The Important Factors Affecting the Development of Fintech in China

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Abstract: The development of financial technology is a worldwide topic. Promoting fintech is critical to the reform of the financial system. This study explores the relationship between gender equality, infrastructure construction, social development, urbanization, and the development of fintech in China. The research uses the female labor force ratio, mobile cellular subscriptions, school enrollment, tertiary (% gross), and urban population ratio as independent variables and uses the number of mobile payment transactions as a dependent variable to measure the development of fintech. The study used multiple regression and ridge regression models for analysis. The results show that the female labor force ratio, mobile cellular subscriptions, school enrollment, tertiary (% gross), and urban population ratio are all positively correlated with the development of fintech in China.

The development of fintech is a crucial issue for any country. The fintech system in the United States and some European capitalist countries is very mature, while in some developing countries, such as China, fintech is still in its infancy. The immature financial technology system limits the boundaries of financial services and hinders the development of the real economy [1]. As Covid-19 continues to spread worldwide, the need for fintech is clear. Contactless, remote payment for financial services is ubiquitous. Moreover, countries like Europe and the United States continuously optimize the financial policy environment and promote economic development through continuous financial technology innovation [2]. Some academics have begun to study the factors that promote the development of fintech. Most of these studies focus on scientific and technological progress, policy support, government supervision, etc., and rarely involve exploring equal relations between men and women, infrastructure construction, social development, and urbanization.

Gender equality is a direction worthy of research. China's economic development is a critical force in promoting the progress of financial technology. At the same time, the pace of China's sustainable economic development is inseparable from establishing the concept of gender equality and the implementation of gender equality policies [3] [4]. The above relationship can illustrate that gender is one of the factors influencing the development of fintech in China. Of course, many other factors can affect the development of Chinese fintech.

This research will mainly focus on the impact of the female labor force ratio, mobile cellular subscriptions, school enrollment, tertiary (% gross), and urban population ratio on the development of fintech in China. At the same time, the study uses the number of mobile payment transactions to quantify the pace of fintech advancement and uses regression models to demonstrate the importance of the above factors to the development of fintech in China. China is a leader in developing countries, a very representative developing country in Asia, and more dynamic in financial development than developed countries in Europe and the United States. The research has a certain degree of value for exploring fintech development in other developing countries.

The research analyses the significant impact of gender equality, infrastructure construction, social development, and urbanization on the development of fintech. Different perspectives expand the research field of fintech influencing factors to a certain extent.

1. Literature Review

Alisa DiCaprio, Ying Yao, and Rebecca Simms examine the impact of gender issues on fintech. By exploring unique datasets, Alisa DiCaprio, Ying Yao, and Rebecca Simms concluded that women are more likely than men to adopt fintech as a financial solution [5]. The findings suggest that women have a numerical advantage over men in using and exploring fintech. Therefore, the significance of gender equality itself should be emphasized more on the issue of financial technology development. The above statement also implies that equality between women and men is crucial to achieving progress in fintech.

Caroline Morrow has highlighted the importance of women in fintech in the literature, proposing and explaining the core idea that the future of fintech is women [6]. The literature points out that women are not only beneficiaries but also drivers of fintech change and innovation in fintech development. Women committed to fintech are likely to create sustainable, digital financial businesses that serve other women and their communities and the economy. This literature supports the notion that the female workforce plays a significant role in enabling fintech development to a certain extent.

Qi Xiong's research on the Indonesian fintech ecosystem found that increasing financial support to Indonesia to help local infrastructure construction can promote the development of the local fintech industry. Due to poverty in Indonesia, few local bank branches, and poor physical infrastructure, the development of local fintech is slow, and residents' awareness of fintech is weak. The literature proposes that Indonesia should exploit the considerable potential of the emerging industry of fintech through the capital introduction and learning from international experience [7]. The above research proves that perfect physical infrastructure construction is one of the indispensable conditions for the development of fintech.

Dat Dinh Nguyen, Hoang Cong Dinh, Duy Van Nguyen surveyed 40 banking experts familiar with fintech in Vietnam and suggested that technological innovations in data analytics, infrastructure, big data, and mobile devices will facilitate fintech start-ups to break away from traditional financial firms through their unique and customized products and services [8]. This view implies that the improvement of physical infrastructure construction in Vietnam will change the original local financial system and promote the transformation of the traditional financial system into a financial technology system, proving the importance of infrastructure construction to the development of financial technology.

Wei Jiang, Yuehua Tang, Rachel Xiao, and Vincent Yao analyzed a comprehensive database of U.S. fintech patents and company recruitment letters over the past decade and found that in order to cope with the impact of financial technology, the labor force needs to have better professional skills, higher education levels, and richer work experience [9]. Facing the disruption from traditional finance to fintech, various financial companies have adopted strategies to rapidly improve the skills of the workforce, which undoubtedly requires the workforce to have higher education levels.

P.J. Morgan and L.Q. Trinh, when examining the relationship between financial literacy and the perception and adoption of fintech products (i.e., financial products offered through the internet and mobile platforms, especially in developing countries), found that highly educated people have The likelihood of awareness of the product is much higher [10]. The findings support that higher education is one of the essential elements of fintech development in a country or region. Only when residents improve their awareness of fintech products and their understanding of fintech concepts can they better promote the innovation and development of fintech.

O. Kowalewski, P. Pisany investigated the determinants of the creation and activity of multinational fintech firms, including developed and developing countries, by using random-effects negative binomial models and interpretable machine learning algorithms. The study not only found that demographic factors may play a role in fintech creation and activity but also concluded that in developed markets, urbanization has an impact on the rate of fintech formation [11]. According to the research the literature, urbanization is also one of the factors affecting the development of fintech.

Although the literature cited above affirms the relationship between fintech development and gender equality, infrastructure development, social development, and urbanization, none of the articles have integrated and systematically analyzed these relationships. Moreover, most of the countries studied in the above literature are relatively backward countries, involving the development of fintech and social relations in various fields rather than specific countries. The paper will focus on studying China, a highly representative developing country, to eliminate the effects of differences in national and local or global financial environments. Based on the literature mentioned earlier, this study will discuss the essential factors influencing the development of fintech in China.

2. Concept of Fintech

The core of financial technology is finance, so the premise of an in-depth understanding of financial technology is to understand the core of finance. The core of finance is to solve the problem of information asymmetry, thereby changing the size, duration, and risk of funds. Only this way can the capital market meet different investment and financing needs. Fintech is the technical application layer in the financial field, solving the core problem of the capital market through scientific and technological means, that is, information asymmetry.

Dan Lv proposed in her literature that the core of financial technology is finance, the most significant risk is extrusion, and comprehensive risk management is an essential part of financial business [12]. In other words, many P2P platforms with serious homogeneity will face large-scale restructuring under the influence of factors such as tight capital, stricter policy supervision, and accelerated industry polarization. Nevertheless, using the Internet to transform the traditional financial industry is not easy because financial technology is not simply taking offline assets and selling them online. Hanting Fang also explicitly mentioned that the essence of fintech is one of the essential branches of innovation economics. It aims to cultivate high-value-added industries, create high-paying jobs, and enhance the economy’s overall competitiveness. Promoting the combination of scientific and technological capital, innovation capital, and venture capital is a new economic paradigm with deep integration [13]. Furthermore, Wenhong Li and Zeshen Jiang mentioned that the specific meaning of fintech varies significantly in different contexts. Sometimes it refers to the digitization or electronification of current financial services, such as online banking, mobile banking, etc., and sometimes it refers to various new technologies that can be applied to the financial field, such as distributed accounts, cloud computing, big data, etc. [14].

All in all, fintech is an unspecified product of the combination of traditional finance and modern technology. With the change in the social environment and social background, the connotation of financial technology will also undergo subtle changes. However, one thing is sure: while fintech exerts its potential, it is conducive to improving the efficiency of the capital market and the evolution of the capital market.

To better demonstrate gender equality, infrastructure development, social development, and the impact of urbanization on fintech development, the author retrieved the data on the proportion of female labor force, Mobile cellular subscriptions, School enrollment, tertiary (% gross), and the proportion of the urban population from the World Bank database, and retrieved the data on the number of mobile payment transactions in China from the Statista database. These data are then plotted into trend graphs in time series [15] [16].

According to Figure 1, from 2009 to 2020, the total number of mobile payment transactions in China increased significantly, and at the same time, the data on school enrollment, tertiary (% gross) also increased significantly. Although the proportion of women in the labor force, mobile cellular subscriptions, and the proportion of the urban population has not increased significantly, they have also shown a slow upward trend.

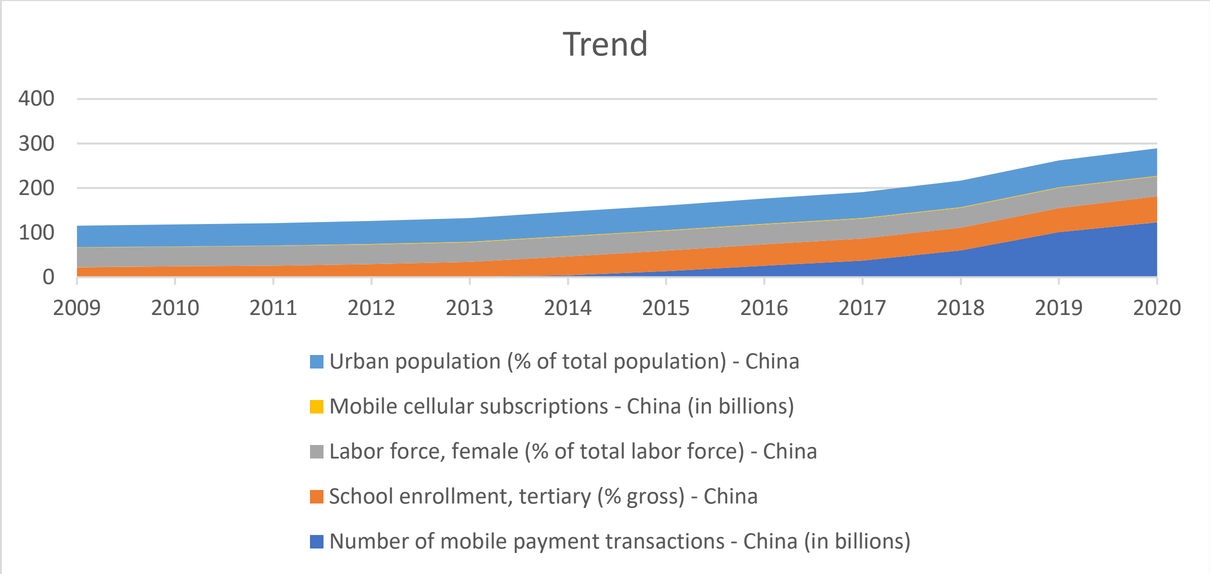

Figure 1 Retrieving data trend graph

3. Regression Model and Model Specification

Regression analysis distinguishes between independent variables and dependent variables. Independent variables are also called explanatory variables, and dependent variables are called outcome variables, and the relationship between them is expressed through a particular functional relationship. Regression analysis can be divided into linear regression analysis and nonlinear regression analysis according to the type of relationship between independent variables and dependent variables; according to the number of independent variables, it can be divided into univariate regression analysis and multiple regression analysis. The fundamental expression of linear regression is $Y = a + b * X + \varepsilon$, where a is the intercept of the line, b is the slope of the line, and ε is the error term. There are some critical values in regression analysis to pay special attention to:

- P-value: If the P-value is less than 0.05, the corresponding independent variable has a significant influence on the dependent variable. The most commonly used test method here is the t-test, which compares two groups to see whether a specific variable X has a significant effect on Y.
- VIF value: The VIF value is a collinearity indicator. When the VIF value is greater than 5, there is a collinearity problem.
- R^2 value: The R^2 value represents the model fit indicator. When the R^2 value is closer to 1, the independent variables in the model explain the variation of the dependent variable better.

The model used in this paper is multiple regression, which is defined as the use of regression equations to analyze the association between multiple X and one Y. The basic expressions, sample expressions, and matrix expressions of the multiple regression model are as follows:

$$Y = \beta_0 + \beta_1 * x_1 + \beta_2 * x_2 + \beta_3 * x_3 + \cdots + \beta_z * x_z + \varepsilon \quad \varepsilon \sim N(0, \sigma^2)$$

$$Y_i = \beta_0 + \beta_1 * x_{i1} + \beta_2 * x_{i2} + \beta_3 * x_{i3} + \cdots + \beta_z * x_{iz} + \varepsilon_i \quad \varepsilon_1, \varepsilon_2, \cdots, \varepsilon_n i.i.d. N(0, \sigma^2)$$

$$Y = X\beta + \varepsilon \quad \varepsilon \to N_n(O, \sigma^2 I_n) \quad Y \to N_n(X\beta, \sigma^2 I_n) \quad (1)$$

Multiple regression often suffers from the problem of multicollinearity, which increases the variance of the coefficient estimates, making the coefficient estimates less stable and more sensitive. There are generally two solutions to the multicollinearity problem in multiple regression: first, stepwise regression. Nevertheless, the stepwise regression method also has flaws, which may lead to eliminating core variables; therefore, we often use ridge regression to solve multicollinearity problems. Ridge regression is a method that can solve the multicollinearity problem without removing core variables.

Ridge regression is a linear model that can avoid overfitting. In ridge regression, the model retains all feature variables but reduces the coefficient values of the feature variables, thereby reducing the influence of the feature variables on the prediction results. Ridge regression is a modified least-squares method that seeks a slightly less efficient but more realistic regression equation at the cost of giving up partial accuracy [17]. In simple terms, ridge regression introduces k unit matrices so that the regression coefficients can be estimated, and the obtained regression estimates are more stable than simple linear regression coefficients and closer to the actual situation. Although introducing the unit matrix into ridge regression will lead to loss of information, the return is a reasonable estimate of the regression model. The mathematical model for this model can be expressed as:

$$\beta^{ridge} = argmin\left\{\sum_{i=1}^{N}(y_i - \beta_0 - \sum_{j=1}^{p} x_{ij}\beta_j)^2 + \lambda \sum_{j=1}^{p} \beta_j^2\right\}$$

$$\beta^{ridge} = argmin\sum_{i=1}^{N}(y_i - \beta_0 - \sum_{j=1}^{p} x_{ij}\beta_j)^2$$

Subject to $\sum_{j=1}^{p} \beta_j^2 \leq t$ (2)

Ridge regression analysis must pay attention to the following two points:

• Whether there is a collinearity problem must be well-founded. For example, the VIF value is too high, or the correlation between the independent variables is too high. If the data are not collinear, ordinary linear least squares regression should be used.

• Ridge regression modeling is divided into two steps: finding the best K value and modeling. In the ridge trace graph, if it tends to be stable after a certain point, the K value corresponding to this point is the optimal K value, and the smaller the K value, the better.

The research object is the relationship between the female labor force ratio, mobile cellular subscriptions, school enrollment, tertiary (% gross), the urban population ratio, and the development of fintech in this specific country of China. Therefore, the data regression model is more suitable. The mathematical model of this study can be expressed as follows:

Fintech development = F(female labor force ratio, mobile cellular subscriptions, school enrollment, tertiary (% gross), urban population ratio) (3)

Replacing complex text with alphabetic abbreviations:

FLFR = female labor force ratio

MCS = mobile cellular subscriptions

SET = school enrollment, tertiary (% gross)

UPR = urban population ratio

Fintech development = number of mobile payment transactions

$$Fintech\ development = F(FLFR, MCS, SET, UPR) \quad (4)$$

The econometric model of this model can be expressed as:

$$F.D. = \beta_0 + \beta_1 * FLFR + \beta_2 * MCS + \beta_3 * SET + \beta_4 * UPR + \varepsilon \quad (5)$$

Where:

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4$ = Coefficients of model (Assume $\beta_1, \beta_2, \beta_3, \beta_4 > 0$)

The above data comes from World Bank indicators and the Statista database. The five key data points about China selected in this study cover 2009 to 2020 [15] [16].

4. Results and Analyses

Table 1 Descriptive statistics table

Basic indicator	Fintech development (B)	SET (%)	FLFR	MCS (B)	UPR (%)
Size	12	12	12	12	12
Min.	0.07	22.443	44.02	0.747	47.88
Max.	123.22	58.42	44.804	1.746	61.428
Ave.	30.788	40.15	44.376	1.286	54.811
S.D.	42.69	12.714	0.255	0.323	4.446
Med.	9.18	44.236	44.367	1.289	54.88
Var.	1822.436	161.658	0.065	0.104	19.771
S.E.	12.324	3.67	0.074	0.093	1.284
Kurtosis	0.874	-1.64	-1.16	-0.874	-1.205
Skewness	1.412	-0.182	0.227	-0.154	-0.056
C.V.	138.66%	31.67%	0.57%	25.11%	8.11%

According to the results, in terms of independent variables, the absolute values of the kurtosis coefficients of the four sets of data are all smaller than the number 3, so they are platykurtic. Graphically, the platykurtic is flatter than the standard normal distribution. Three of the data sets have negative skewness coefficients, and in terms of graphical representation, they have long tails in the negative direction of the number line, meaning that the mean of the data is to the left of the peak. On the other hand, the skewness coefficient of the female labor force ratio is positively skewed, so it has a long tail in the positive direction of the number line, and the mean of the data is to the right of the peak. The average school enrollment, tertiary (% gross) is 40.15%, the standard deviation is 12.714, the median is 44.236%, and the minimum and maximum values are 22.443% and 58.42%, respectively. These figures of Female labor force ratio are 44.376%, 0.255, 44.376%, 44.02%, and 44.804% in order. These data of Mobile cellular subscriptions are 1.286B, 0.323, 1.289B, 0.747B, and 1.746B in order. These data of Urban population ratio are 54.811%, 4.446, 54.88%, 47.88%, and 61.428%. The standard deviation rate is the ratio of the standard deviation to the mean and measures how variable data values are. The standard deviations of the four sets of independent variable data are small compared to the mean, so the standard deviation rates of the four sets of data are small.

Regarding the dependent variable fintech development (number of mobile payment transactions), the absolute value of the kurtosis coefficient of the data is less than the number 3, which is platykurtic. The skewness coefficient of the data is 1.412, so the mean is to the right of the peak. Unlike the independent variable, the standard deviation of the data of the dependent variable is larger than the mean, so the standard deviation rate of the data is more significant, and the degree of variation of the data value is more pronounced.

Table 2 Correlation coefficient table

Pearson correlation coefficient		Correlation coefficient
		Number of mobile payment transactions - China (in billions)
School enrollment, tertiary (% gross) - China		0.815**
p -value	0.001	
Labor force, female (% of total labor force) - China		0.780**
p -value	0.003	
Mobile cellular subscriptions - China (in billions)		0.842**
p -value	0.001	
Urban population (% of total population) - China		0.864**
p -value	0	
* $p < 0.05$ ** $p < 0.01$		

As can be seen from the above table, correlation analysis was used to study the correlation between fintech development and SET, FLFR, MCS, and UPR, respectively, and the Pearson correlation coefficient was used to indicate the strength of the correlation. The specific analysis shows that the correlation coefficient values between fintech development and SET, FLFR, MCS, and UPR were 0.815, 0.842, and 0.864, respectively, and all showed a significant level of 0.01. Therefore, indicating a significant positive correlation between fintech development and SET, FLFR, MCS, and UPR. In addition, the absolute values of the correlation coefficients between fintech development and SET, MCS, and UPR have all exceeded 0.8, so there is a multicollinearity problem [19]. Due to the limited amount of retrieved data, a ridge regression model is required to solve this problem.

Table 3 Normal Distribution test form

Normality test					S-W test	
Name	Ave.	S.D.	Skewness	Kurtosis	W-Value	P-Value
Fintech development	30.788	42.69	1.412	0.874	0.762	0.004**
SET	40.15	12.714	-0.182	-1.64	0.907	0.196
FLFR	44.376	0.255	0.227	-1.16	0.958	0.752
MCS	1.286	0.323	-0.154	-0.874	0.961	0.799
UPR	54.811	4.446	-0.056	-1.205	0.966	0.866
* $p < 0.05$ ** $p < 0.01$						

Normality tests were performed for fintech development, SET, FLFR, MCS, and UPR. Since the sample size of the study data was all less than or equal to 50, the S-W test was used instead of the K-S test or Jarque-Bera test. Specifically, fintech development showed significance (p<0.05), meaning that fintech development did not have a normality trait. In addition, SET, FLFR, MCS, and UPR did not show significance, implying that SET, FLFR, MCS, and UPR have normality properties. Because the normality test has strict requirements and usually cannot be satisfied, if the absolute value of kurtosis is less than ten and the absolute value of skewness is less than three, it can also indicate that although the data is not absolutely normal, it is accepted as a normal distribution [18]. Therefore, the retrieved data satisfy the normal distribution.

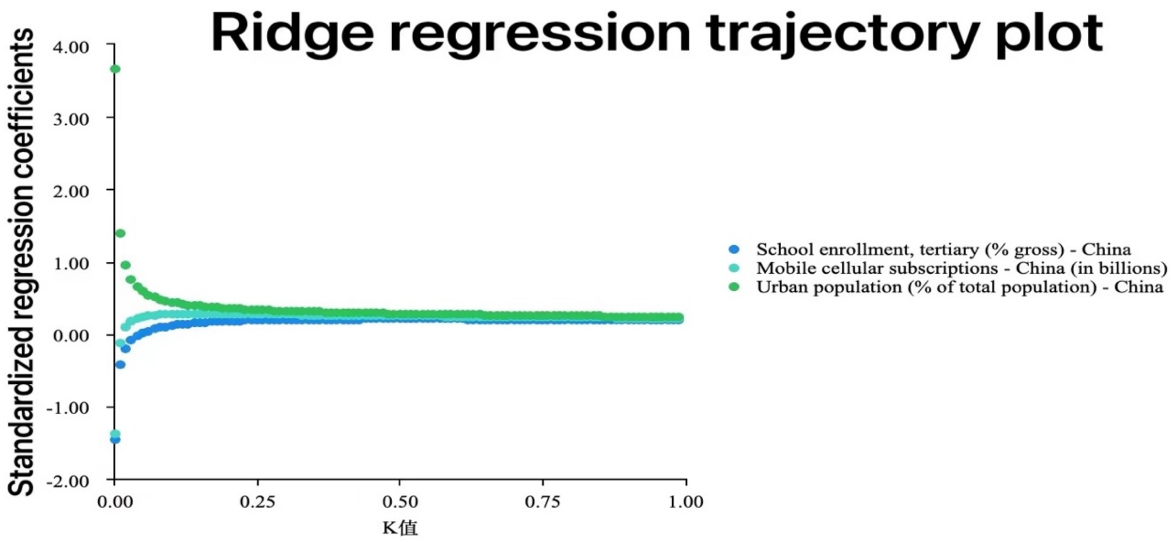

Figure 2 Ridge regression trajectory plot

Since the absolute values of the correlation coefficients between fintech development and SET, MCS, and UPR have all exceeded 0.8, there is a multicollinearity problem. We perform ridge regression analysis on these three independent variables. The above figure is a ridge regression trajectory plot obtained by ridge regression analysis with SET, MCS, and UPR as independent variables and fintech development as the dependent variable. According to the figure, the optimal K value is taken as 0.99.

Table 4 Model summary

Model summary			
Sample size	R^2	Adjust R^2	Model error - RMSE
12	0.675	0.553	23.303

As when the K value is taken as 0.990, the model $\boldsymbol{R^2}$ value is 0.675, which means that SET, MCS, and UPR can explain 67.5% of the variation in fintech development.

Table 5 F-test form

F-test form					
	Sum of square	df	Mean square	F	p-value
Return	13530.477	3	4510.159	5.537	0.024
Residual	6516.32	8	814.54		
Total	20046.797	11			

Ridge The result of the F-test is that the F-value is equal to 5.537, and the p-value is less than 0.05, which means that at least one of the three independent variables of SET, MCS, and UPR has an impact on fintech development.

According to the results of ridge regression analysis, the regression coefficient value of SET is 0.645, and the p-value is less than 0.05, which means that SET has a significant positive impact on fintech development. The regression coefficient value of MCS is 28.529, and the p-value is less than 0.05, which means that MCS has a significant positive impact on fintech development. The regression coefficient value of UPR is 2.230, and the p-value is less than 0.05, which also means that UPR has a significant positive impact on fintech development.

Table 6 Ridge Regression analysis results

Ridge regression analysis		
	Ridge regression analysis	t-value
Constant	-154.031**	-3.552
SET	0.645*	3.21
MCS	28.529**	3.683
UPR	2.230**	4.429
R^2	0.675	
Adjust R^2	0.553	
F-value	F (3,8)=5.537, p=0.024	
Dependent variable: fintech development		
* p < 0.05 ** p < 0.01		

5. Discussion and Conclusion

This paper aims to study whether gender equality, infrastructure construction, social development, and urbanization will affect the development of fintech in China. The results of ridge regression analysis show that mobile cellular subscriptions, school enrollment, tertiary (% gross), and urban population share all have positive implications for China’s fintech development. At the same time, the positive effect of the proportion of the female labor force on the development of China’s fintech is proved by multiple regression analysis.

According to the research results, China should promote the increase in the female social labor force, increase investment in infrastructure construction, improve the social development system, and actively promote the development of urbanization to accelerate the progress of China’s fintech. A limitation of this study is that the selected data are limited, which makes it impossible to perform a ridge regression analysis on the four independent variables simultaneously. Suppose the independent variable data of the proportion of the female labor force is added to the ridge regression analysis. In that case, the model cannot pass the F-test and cannot specifically analyze the relationship between the independent variables and the dependent variable. In addition, the key factors affecting the development of China’s fintech are not only the four aspects studied in this paper, and the quantitative data of the number of mobile payment transactions cannot fully reflect the development of China’s fintech. Future research can also obtain sufficient quantifiable or non-quantifiable data representing the state of fintech development in China from other fields for more in-depth analysis.

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