Technological Innovation and Stability of Economic Growth: An Empirical Research in China

Chen Yu[1, a]
[a]e-mail: 20120675@bjtu.edu.cn

[1]School of Accounting, Beijing Jiaotong University, Haidian, Beijing, China

Abstract—Based on the inter provincial panel data from 2014 to 2019, this paper empirically investigates the impact of technological innovation on the stability of economic growth. The conclusions are as follows: first, on the whole, technological innovation plays a positive role in promoting the stability of economic growth and can significantly improve the stability of economic growth; Second, the number of patent applications accepted can promote the positive effect of the number of technology contracts on the stability of economic growth; Third, excessive investment in technological innovation has an adverse effect on the stability of economic growth. Based on the above conclusions, this paper puts forward some suggestions: encourage to improve the quantity of technological innovation, improve the quality of technological innovation, and rationally control the investment in technological innovation.

Keywords-technological innovation; Stability of economic growth; Innovation input-output

1 Introduction

At present, the world economic situation under the epidemic is complex, Under the impact of the new crown pneumonia epidemic and the complex economic situation at home and abroad, we need to pay special attention to how to achieve steady economic growth. In recent years, China's economic development has been in the stage of rapid growth. The state attaches great importance to the quality of China's economic increase, and the stability is an important part of high-quality economic development. Lucas [1] found through a series of calculations that the welfare cost of reducing economic growth is much greater than the welfare cost of economic fluctuations. Therefore, we should focus on economic growth and maintain economic growth at a high speed without paying attention to economic fluctuations. However, Chen Yanbin [2] believes that in combination with the actual situation of China, the error of Lucas model and the high growth rate of China's economy lead to a serious overestimation of the welfare cost of reducing economic growth, and the large volatility of China's economy leads to an underestimation of the welfare cost of economic fluctuation. Therefore, while paying attention to economic development in China, we should pay special attention to the stability of economic growth, so that we can only maintain China's high-quality economic growth.

At present, informatization and digitization promote China's economic development, and technological innovation has attracted much attention as the driving force. Most scholars believe that technological innovation can drive China's high-quality economic growth. For example, Li Chenggang [3] constructed the dynamic spatial Du bin model, combined with the intermediary

MSIEID 2022, December 09-11, Chongqing, People's Republic of China

DOI 10.4108/eai.9-12-2022.2327677

effect model, and found that the local technological innovation has a significant positive correlation with economic growth, but the technological innovation in the surrounding areas has a significant negative correlation with economic growth. Some also explore the impact of green technology innovation from the perspective of green economy. Fan Dan et al. [4] found that environmental regulation means and green technology innovation are the two driving forces to promote green economy. There are also studies on the impact of multi factors and technological innovation on economic growth, such as industrial agglomeration [5], social capital [6], and population aging [7].

It can be seen that the above research has limitations. First, most studies focus on the impact of technological innovation on economic increase. Although they also focus on high-quality economic growth, they have not paid special attention to the relationship between technological innovation and economic stability. Second, there is no consistent conclusion on the impact of technological innovation on the stability of economic growth. Technological innovation has both positive and negative effects on the stability of economic growth. On the one hand, technological innovation is conducive to improve the technological capacity of enterprises and enhance market competitiveness. In addition, innovative technical is conducive to improve the management efficiency and ability, and make the operation and management of enterprises more refined and controllable. Enterprises can increase their ability to resist the risk of economic fluctuations. On the other hand, there are certain risks in the application and promotion of new technologies in the market. The formation of customer habits and the change of production mode need an adaptation period. The false prosperity and bubbles caused by new technologies will cause economic fluctuations more easily. Therefore, this study attempts to further explore whether technological innovation has an impact on the stability of economic growth? And what kind of impact?

2 Materials and Methods

This study selects the panel data of 31 provinces and cities in China from 2014 to 2019 as a sample to study the impact of technological innovation on the stability of economic growth in different regions and years in China. Inter provincial panel data is not sensitive to missing variables, and can reduce the impact of multicollinearity to a great extent. At the same time, it can better reflect the characteristics of different regions in different years and more in line with the economic law. There are many missing data before 2020 and 2014. For the sake of data preciseness and accuracy of measurement results, the time dimension of all data is uniformly adjusted to 2014-2019, and each group of samples contains 186 groups of observed values. In addition, the data were standardized in order to compare the coefficients. The data of this study are from wind database, China Statistical Yearbook and the State Intellectual Property Office. Stata12.0 was used for data analysis software.

2.1 Index Construction

2.1.1 Explained Variable

The explanatory variable is the stability of economic growth. It mainly refers to the economic growth stability index in the economic growth quality index system constructed by He Xingbang [8], and selects the annual CPI of each province to measure the stability of economic growth.

2.1.2 Explanatory Variable

Most scholars use R & D funds and the number of patent applications accepted to measure the indicators reflecting technological innovation, but the patent indicators are more suitable for time series data, and it is not reasonable to include them in provincial panel data [9]. The whole process of technological innovation from input to output will affect the stability of economic growth. Therefore, this paper selects the full-time equivalent of researchers in Industrial Enterprises above Designated Size, the number of patent applications accepted and the number of technology development contracts in the technology market to measure the degree of technological innovation from the perspectives of innovation input, innovation output and the whole process of innovation input and output.

2.1.3 Control Variable

The control variables include: the per capita GDP variable is used to control the impact of regional economic development level on the stability of economic growth; The population dependency ratio variable is used to control the impact of labor conditions on the stability of economic growth; The urban per capita Road area variable is used to control the impact of regional infrastructure conditions on the stability of economic growth; Local public financial expenditure variables are used to control the impact of government financial behavior on the stability of economic growth.

2.2 Model Design

The data used for empirical test is composed of short panel data of 31 provinces and cities in 6 years, and a fixed effect model including time effect is constructed. Macroeconomic data are greatly affected by the economic environment. The introduction of time fixed effect can solve the problem of missing variables that do not change with individuals but change with time.

The basic form of the fixed effect model is:

$$CPI_{it} = \beta_0 + \beta_1 Deven_{it} + \alpha Z_{it} + u_t + \varepsilon_{it} \quad (1)$$

$$CPI_{it} = \beta_0 + \beta_1 Deven_{it} + \beta_2 Patent_{it} + \alpha Z_{it} + u_t + \varepsilon_{it} \quad (2)$$

$$CPI_{it} = \beta_0 + \beta_1 Deven_{it} + \beta_2 Patent_{it} + \beta_3 Researcher_{it} + \alpha Z_{it} + u_t + \varepsilon_{it} \quad (3)$$

Among them, CPI is the resident consumption index of each province and city in different years; Deven is the number of technology contracts in the technology market of each province and city in different years; Patent is the number of patent applications accepted by provinces and cities in different years; Researcher is the full-time equivalent of researchers in Industrial Enterprises above Designated Size in various provinces and cities in different years; Z is other control variables; u_t is time fixed effect; ε_{it} is an error term subject to independent identically distributed.

3 Results & Discussion

This study adopts a fixed effect model including time fixed effect. The fixed impact model parameter estimation method uses the least square virtual variable estimation method, but the addition of virtual variables will cause the loss of degrees of freedom, but the impact of individual characteristics can be estimated one by one. Heteroscedasticity and autocorrelation were processed by panel correction standard error.

3.1 Variable Descriptive Statistics

Descriptive statistics are made on the main variables involved in the article. Table 1 is the descriptive statistical results of the variables.

Table 1 Descriptive statistics of variables

Variable	Obs	Mean	Std. Dev.	Min	Max
CPI	186	12.46774	5.709313	1	27
Researcher	186	90600.33	126093	43	642490
Deven	186	11783.12	16153.35	36	83171
Patent	186	106944.2	143702.2	248	807700
Rgdp	186	59362.32	27462.17	26165.26	164220
Population feed rates	186	14.73656	3.427054	7.01	23.82
Road area	186	16.29355	4.692309	4.11	26.19619
Fisal	186	5.40e+07	2.86e+07	1.00e+07	1.73e+08

3.2 Analysis of Empirical Results

The regression results are shown in Table 2. This study gradually introduces different explanatory variables for fixed effect model regression analysis, so as to test the impact of different technological innovation indicators on the stability of economic growth. The results are relatively stable.

The results in column (1) show that the coefficient of the variable of the number of technology contracts in the technology market is positive. Every time the variable increases by 1, the economic stability increases by 4.005. The growth of the number of technology contracts in the technology market significantly promotes the improvement of the stability of economic growth. Each time dummy variable is very significant, which proves that the model does have a time effect. The experimental results show that technological innovation does significantly affect the stability of economic growth, and has a positive impact. The signing of technology contract will supervise and urge enterprises to implement technological innovation and achieve effective results of technological innovation. It can better reflect the whole process of technological innovation from input to output. As a measurement variable of technological innovation, it is more persuasive.

Table 2 Regression results based on full sample

variable	(1)	(2)	(3)
Deven	4.005***	4.279***	4.278***
	(1.232)	(1.228)	(1.241)
Patent		-1.399*	-1.360*
		(1.020)	(1.203)
Researcher			-.0912
			(1.831)
Rgdp	-4.142***	-4.110***	-4.107***
	(1.686)	(1.671)	(1.706)
Population feed rates	0.379	0.129	0.123
	(1.065)	(1.112)	(1.053)
Road area	1.079*	1.020*	1.023*
	(0.987)	(1.011)	(1.009)
Fisal	2.878**	4.298***	4.306***
	(1.551)	(1.957)	(2.012)
2015.time	-6.143***	-6.296***	-6.301***
	(0.739)	(0.756)	(0.789)
2016.time	-2.679***	-2.756***	-2.766**
	(1.253)	(1.257)	(1.411)
2017.time	-5.470***	-5.644***	-5.655***
	(1.527)	(1.529)	(1.671)
2018.time	-0.704	-0.905	-0.917
	(1.564)	(1.573)	(1.732)
2019.time	5.113***	4.734***	4.726***
	(2.113)	(2.119)	(2.245)
Constant	14.115***	14.279***	14.287***
	(1.089)	(1.095)	(1.207)
R-sauared	0.6758	0.6778	0.6778
Number of pro	31	31	31
* p<0.1; ** p<0.05; *** p<0.01			

The results in column (2) show that there is a negative correlation between the number of patent applications accepted and the stability of economic growth. Every time the number of patent applications accepted increases by 1, the stability of economic growth decreases by 1.399, and the number of patent applications accepted significantly reduces the stability of economic growth. However, after adding the variable of the number of patent applications accepted, the variable of the number of technology contracts is still significant and the positive correlation is enhanced. For each additional unit of technology contract, the stability of economic growth increases by 4.279, which further promotes the stability of economic growth. It can be seen that the number of patent applications accepted can not be falsely high. Too many low-quality patent applications will cause a waste of resources, which is not conducive to economic stability. Ensuring patent quality can effectively promote the positive effect of the number of technology contracts on the stability of economic growth. The number of patent applications accepted is a variable to measure the output of technological innovation. It indicates the degree and ability of technological innovation. Due to the quality problems of patent applications, the degree of technological innovation may be falsely high and the accuracy is not high.

The results in column (3) show that the full-time equivalent of researchers in Industrial

Enterprises above Designated Size will weaken the stability of economic growth. For each unit increased, the stability of economic growth will decrease by 0.091 units. This variable does not significantly affect the stability of economic growth. After adding this variable, the weakening effect of the number of patent applications accepted on the stability of economic growth is slightly weakened. The full-time equivalent of researchers in Industrial Enterprises above Designated Size mainly measures the investment in technological innovation. It can be seen that too high investment in technological innovation will lead to unstable economic growth.

On the whole, technological innovation will effectively promote the stability of economic growth and ensure stable development while ensuring rapid economic development. The specific reasons may be as follows: first, technological innovation promotes the improvement of the overall technological level of society, which can not only predict the risk level in advance and be controlled in advance; It can also catch fluctuations and anomalies in time and make the most timely response; Finally, the accident can be handled with the least loss afterwards to reduce the loss. So as to ensure stable economic growth. Second, technological innovation is also conducive to promoting benign market competition. It can be used as a driving force to stimulate the growth of enterprises, help individuals obtain competitive advantages and deal with the risk of economic change.

3.3 Robustness Check

Economic growth stability has a certain inertia trend, and technological innovation and economic growth stability may also have a certain two-way causal relationship, so the fixed effect model may have endogenous problems. Therefore, this study uses the economic growth stability lagging behind the first stage to control the inertia trend, and takes the number of technology contracts lagging behind the second stage as the instrumental variable to test whether the regression result is stable through the GMM model. The basic regression model is:

$$\begin{aligned} CPI_{it} = \beta_0 + \beta_1 CPI_{it-1} + \beta_2 Deven_{it} + \beta_3 Patent_{it} \\ + \beta_4 Researcher_{it} + \alpha Z_{it} + u_t + \varepsilon_{it} \end{aligned} \tag{4}$$

Among them, CPI_{it} is the stability of economic growth, CPI_{it-1} is the first lag term of economic growth stability, and the other variables are consistent with the above.

Table 3 Regression results

VARIABLES	(1)	(2)	(3)
CPI	0.138*	0.135*	0.140*
	(0.0778)	(0.0750)	(0.0719)
Deven	3.967***	3.941***	3.665**
	(1.440)	(1.406)	(1.411)
Patent	-1.717	-1.393	
	(1.207)	(1.021)	
Researcher	0.720		
	(1.953)		
Rgdp	-4.334**	-4.338**	-4.382**
	(1.700)	(1.727)	(1.734)
Population feed rates	-0.679	-0.775	-0.523
	(1.383)	(1.513)	(1.486)

Road area	1.672* (0.891)	1.697* (0.912)	1.761* (0.911)
Fisal	4.948* (2.578)	5.216** (2.173)	3.810** (1.581)
Constant	5.986*** (1.433)	6.069*** (1.298)	5.990*** (1.288)
R-squared	0.715	0.715	0.713
Number of pro	31	31	31
* p<0.1; ** p<0.05; *** p<0.01			

Table 3 shows the regression results of robustness test. The results show that technological innovation still plays a positive role in the stability of economic growth, and the results are significant. Therefore, the conclusion of the previous analysis is robust.

4 Conclusions

In order to explore the impact of technological innovation on the stability of economic growth, this study constructs a time fixed effect regression model, and selects the number of technology contracts in the technology market, the number of patent applications accepted and the full-time equivalent of researchers in Industrial Enterprises above designated size as variables to characterize the degree of technological innovation from three perspectives: the whole process of technological innovation input-output, innovation output and innovation input. The results show that: first, on the whole, technological innovation plays a positive role in promoting the stability of economic growth and can significantly improve the stability of economic growth; Second, the number of patent applications accepted can promote the positive effect of the number of technology contracts on the stability of economic growth; Third, excessive investment in technological innovation has an adverse effect on the stability of economic growth.

Based on the above research, it has some enlightenment for economic development: first, actively promote and promote technological innovation. In order to ensure high-quality economic growth and deal with economic fluctuations, we should actively promote technological innovation activities and increase the number of technological innovation achievements; Second, improve the quality of technological innovation rather than blindly develop the quantity. We should adhere to the combination of system construction and cautious opening, formulate perfect technical innovation cost certification indicators, and reasonably evaluate the achievements of technical innovation, so as to improve the quality of technical innovation; Third, while improving the quantity and quality of technological innovation, we should ensure the stable growth of technological innovation investment, not too fast, and we should carry out technological innovation activities rationally.

References

[1] Lucas, Robert. (1987) Models of Business Cycles, Ox- ford: Basil Blackwell.

[2] Chen Yanbin. (2005) China's economic growth and economic stability: which is more important. Managing the world,07:16-21.

[3] Li Chenggang, Yang Bing, and Miao Qixiang. (2019) Regional economic growth effect of technological innovation and industrial structure transformation -- An Empirical Analysis Based

on dynamic spatial Dobbin model. Scientific and technological progress and countermeasures, 36(06): 33-42.
[4] Fan Dan and Sun Xiaoting. (2020)Environmental regulation, green technology innovation and green economic growth. China's population, resources and environment,30(06):105-115.
[5] Hao Yongjing, Cheng Sining. (2019) Industrial agglomeration, technological innovation and economic growth of urban agglomeration in the middle reaches of the Yangtze River -- from the perspective of heterogeneous industrial agglomeration and collaborative agglomeration. Industrial technology economy,38(01):41-48.
[6] Chen Chengfeng, Xu Peiyuan. (2015)The impact of social capital on technological innovation and economic growth -- Based on China's empirical evidence. Journal of Shanxi University of Finance and economics,,37(10):23-32.
[7] Wang Jianxu, Wang Shujuan.(2017)Population aging, technological innovation and economic growth -- from the perspective of the transformation of factor endowment structure. Journal of Xi'an Jiaotong University (SOCIAL SCIENCE EDITION),37(06):27-38.
[8] He Xingbang. (2019) Technological innovation and the quality of economic growth -- An Empirical Analysis Based on inter provincial panel data. China Science and Technology Forum, 10: 24-32+58.
[9] Liu Tingting.(2017)R & D investment, innovation mechanism and economic growth -- theoretical analysis and empirical test under the new technology index system. Nankai Economic Research.03:139-153.