

Inclusive Finance and Enterprise Technological Innovation in the Context of Big Data: Evidence from Listed Companies

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Abstract: Computer software engineering development projects involve many fields, and there are many risks and complex and unknowable factors. In this systematic project, due to the particularity of software products, it is necessary to pay attention to and apply various digital and modern technologies to make computer software engineering become a Leading the driving force of innovation and development in various industries and meeting the needs of modern development. Based on the development and application of digital technology in computer software engineering, this paper elaborates the methods and technologies commonly used in engineering development, and proposes corresponding optimization strategies for the application of digital technology.

1 INTRODUCTION

A lot of convenience has come, and it has played an irreplaceable key role in the context of the rapid development of information and modern society. Computer software engineering is a new thing. After it entered our country, it has achieved great development and progress at the technical level. On the platform of modern and digital technology application, through the linking and sharing of information, a new industrial chain and core have gradually formed. With the extensive development of digital technology, computer software engineering has replaced and surpassed traditional technology. However, in the process of digital technology development of computer software engineering, there are still some problems and defects. Considering the innovation of some application technologies themselves The lack of performance limits the application and development of machine software engineering to a certain extent. To this end, it is necessary to strengthen the computer digitization technology independently developed and innovated in our country. Only on the premise of grasping the independent and innovative digitization and modernization technology can we promote the forward and healthy development of computer software engineering and safeguard the national security and defense forces of our country. Escort and

promote the progress and development of my country's modernization cause.

2 LITERATURE REVIEW

Many scholars have actively explored the causes of the financing difficulties of enterprises and put forward corresponding solutions. Due to bank credit rationing, enterprises can't get access to loan, their collateral value is the root cause of suffering to bank credit rationing (Stiglitz, 1981, Weiss, 1981, Wang, 2003, Zhang, 2003). Lack of "hard information" caused by information asymmetry is also an important factor restricting its financing (Lin, 2001, Li, 2001). The banks which use relational loans can ease the enterprises' financing dilemma, because the relational loan depends on the "soft information" of the enterprise (Berger, 1995, Udell, 1995). During the epidemic, China's Central Bank also implemented preferential credit policies such as reserve reduction, aiming to help enterprises acquire loan and alleviate their pressure of cash flow, but said most of the enterprises have not acquired bank loans, its cash flow pressure has not been eased (Zhu, 2020, Zhang, 2020, Li, 2020, Wang, 2020).

Inclusive finance provides a new way to solve the financing problems of enterprises. The concept of inclusive finance was proposed by the United Nations

in 2005, and its essence is to resolve financial exclusion. In recent years, commercial Banks have set up inclusive finance institutions, using digital financial means to provide finance to enterprises (Zhu, 2020, Zhang, 2020, Li, 2020, Wang, 2020). The inclusive finance institutions have dedicated risk management and compensation mechanism, this mechanism reduce the bank risk bearing level, improve the credit availability (Yu, 2020, Kang, 2020, Zhou, 2020). Digital financial advantage continuously emerging, on the one hand, digital financial in the information gathering has incomparable advantage over traditional financial, this advantage allows it to effectively identify risks, according to the data collected for the credit quality of the enterprises to provide financing support (Yu, 2020, Dou, 2020). On the other hand, digital finance with the help of the Internet technology, can reduce the cost of financing of enterprises, improve the financing efficiency (Liang, 2018, Zhang, 2018). In addition, digital financial also broke through the traditional financial institutions physical network restrictions on financial services, it is not limited to offline services model make it possible for financial services of universal coverage, many scholars believe that commercial banks use digital inclusion financing is feasible to resolve enterprise financing difficulties.

3 RESEARCH DESIGN

3.1 The Source of Data

In this paper, the annual data of listed companies from 2011 to 2017 are taken as sample data, and the sample data are screened as follows: First, the listed ST and delisted as well as the financial, real estate and insurance categories during 2011-2017 are excluded; Second, the variables in the data are Winsorized. Third, for the missing financial information of a large number of enterprises, this paper will be removed. The financial and patent application data of enterprises used in this paper come from Guotai 'an Database, and the digital Financial Inclusion Index adopts The Digital Financial Inclusion Index (2011-2018) compiled by Peking University.

3.2 Model Setting and Variable Definition

Based on existing studies, this paper constructs the following model:

$$innov = \beta_0 + \beta_1 difi_{jt} + \beta_2 control_{jt} + \varepsilon_{jt} \quad (1)$$

Where, i, j, t represent company, region and year. The explained variable *innov* is the innovation capability of enterprises, and the explained variable *difi* is digital inclusive finance. *Control* is the Control variable, including enterprise size, profitability *roa*, Cash flow *cash*, fixed asset share *fas*, corporate leverage *lev*, and Capital intensity *cap*. In addition, the model controls the fixed effects of time and industry, and ε is the error term.

Among them, the explained variable *innov* represents the innovation ability of enterprises. Existing literatures usually measure enterprise innovation by the innovation input and output of enterprises, but the data statistics of enterprise innovation input and output in current databases are missing. At the same time, patent application can represent the innovation ability of enterprises. Therefore, this paper uses the total number of three types of patent applications of listed companies to measure enterprise innovation.

The core explanatory variable *difi* represents the digital financial inclusion index. Since the digital financial inclusion index value at the provincial level is too large compared with other variables, this paper takes logarithm of the digital financial inclusion index.

Control is a series of enterprise-level data to reduce the endogenous problem of the model. The following variables are selected in this paper: Profitability (*roa*), capital intensity (*cap*), enterprise age (*age*), enterprise size (*size*) and enterprise leverage (*lev*), Cash flow (*cash*), fixed asset share (*fas*). In addition, the model controlled for annual and industry fixed effects.

Table 1: Variable Definition.

Variable name	Variable symbol	Variable definition
The innovation ability	<i>innov</i>	The total number of patents filed by enterprises (including inventions, practical shapes and designs) is logarithmic
Profitability	<i>roa</i>	Net profit margin on total assets
Capital intensity	<i>cap</i>	Ratio of total assets to total operating income
Enterprise age	<i>age</i>	Year of observation minus year of establishment
The enterprise scale	<i>size</i>	Take the logarithm of total enterprise assets
Corporate leverage ratio	<i>lev</i>	Corporate asset-liability ratio
Cash flow	<i>cash</i>	Net cash flows from operating activities

Variable name	Variable symbol	Variable definition
Share of fixed assets	fas	Fixed assets account for the proportion of total assets

4 RESULTS AND ANALYSIS

Table 1 shows the empirical test results of the impact of digital financial inclusion on enterprise technological innovation. In Model (1), the fixed effect of "time-industry" is controlled. The results show that the regression coefficient of digital inclusive finance (difi) on enterprise patent application is positive, and passes the significance test of 1%, which indicates that the development of digital inclusive finance helps promote enterprises to improve their independent innovation ability.

From the perspective of control variables, some factors of enterprises themselves will also affect the local technology innovation of enterprises. The regression coefficient of capital intensity, leverage ratio and cash flow of an enterprise is significantly positive, which indicates that the more capital intensity, the higher the share of fixed assets and the more cash flow of an enterprise, the more beneficial it is to technological innovation.

Table 2: Results of Regression.

	(1) innov	(2) innov
difi	30.43*** (6.54)	17.69*** (4.33)
roa		62.19 (1.35)
cap		2.34e-08*** (32.63)
age		-0.193 (-0.52)
size		59.72 (0.22)
lev		97.90*** (7.95)
cash		4.26e-08*** (7.72)
fas		48.35 (0.15)
cons	-49.79* (-1.99)	-95.85 (-0.29)
Industry, Year	control	control
N	8287	8287
adj.R ²	0.005	0.266

Note: The brackets are t values, where *, ** and *** represent significance levels of 10%, 5% and 1% respectively

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6 THE APPLICATION PROCESS OF DATA MINING

1) Data mining environment. Data mining refers to a complete process that mines previously unknown, effective, and practical information from a large database, and uses this information to make decisions or enrich knowledge.

2) Data mining process diagram. The figure below describes the basic process and main steps of data mining.

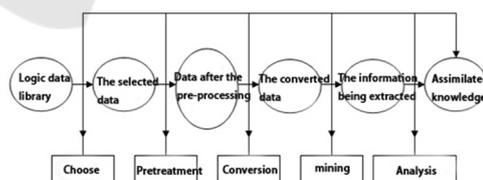


Figure 1. The basic process and main steps of data mining.

3) Workload of data mining process

The business object being studied in data mining is the foundation of the entire process. It drives the entire data mining process. It is also the basis for testing the final results and guiding the analysts to complete the data mining and consultants. The steps in Figure 2 are completed in a certain order, of course. There will also be feedback between steps in the whole process. The process of data mining is not

automatic, and most of the work needs to be done manually. Figure 3 shows the ratio of the workload of each step in the whole process, which can be seen as 60% Time is spent on data preparation, which shows that data mining has strict requirements for data, and subsequent mining work only accounts for 10% of the total workload.

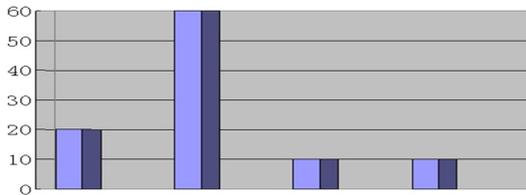


Figure 2. Proportion of workload in the data mining process.

4) The general content of each step in the data mining process is as follows:

(1) Determine the business object

Clearly define business problems. Recognizing the purpose of data mining is an important step in data mining. The final structure of mining is unpredictable, but the problems to be explored should be foreseeable. For data mining, data mining is blind.

(2). Data preparation

1) Data selection. Search all internal and external data information related to business objects, and select data suitable for data mining applications.

2) Data preprocessing. The quality of the research data is prepared for further analysis, and the type of mining operation to be carried out is determined.

3) Data conversion. The data is converted into an analysis model. This analysis model is established for the mining algorithm. The establishment of an analysis model that is really suitable for the mining algorithm is the key to the success of data mining.

(3). Data mining

Except for the selection of the appropriate mining algorithm for mining the obtained converted data, all other tasks can be completed automatically.

(4). Result analysis

The analysis method used to interpret and evaluate the results should generally be determined by data mining operations, and visualization techniques are usually used.

(5). Assimilation of knowledge

Integrate the knowledge obtained from the analysis into the organizational structure of the business information system. The step-by-step implementation of the data mining process requires personnel with different expertise in different steps. They can be roughly divided into three categories. Business analysts: required to be proficient in

business, able to explain business objects, and determine the business requirements for data definition and mining algorithms based on each business object.

Data analysis personnel: proficient in data analysis technology, have a relatively proficient grasp of statistics, and have the ability to transform business requirements into various steps of data mining, and select the appropriate technology for each operation.

Data management personnel: proficient in data management techniques, and collect data from databases or data warehouses. It can be seen from the above that data mining is a process of cooperation between a variety of experts, and it is also a process of high investment in capital and technology. This process must be repeated in the repeated process, constantly approaching the essence of things, and constantly prioritizing problems. Data reorganization and subdivision, adding and splitting records, selecting data samples, visualization, data exploration, clustering analysis, neural network, decision tree mathematical statistics, comprehensive interpretation and evaluation of time series conclusions, data knowledge, data sampling, data exploration, data adjustment, modeling evaluation. For example: Relevance Analysis. Relevance analysis is to give the similarity of items or objects. There are mainly the following application scenarios. Providing different services or advertisements to the target audience. Movie recommendation or Taobao product recommendation. Genetic analysis to discover common ancestors. To simplify the code, we only consider two items at the same time. Let's say that user A buys milk and bread. We want to follow the principle that if user A buys X, then he is likely to buy Y as well.

```

1 import numpy as np
2 file = "affinity_dataset.txt"
3 X = np.loadtxt(file)
4 n_samples, n_features = X.shape
5 print("This dataset has {} samples and {} features".format(n_samples, n_features))
6 # the name of your features
7 features=["bread", "milk", "cheese", "apples", "bananas"]
    
```

Figure 3. Code set.

7 CONCLUSIONS AND RECOMMENDATIONS

In recent years, the development of digital inclusive finance has attracted high attention from all walks of life, it also has a profound influence on China's economic development. This paper studies the impact of digital inclusive finance on enterprises' innovation ability, empirically tests the impact of digital inclusive finance on enterprises' technological

innovation with the help of the data of Chinese listed companies from 2011 to 2017, and draws the following conclusions. The development of digital inclusive finance plays a significant role in promoting the technological innovation of enterprises. The possible mechanism of digital inclusive finance to promote technological innovation of enterprises is that it alleviates the financing constraints of enterprises and enables enterprises to increase investment in R&D activities. It is worth mentioning that there are still some shortcomings in this paper. This paper does not test the influence mechanism of digital inclusive finance on enterprise technological innovation, which is also the next research of the author.

Combined with the test results of digital inclusive finance on enterprise technological innovation, This paper puts forward the following policy suggestions. First, we should actively promote the development of big data technology, encourage financial institutions to provide financing services to enterprises by means of digital inclusive finance, and provide full financial support for technological innovation activities of enterprises. According to the Plan for Promoting The Development of Inclusive Finance (2016-2020) issued by The State Council, inclusive finance refers to providing appropriate and effective financial services at an affordable cost to all social strata and groups in need of financial services based on equal opportunities and the principle of business sustainability. Small and micro enterprises, farmers, urban low-income groups, poor people, the disabled, the elderly and other special groups are the key service objects of inclusive finance in China. It is of great significance to develop inclusive finance to help those who have long been outside the formal financial system to obtain effective financial support.

Second, the characteristics of digital inclusive finance, such as low threshold and high convenience, make it have a positive impact on many aspects of the economy. However, the distorted development of Internet companies blindly pursuing profits not only has a huge impact on traditional commercial banks, but also endangers the stability of the entire financial system. From the liability side of banks, various financial products launched by digital inclusive finance make the deposit competition faced by commercial banks increasingly fierce. Financial products represented by Yu'eobao have been highly sought after by investors since their issuance. They not only promise flexible access to investors' funds, but also bring investors returns higher than bank deposits, leading to continuous loss of savings deposits in commercial banks. From the asset side of

the bank, the bank may choose the assets with high risk and high return to make up for the loss of its liability side. From the point of view of payment end, Alipay, wechat Pay and other third-party payment platforms have formed a situation of competing with banks. Banks' fee income has been slashed by the fact that most payments are bypassing the banking system, with no fees charged and money transferred immediately to their accounts. The digitalization of finance makes high-risk behaviors more hidden. Regulators should be alert to non-performing asset securitization and financial products of commercial banks. Although these financial products are covered with the cloak of inclusive finance, they are essentially Ponzi Financing, which undermines the stability of commercial banks and even the entire financial system. Therefore, the management's supervision of the financial field should follow closely the financial innovation and prevent financial risks.

REFERENCES

- Berger A. N., Udell G. F., "Relationship Lending and Lines of Credit in Small Firm Finance". *Journal of Business*, 1995.
- Liang Bang, Zhang Jianhua." The Impact of China's Inclusive Financial Innovation on Smes' Financing Constraints ", *Journal of China Science and Technology Forum*, Vol.11, pp.94-105, 2018.
- Lin Yifu, Li Yongjun." Development of small and medium-sized Financial institutions and financing of small and medium-sized enterprises". *Journal of Economic Research*, Vol.1, pp.10-18+53-93, 2001.
- Stiglitz J. and Weiss A., "Credit Rationing in Market with Imperfect Information. *The American Economic Review*", 1981.
- Wang xiao, Zhang Jie. "The relationship between bank credit rationing and sme lending: a Theoretical model of Endogenous Collateral and firm size", *Journal of Economic Research*, Vol.3, pp.68-75+92, 2003.
- Wuxiang Zhu, Ping Zhang, Pengfei Li, Ziyang Wang. "The impact of COVID-19 on smes' dilemma and policy efficiency: an analysis based on two national questionnaire surveys ", *Management World*, Vol.4, pp.13~26, 2020.
- Yu P, Dou J X. Digital inclusive finance, "firm heterogeneity and innovation of msmes", *Contemporary Economic Management*, Vol. (12), pp79~87,2020.
- Yu Weifeng, Kang Qi, Zhou Yongfeng." Can the Establishment of Inclusive Finance Division in Commercial banks improve the credit availability of small and micro enterprises? -- Empirical Test based on PSM-DID model ", *International Journal of Finance*, Vol.11, pp.77-86, 2020.