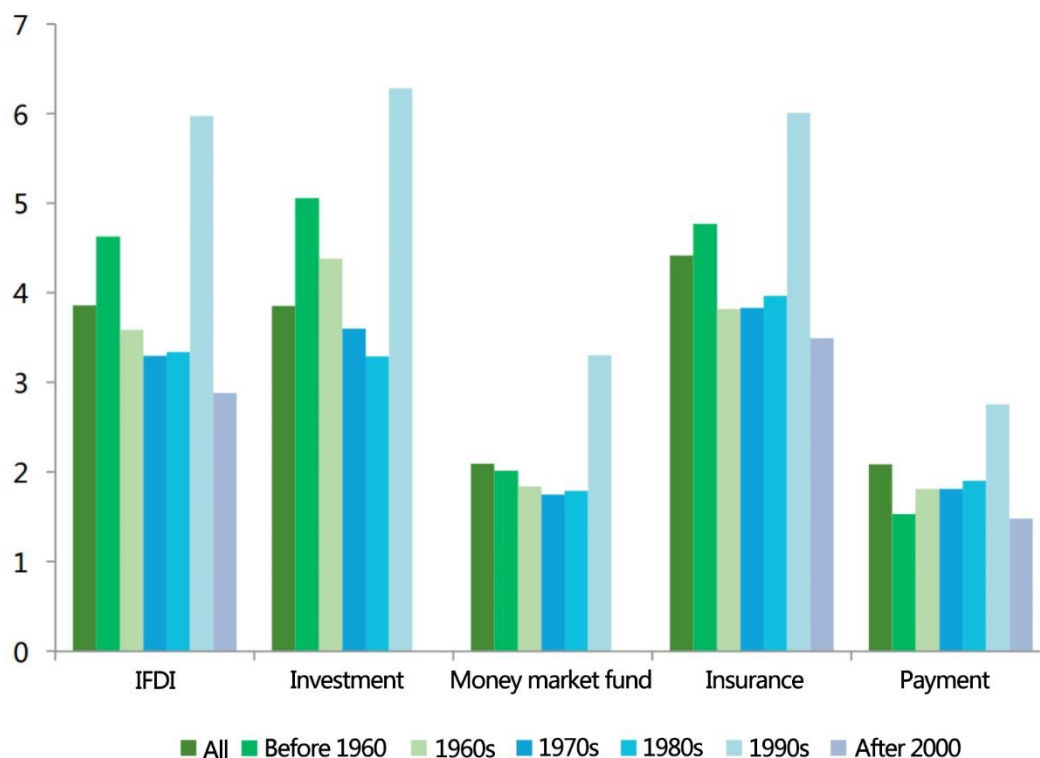
Figure 4. Internet Finance Development Indices by Business Category, December 2015 Relative to January 2014, across Birth Cohorts

Patterns and Factors Underlying Regional IF Development

Compared with the hinterland, coastal cities exhibit a higher level of IF development but a slower rate of growth.

To illustrate the relative levels of development of IF in China, Map 1 shows the regional IF development indices as of December 2015. The top 50 cities are in red; those ranked 51 to 100 are in orange; 101 to 200 are in yellow; and the rest are in green. Clearly, the higher-ranked cities are concentrated in the eastern coastal region, with a few of the top 50 cities located in the hinterland. Theoretically, IF is supposed to be free of geographical limitations, as it is provided through the Internet and does not depend on any physical establishment. However, as revealed in Map 1, cities with highly developed IF are clustered in the coastal region where the economy is generally more developed compared with the rest of the country. This finding implies that the development of IF is not decoupled from the real economy or the traditional financial sector. We will provide further discussion on this point in the rest of this section.
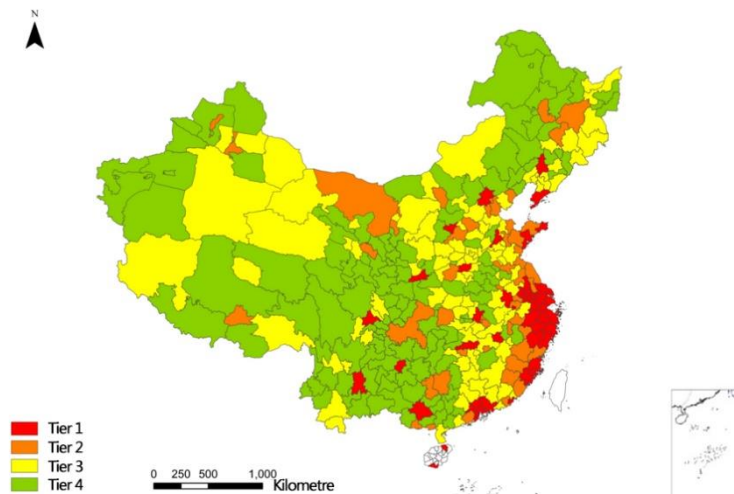
**Map 1. Visualization of the Internet Finance Development Indicators Based on City Rankings**
Source: Authors' calculations using the PKUIFDI.

In Map 2, cities are ranked based on the average rate of growth of IF between January 2014 and December 2015. Similar to Map 1, red, orange, yellow, and green indicate the top 1-50, 51-100, 101-200, and the rest of the cities, respectively, by their growth rates. As shown in Map 2, compared with those located in the coastal regions, cities in the central and western regions exhibit higher growth momentum. This partly reflects the fact that the hinterland started with a lower base and has accelerated more recently, and also illustrates the trend of convergence of growth and the inclusive nature of IF. To highlight this point, we plotted the city-level growth of the IF development indices (as fold change) against their IF base index values as of January 2014 (Figure 5), and found a clear negative correlation between the two variables. Although most cities conform to this pattern, a few places, including Hangzhou and Shenzhen, show strong growth despite a relatively high base level of IF development at the beginning of the period.
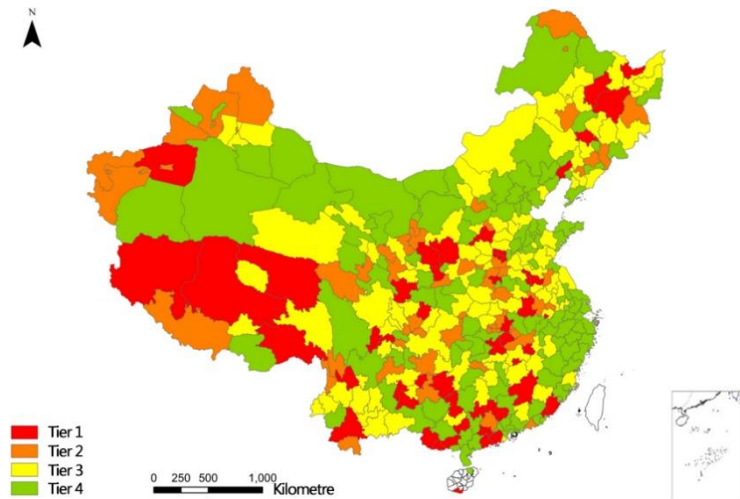
Map 2. Visualization of the Growth Rates of Internet Finance Development Indices Based on City Rankings

Source: Authors' calculations using the PKUIFDI.
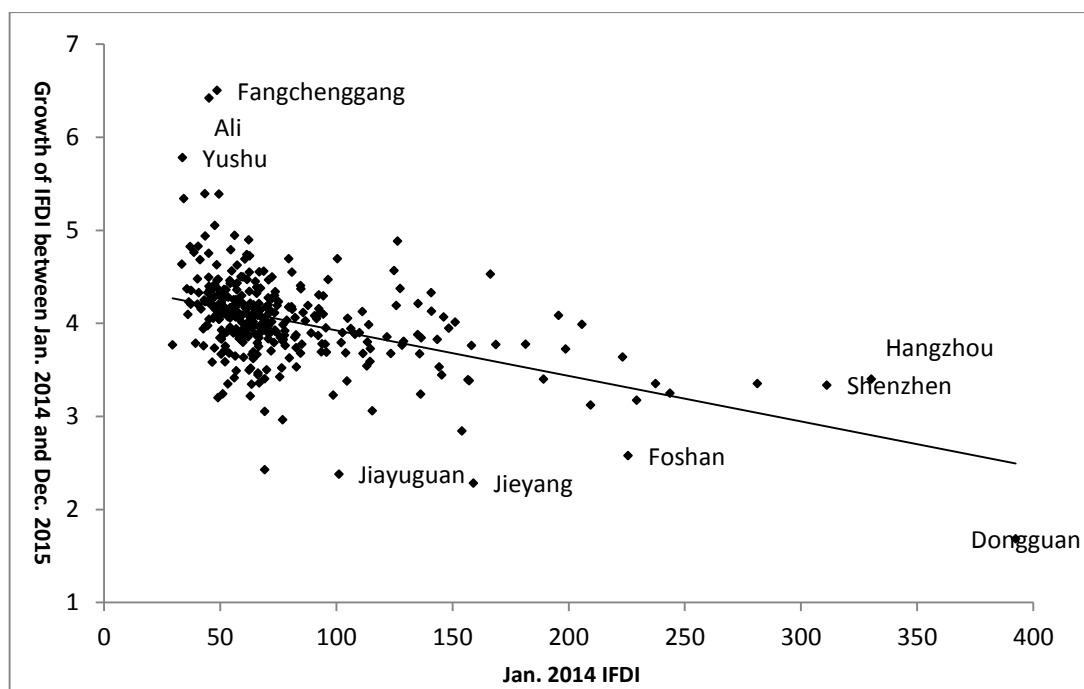
Figure 5. City-Level Growth of Internet Finance Development between January 2014 and December 2015 and Base Index Values in January 2014

Source: Authors' calculations using the PKUIFDI.

The level of IF development is positively correlated with the overall level of economic development.

To explore the factors that affect IF development, we first scattered the IF development indices as of December 2015 and the level of per capita gross domestic product (GDP) as of 2013 (Figure 6). The correlation between the two variables is highly positive, with a correlation coefficient of 0.63, indicating that IF development goes hand-in-hand with local economic

development in general. Although the pattern is evident, there are several outliers. For example, some coastal cities—including Hangzhou, Guangzhou Shenzhen, Zhuhai, and Xiamen— demonstrate even higher levels of IF development than what the overall correlation suggests. In contrast, several resource-rich cities—such as Ordos, Karamay, Alxa, and Haixi—have attained a reasonably high per capita GDP, but their IF development continues to lag. The general trend of IF development seems to be led by coastal regions and gradually spread to the hinterland.
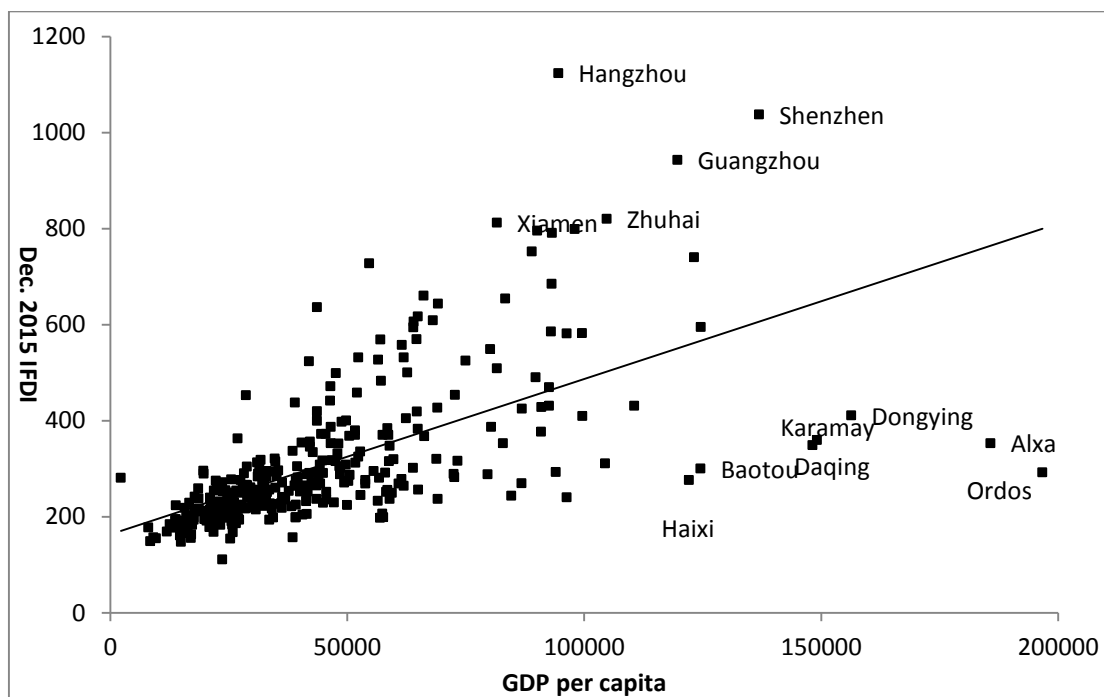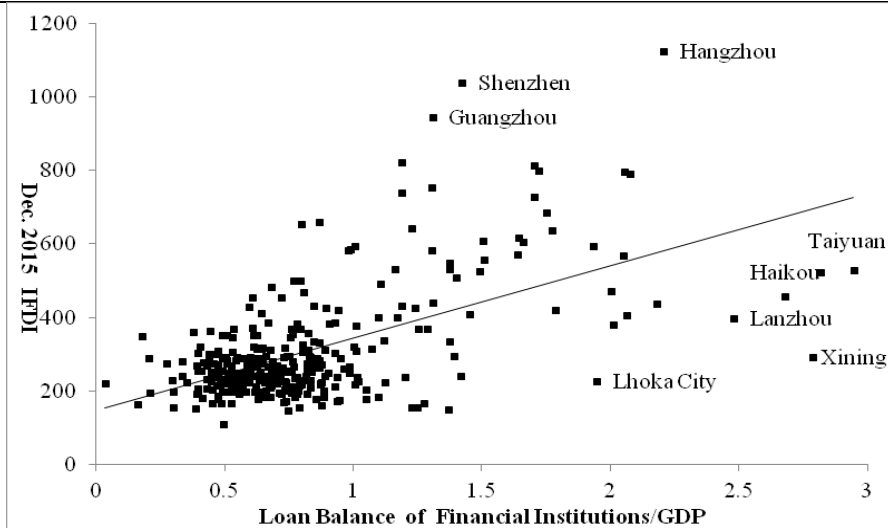

Figure 6. City-Level Internet Finance Development as of December 2015 and GDP per Capita in 2013

Source: Authors' calculations based on the PKUIFDI and the China Statistical Yearbook for Regional Economy 2014.

The development of IF and the traditional financial sector appears to be in tandem.

The relationship between IF and the traditional financial sector has received much attention from the industry and academia. Using the IF development index and financial depth measured by the total loan balance relative to GDP, the correlation between these two variables at the city level is positive, with a coefficient of 0.59. To date, the majority of IF business activities is not accounted for in the formal financial statistics; hence, the loan balance of financial institutions does not include IF. However, the positive correlation between IF and the traditional financial sector presented here should not be taken at a face value. It is possible that the correlation merely reflects that both IF and the traditional financial sector are shaped by a range of common fundamental determinants. Furthermore, the simple correlation does not capture the relationship between the demand for financial services that is unmet by traditional financial institutions and the supply of IF providers. Consequently, we cannot yet answer the crucial question as to whether IF complements or crowds out traditional financial services.

Figure 7. City-Level Internet Finance Development Indices (December 2015) and Total Loan Balance Relative to Gross Domestic Product (2013)

Source: Authors' calculations based on the PKUIFDI and China Statistical Yearbook for Regional Economy 2014.

The level of IF development is highly correlated with the availability of the Internet.

The definition of IF used in this study is the so-called narrowly defined IF, which includes financial businesses operated by Internet companies. As a result, it is intuitive to predict that the development of IF is affected by the prevalence of Internet use. Similar observations have been made in previous studies on IF. For instance, Li (2015) argued that the rapid expansion of Internet access in China provided a solid base for IF development. Figure 8 is a scatter plot of IF development indices as of the end of 2015 against mobile phone use in China, measured by the number of mobile phones used per 100 people in 2013. The correlation coefficient is as high as 0.74.
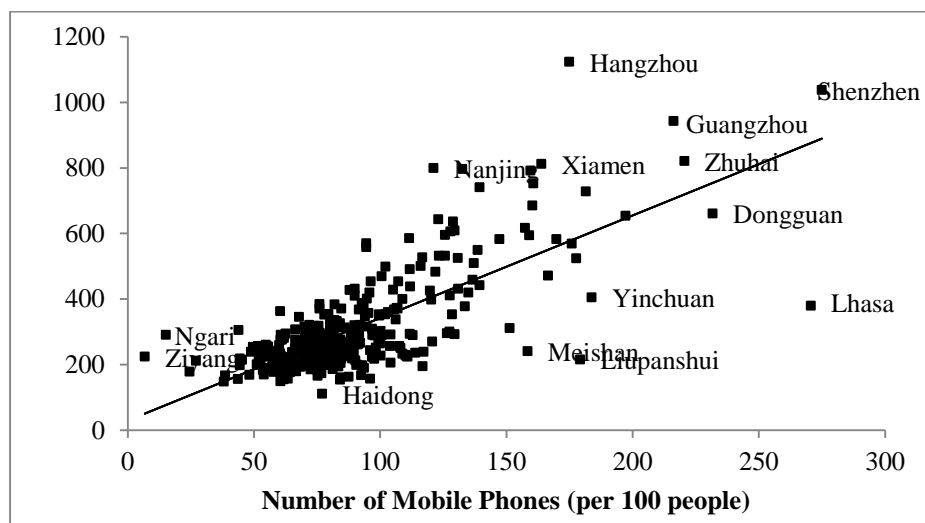
Figure 8. City-Level Internet Finance Development Indices (December 2015) and the Number of Mobile Phones Used per 100 People (2013)

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Source: Authors' calculations based on the PKUIFDI and China Statistical Yearbook for Regional Economy 2014.

Several factors affect regional IF development.

Employing ordinary least squares (OLS) regression analysis, the rest of this section investigates the factors underlying IF development. The dependent variable is the city-level index of IF development as of December 2015, and the covariates include a series of local socioeconomic characteristics as of 2013.

Table 2 presents the first set of OLS regression results. The level of IF development is positively correlated with the coverage of mobile phones. Furthermore, GDP per capita, population density, the share of tertiary industry, and openness (defined as the total value of imports and exports relative to GDP) are also positively correlated with IF development. The ratio of local government fiscal expenditure to GDP does not seem to play a major role, revealing the marketized (as opposed to government-led) feature of the IF industry. The teacher-to-student ratio in primary schools, number of hospital beds per 10,000 people, and average length of roads per person characterize different dimensions of public infrastructure, of which the last variable is positively correlated with IF development. In addition, provincial capitals seem to be endowed with advantages for IF development. Relative to the eastern coastal region, cities in the west seem to be disadvantaged in IF development, whereas being located in the central area makes no difference. These findings suggest that the inclusiveness of IF has manifested in the center, but not to a very large extent in the hinterland.

Lastly, our research revealed an interesting finding related to the distance of a city to the major cities where IF is highly developed, such as Beijing, Shanghai, Hangzhou, and Shenzhen. The regression results show that the distance to Beijing, Shanghai, or Shenzhen is positively correlated with IF development, and the distance to Hangzhou is negatively correlated. We interpret these results as some indication of the correlation between IF development and the unofficial headquarters of China's IF, Hangzhou.[8]

Table 2. Factors Affecting Internet Finance Development: Overall Index

Factor	(1) IFDI	(2) IFDI	(3) IFDI	(4) IFDI
Loans/GDP	84.20***	91.98***	81.38***	37.50**
	(30.28)	(30.22)	(24.09)	(15.95)
Mobile phones	2.54***	1.37**	0.93**	1.25***
per 100 people	(0.50)	(0.65)	(0.36)	(0.36)
Log GDP per capita		83.63***	80.53***	56.22***
		(21.61)	(17.21)	(14.81)
Log population density		25.59***	31.65***	17.39***
		(6.61)	(7.45)	(6.16)
Share of tertiary industry			178.37***	132.80**
			(64.79)	(60.60)
Openness			1.01***	0.96***
			(0.22)	(0.19)
Fiscal expenditure/GDP			-54.51	-66.56

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[8] The largest IF company in China (and in the world), Alibaba Group, and its affiliated Ant Financial Services Group are located in Hangzhou.

		(47.89)	(53.80)
Teacher-to-student ratio		-3.54	1.23
in primary school		(3.09)	(3.25)
Medical beds per		-0.95**	-0.53*
10,000 people		(0.41)	(0.29)
Length of roads per person		0.45***	0.36***
		(0.09)	(0.06)
Provincial capitals			79.27***
			(21.32)
West			-30.85**
			(12.91)
Central			-26.82*
			(14.78)
Distance to Beijing			6.91***
			(1.39)
Distance to Shanghai			26.24**
			(9.97)
Distance to Hangzhou			-38.10***
			(11.22)
Distance to Shenzhen			7.07***
			(1.79)
N	335	335	335	335
R²	0.5956	0.7370	0.8259	0.8836

Note: Robust standard errors are in parentheses. *, **, and *** denote 10%, 5%, and 1% significance level, respectively.

To examine further the factors underlying IF development, we next analyze the IF indices by business category, including Internet payments, Internet money market funds, Internet insurance, and Internet investment. As shown in Table 3, the traditional financial sector and the prevalence of mobile phones have positive effects on all four business categories. Theses findings are consistent with earlier results of overall IF development, confirming that the traditional financial sector and Internet infrastructure provide the necessary basis for IF development.

Of the other covariates, the effects revealed by the regressions are also generally consistent with the findings based on the overall IF development index. An interesting difference is that compared with other business categories, being a provincial capital and being located in a central or western region appear to have distinct effects on the development of Internet insurance. Provincial capitals do not seem to have any advantage, and cities located in the west do not seem to be disadvantaged relative to their coastal counterparts. Although some provinces, such as Ningxia, Xinjiang, Tibet, and Qinghai and Hainan, are located in relatively remote areas, and generally have lower levels of IF development, they are often ranked highly on the Internet insurance index. This is probably because a large share of Internet insurance is delivery insurance, and it is precisely those who live in the hinterland who would make more use of this service to insure themselves against potential problems during shipping. With the increase in insurance premiums per person, the level of Internet insurance development is relatively high in these cities.

Table 3. Factors Affecting Internet Finance Development: By Business Category

	(1)	(2)	(3)	(4)
Factor	Payments	Money market funds	Investment	Insurance
Loans/GDP	17.97**	14.82	43.66**	75.92***
	(8.57)	(10.99)	(20.42)	(15.11)

Mobile phones	0.78***	0.61***	0.85*	1.24***
per 100 people	(0.20)	(0.22)	(0.43)	(0.28)
log GDP per capita	27.78***	33.23***	71.10***	86.22***
	(8.18)	(8.77)	(17.07)	(12.33)
Log population density	8.45**	10.86**	18.01*	13.40**
	(3.47)	(4.37)	(8.89)	(6.48)
Share of tertiary industry	71.04**	79.43*	110.85	137.68*
	(28.71)	(39.70)	(105.50)	(69.93)
Openness	0.48***	0.64***	1.26***	0.78***
	(0.10)	(0.12)	(0.29)	(0.19)
Fiscal expenditure/GDP	-47.91*	-24.62	-28.77	-8.26
	(27.89)	(31.57)	(60.07)	(44.97)
Teacher-to-student ratio	0.06	0.56	2.75	0.02
in primary school	(1.67)	(2.08)	(4.36)	(3.75)
Medical beds per 10,000 people	-0.38**	-0.23	-0.31	-0.60**
	(0.17)	(0.18)	(0.45)	(0.29)
Length of roads per person	0.17***	0.18***	0.24***	0.39***
	(0.04)	(0.04)	(0.07)	(0.06)
Provincial capitals	44.39***	56.19***	71.77**	32.73
	(8.95)	(14.21)	(31.33)	(24.05)
West	-24.28***	-16.94*	-25.46	-9.66
	(7.30)	(8.44)	(23.74)	(15.07)
Central	-19.92**	-12.59	-23.81	-4.17
	(8.12)	(8.81)	(25.55)	(13.88)
Distance to Beijing	3.36***	3.33***	5.36**	8.03***
	(0.73)	(0.88)	(1.96)	(1.41)
Distance to Shanghai	17.20***	20.56***	20.67	10.97
	(5.93)	(6.28)	(17.64)	(8.46)
Distance to Hangzhou	-23.19***	-28.17***	-32.63	-18.57**
	(6.58)	(7.17)	(19.70)	(8.43)
Distance to Shenzhen	3.54***	5.35***	8.78***	4.11***
	(1.05)	(1.17)	(2.51)	(1.25)
N	335	335	335	335
R^2	0.8916	0.8572	0.7885	0.8861

Note: Robust standard errors are in parentheses. *, **, and *** denote 10%, 5%, and 1% significance level, respectively.

4. Conclusions

IF is a massive experiment with global implications, and China is at the center stage. Yet the future of IF is full of uncertainties. In an attempt to capture the development of IF in China in a timely and accurate fashion, we developed the "Peking University Internet Finance Development Index," which comprises a set of indices that capture the trends and patterns of IF in China at the national and regional levels, and by business categories and individual characteristics. The resultant indices clarify the overall development of IF in China. Given the rapidly changing nature of the IF industry, the construct of the index is sufficiently flexible so that it can accommodate the future emergence of new business categories and weight adjustments when required.

January 2014 was set as the base month, with a base value of 100. Our calculations show that the IF development index reached 386 by December 2015, demonstrating rapid overall growth. However, there are large variations across different IF business categories, in the level of development and the rate of growth. The fluctuations within each business category also reveal several distinctively Chinese patterns.

Preliminary analysis using the regional IF indices suggests the following. First, cities with higher levels of IF development are primarily concentrated in the east of China, with a few located in the west or central area. Second, with the relatively rapid development of the western part of the country, the regional growth rates of IF exhibit a certain degree of convergence and inclusion. Third, the highly positive correlations between IF and the traditional financial sector, availability of Internet infrastructure, and overall level of economic development imply that the development of IF relies on the development of the real economy and the established financial industry. Last, although theoretically IF is independent of geographical restrictions, our results suggest that the geographic features of IF remain prominent.

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