-RESEARCH ARTICLE-

THE ANALYSIS OF THE REGIONAL ECONOMIC GROWTH AND THE REGIONAL FINANCIAL INDUSTRY DEVELOPMENT DIFFERENCE IN CHINA BASED ON THE THEIL INDEX

Chuan Chih. Mao

Business School, Chizou University, CZU China
E-mail: dominicusmao@gmail.com
https://orcid.org/0000-0003-2215-9907

Zhi Xin.Ma

Business School, Chizou University, CZU China
E-mail: 1160251833@qq.com

—Abstract—

Based on the panel data of 31 provinces and cities across China (except Hong Kong, Macao, and Taiwan) from 2003 to 2018, this paper identifies four economic regions i.e., eastern, central, western, and northeast, according to the national development layout. We study the degree of economic and financial disparities and its influencing factors in large economic regions of China. We use Granger causality measure to test whether there is a causal effect between economic and financial development in the regions of China. The relationship between growth, industrial structure, and economic vitality is comparatively analysed. The results of the study find that the economic and financial disparities in the four major regions are generally in a downward trend for these years. In addition, the relationship between the financial development of the four major regions and their economic growth, industrial structure, and economic vitality has obvious regional disparities. Lastly, we conclude that financial development does not necessarily follow economic development.

Keywords: Chinese major economic regions, Theil index, regional financial development, financial deepening

JEL Classification: G21, G24, G32

1. INTRODUCTION

In order to effectively improve the economy, since the founding of New China, the Chinese government has adopted a regional development plan to develop the economy (Ouyang et al., 2018). The main purpose is to effectively improve the national economic level while promoting a well-coordinated inter-regional process of economic development. After a long period of exploration and continuous innovation, and repeated attempts by the Chinese government, China has determined the current regional division module, dividing China into four economic regions: East, central, west, and northeast. The western region covers twelve provinces, municipalities, and autonomous regions, including Tibet, Xinjiang, Inner Mongolia, Guangxi, Ningxia, Qinghai, Sichuan, Chongqing, Guizhou, Yunnan, Gansu, and Shaanxi, which are covered by the Western Development Policy; the eastern region refers to Beijing, Tianjin, Ten provinces and cities including Hebei, Shandong, Shanghai, Zhejiang, Jiangsu, Hainan, Fujian, and Guangdong which are mainly coastal areas; the central region refers to six provinces including Shanxi, Henan, Jiangxi, Hubei, Hunan, and Anhui; the northeast region includes the three provinces of Heilongjiang, Liaoning and Jilin. China has developed and tried out a number of regional integration plans in recent years, which facilitate creation of new patterns of growth and development, Economic growth has increased over time, and the difference between economic development and financial development has demonstrably been on the decline (Charfeddine et al., 2019).

In terms of domestic economic development, it merits to note there are disparities in the overall scale and level of regional financial development, as well as uneven development between regions. In the process of economic development, there is an inseparable relationship between financial development and the economy, and financial development is usually considered as the core element of economic development (Ibrahim et al., 2018). If the level of disparity in financial development is high, the gap in regional financial development will become wider; as a result, the coordinated development of regional economies will be hampered. Figure 1 shows trends in regional financial development while Figure 2 highlights the GDP per capita.
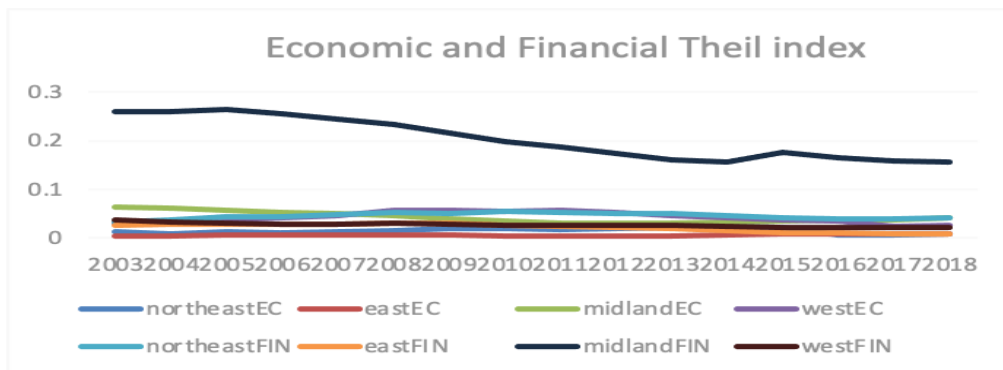
Figure 1: Regional financial development disparities
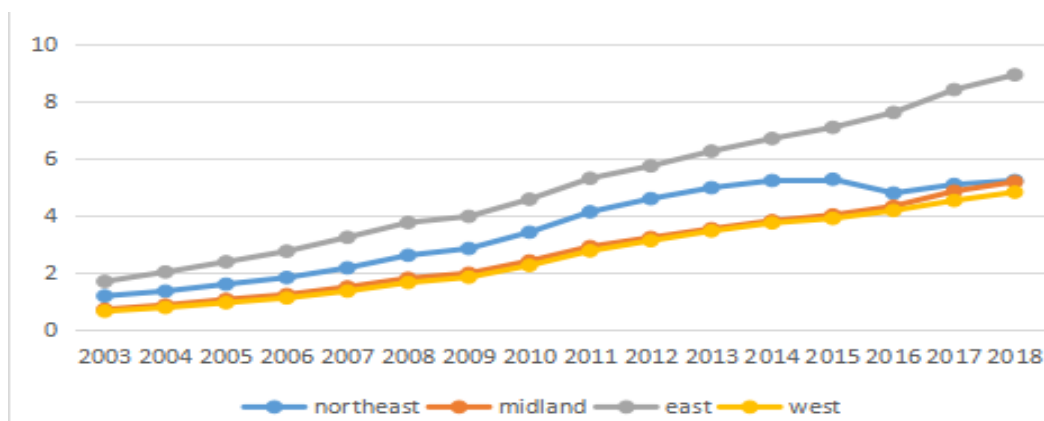**Source:** Empirical Economics Results by this survey

Figure 2: The development status of GDP per capita from 2003 to 2018
Source: National Chinese data (data.stats.gov.cn)

According to the study of Salahuddin et al. (2018), it is empirically found that when economic development reaches a certain level, the changes of financial interrelation ratio (FIR) will be reviewed. From the view of time series, the national income growth rate is slower than the rate of financial assets, therefore, the financial correlation has increased in China. The development status of GDP per capita from 2003 to 2018 has increased every year. The difference of financial and economic development tends to be steady over time. The same is true for financial development, and the researchers identifies the study sample from more than 30 countries for all years since 1963 about 100 years. Figure 3 and Figure 4 present a side-by-side comparison of regional economic and financial disparities by using economic and financial Theil index. The Theil index is a statistic that is used to measure economic inequality. It measures the entropic "distance" the population is away from the "ideal"

egalitarian state of everyone having the same income. Entropy refers to the amount of disorder, while negative entropy refers to something has less disorder, or more order. Thus, the results have been shown that the contribution of inter-block is more than the intra-class in case of economic factor. The rate of contribution of intra-class in the economic factor is 0.05 to 0.02 for given the units while rate of contribution of inter-block in the economic factor is 0.1 to 0.06. On the other hand, the results also have been shown that the contribution of inter-block is less than the intra-class in case of financial factor. The rate of contribution of intra-class in the financial factor is 0.17 to 0.15 for given the units while rate of contribution of inter-block in the financial factor is 0.14 to 0.12.
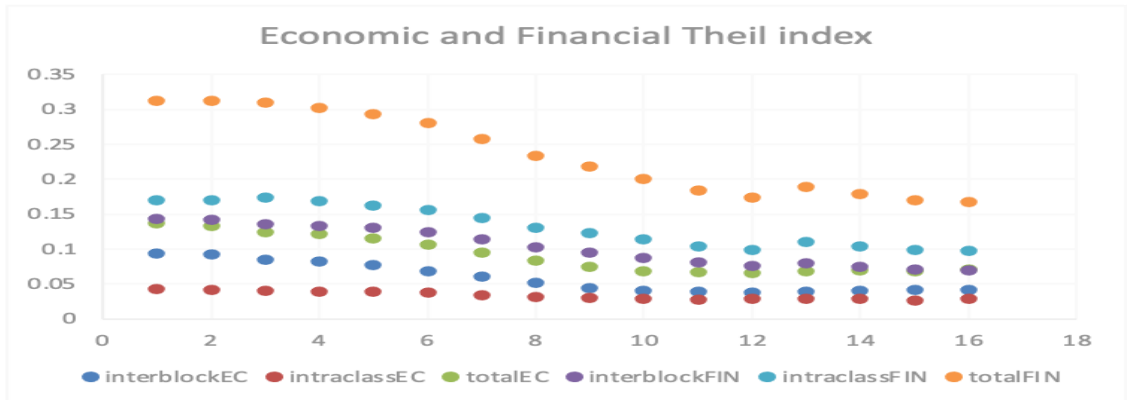

Figure 3: Comparison of regional economic and financial disparities: Economic and Financial Theil index
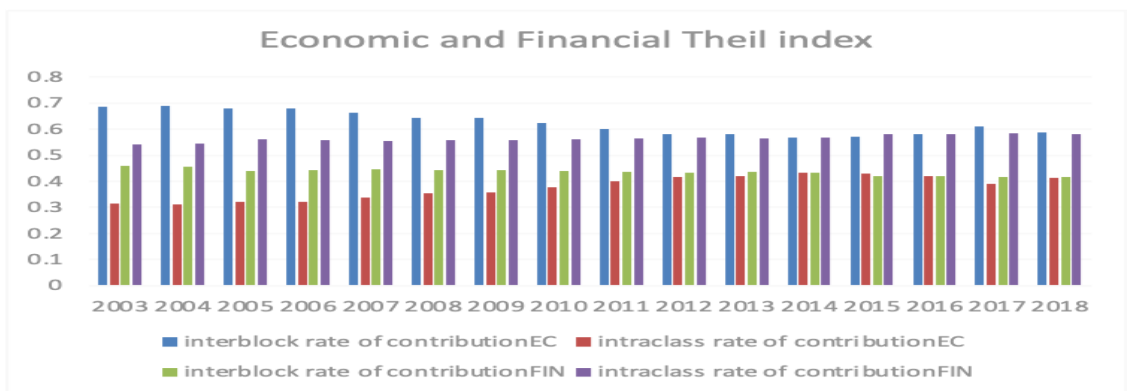**Source:** Empirical Economics Results by this survey

Figure 4: Comparison of regional economic and financial disparities: Economic and Financial Theil index（2003—2018）
Source: Empirical Economics Results by this survey

Theil index shows that total economic variability is higher than total financial variability. The degree of influence between the economic Theil index groups is more significant than that within the regional groups, while the financial Theil index shows an opposite trend. Based on figure 2 we observe that China's central, eastern and western regions generally show an upward trend in per capita GDP from 2003 to 2018 (Y axis represents the years for the period of 2003-2018). Among them, the northeast region had a dip in its economy in 2015. The development trend is better than the western and central regions, and the gap between the three has been narrowing since 2016. From 2003 to 2018, the per capita GDP of the eastern region has shown increase from 16,900 yuan to 89,400 yuan. After 15 years, the GDP per capita increases by 5.3 times; the per capita GDP of the central and western regions both, increases by more than seven-fold in 15 years; The eastern region shows an increase by about five times while the northeast region experiences the lowest growth rate, only 4.4 times in 15 years.

From the perspective of the growth rate of per capita GDP, the growth rate of the eastern region is slower than that of the central and western regions. At the same time, the growth rate of the northeast region is the lowest in fifteen years, however, from the absolute value of the data, the eastern region ranked lowest for growth rate in the year 2003. The starting point is higher than the other three regions. In 2003, the per capita GDP of the eastern region and the western region was 16,900 yuan and 6,500 yuan, respectively. In the years of development that follow, the gap between the eastern region and the other three regions is seen gradually increasing. Figure 5 shows the financial ratios.
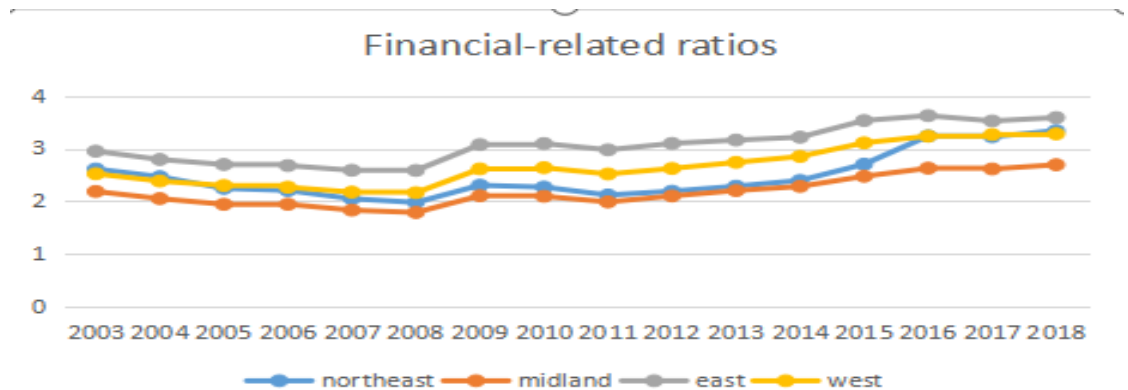

Figure 5: Financial-related ratios from 2003 to 2018
Source: self-organized by this research

Since 1960, Europe has FIR between1/3-2/3, and the United States since 1990 to 2000 has higher level of FIR than that. From 2003 to 2018, the middle region of China FIR

is between 2-3. The other regions are above three. This serves to prove that China's financial development has reached a higher level in comparison to other countries. Due to the rapid development of the financial industry, the number of related financial institutions and financial instruments has also begun to develop rapidly, followed by an expansion in the scale of financial assets. The financial interrelation ratio is the ratio between the scale of financial assets and national wealth. It is a frequently used indicator in financial development research. For China, financial institutions are mainly banks, and the ratio of total deposits and loans of financial institutions to GDP is used as an indicator to measure financial development.

It can be found that given China's economic growth, the scale of China's financial institutions has greatly increased, and the loan ratio too has increased every successive year. The greater the proportion of the financial industry in economic development (Bist, 2018), the more it is able to accelerate the speed of economic resource allocation, thereby increasing the utilization rate of relevant resources, and at the same time, enhancing the ability to flow between funds; however, it will also lead to an increase in the possibility of uneven distribution of funds between regions. Moreover, the deposit-loan ratio in the eastern region is significantly higher than that in other regions, while the value in the central region is at a relatively lower among the four regions (Nasir et al., 2019).

This paper divides China into four regions by using Theil index and exploring the distribution of economic and financial differences through an inter-block and intra-class lens in order to determine the composition characteristics of the Theil index. To determine the difference between levels of economic development and financial development among the four regions, the paper explores the time series relationship of Theil Index in order to demonstrate the impact of time on differences as well as measure the stationary of each area with unit root test. In addition, the Bartlett's test is used to analyze whether the differences among four major regions are significant. Granger causality explores and analyses the causal relationship between the economic and financial differences and the main variables of this study in order to outline the characteristics of the four major regional economic and financial differences. The ultimate objective of the study is to find policy-oriented and welfare-oriented ways of decreasing regional economic differences and promote coordinated regional development

The economic development of a country is manifested in improved growth rates in all economic institutions along with enhanced economic activity (Charfeddine et al., 2019). The overall economic development of the country and its position in the international market is dependent on economic development at the regional level. The development of all business units relating to different sectors at the regional level determines the overall economic growth of the country. Business organizations

belonging to the same industry show a different level of growth in different regions of the same country. The economic development of business organizations in different regions depends on the development of financial institutions operating in the same regions (Ouyang et al., 2018). By ensuring regional financial development and regional economic development, the overall economic growth rate of the country can be enhanced. This issue requires an in-depth investigation from researchers and practitioners. The present study aims to analyzed the impact of regional financial development on the regional economic development and the overall economic development of the country. In past studies, the contribution of financial development to the economic development has been analyzed, or they have examined the influences of regional financial development only on regional economic development without considering their impact on the country's overall growth or position in the international market. Only a limited number of studies are found which address the impact of regional financial development on regional economic development and the country's overall economic growth. In this regard, this study is an exception within the existing body of literature as it looks at the influences of regional financial development on regional economic development and the overall country's economic growth. The ultimate objective of this article is to depict the differences in China's regional economic and financial development disparities as well as help in the formulation of policy recommendations as a reference guide for Chinese government/policymakers to ensure better governance and promote public welfare.

2. Literature Review

China is the second largest economy in the world. The relationship between regional economic growth and financial e determines the level of political stability, which in turn, influences world market and politics. Numerous scholars have contributed to the literature on the subject, covering four key issues:

2.1 Regional economy and regional finance are different significant

In China, for the period 1978-1999, the Financial Interrelations Ratio (FIR) data found evident regional imbalances in China's financial development. The difference exceeds the fiscal and economic gap geographical factors. Financial personality and organization are the main factors responsible for differences in regional finance. Besides, factors pertaining to location and economic development, financial institution and policy environment are also important factors leading to financial development differences (Saud et al., 2019). According to the Theil Index, we can determine that economic development trends seen along the line by Yangtze River economic zone are significant. Traffic problems, population flow, population quality, industrial structure and quality problems are identified as the main causes of regional economic differences (Kahouli, 2017).

Regional economy and regional finance are two significant factors of regional progress. The two terms are different, but they both depend on one another. The regional economy covers all economic resources within a particular region and economic activities being conducted therein. Geographical changes, demographic composition of the population, the culture of the region, and people's behaviour affects the economic conditions in that region. Therefore, favourable geographical conditions, the appropriate number of people, cultural characteristics, and the people's economic bent of mind makes for a strong regional economy, strengthening the development prospects of the regional economy. The study of Pan et al. (2019) implies that the regions of the country where financial institutions experience rapid progress performed their duties efficiently, and all the other organizations working across different economic sectors (agriculture, industry, and service sector) also show relatively higher performance accounting for a more proportional development. According to the literary work of Zaidi et al. (2019), which investigates regional progress, in the regions where financial institutions have a variety of convenient services, the business organizations are more likely to show better operational and financial performance as it is a robust regional financial system which provides and assures financial security to economic institutions.

2.2 The correlation between regional financial development and regional economic development

In this part of the study, we explore whether there is a correlation between the financial development of China and the economic growth between the regions based on data from 1978 till 2000 from every region in China. The results from the econometric analysis show that both report a significant correlation relation. The relationship between the East and the whole country presents a positive correlation. The central and western regions are almost negatively related; the time lag effect is presented (Urbano et al., 2020). However, there is no correlation with investment growth, although the conclusion on investment is not obvious; and the relationship between financial development and economic development in the eastern region show a positive correlation, while the central and western regions show an almost negative correlation and report a lag effect. There is a positive causal relationship in the east while the relationship in the western region is one of mutual inhibition. Financial development can improve the effectiveness if the gap between economic developments is narrowed. Both of them develop harmoniously when there is a strong linkage between the two (Shahbaz et al., 2017). There are obvious differences between the regions. From East to west, the rate between developed slowly. According to the empirical econometric analysis, the correlation between financial development domestically and abroad, financial deepening and financial development are the two important factors for economic development (Bermejo Carbonell et al., 2018). The difference of scale and

structure in China is the main reason for the difference in financial development, explaining the regional imbalances in economic growth.

According to the views of Mahmood et al. (2019), regional financial development and regional economic development are interlinked. Any organization which has been established with an aim to perform economic activities to earn profits will survive and flourish more access to financial resources. The nature and variety of capital, assets, and service of financial institutions determines the fluency of activities of other organizations across any economic sector (agriculture, industry, and service), operating within the same region(s). It is financial institutions that provide financial support to the regional economic institutions at the time of the start of the business, to help it establish and grow, and to protect themselves from financial crises. Ibrahim et al. (2018), in his literary work, demonstrates the significant role of the financial sector in promoting the overall economic sector of the country. In this study, he argues that the health and scope of the financial system in a particular region determines the health and scope of the business organizations operating within that region. Developing financial institutions facilitates the economic system of the region as it enables organizations to acquire different resources (informational, physical, and human resources) to perform their operations fluently.

2.3   Regional economy and regional finance differences are existing

Using data of the financial-related ratio (FIR) index in China between 1978-1999, the survey shows that there is an evident regional imbalance in China's financial development, and the gap between finance exceeds the gap between finance and the economy. Geographical factors, financial personality and self-organization are the main factors affecting the differences in regional finance (Sheng et al., 2018). Moreover, important factors that cause the differences in financial development also include location/region, economic development, financial institutions, and policy environment. Through Theil index analysis, it is found that there are differences in the economic development of the Yangtze River Economic Belt economic regions. It further points out that traffic problems, population flow, industrial structure and quality problems are the main drivers of regional economic differences (Asteriou et al., 2019).

As the regional financial system and regional economic system are interrelated, any changes in the working dynamics and development trajectories of any of the two systems ultimately affects the other. The investigation by Li et al. (2020), on economic development and the affecting factors, posits that the regions where financial institutions tend to bring change in their policies and strategies whether related to their inner operations or their customer services, there is a definite effect on the policies and operations of the commercial entities including agricultural, industrial, or service providing organizations. Financial resources are the backbone of an economic body. It

is financial resources that ensures an organization's access quality material, innovative technology, and an efficient workforce. Moreover, financial security that enables economic institutions to recover and reboot from an unprecedented financial crisis. Thus, regional financial development guarantees the economic development of the region as well (Wang et al., 2017).

2.4 Is there a correlation between regional financial development and economic development?

According to the empirical analysis, it proves that financial deepening and financial development are important factors for China's economy. Based on the data for1978-2000 in China, the level of financial development of the region is clearly linked to the level of economic growth of the region. The relevance between financial markets and economic growth is even more obvious. The relationship between the East and the financial development and economic development of the whole country presents a positive correlation (Y. Zhang et al., 2020). Furthermore, the central and western regions present an almost negative correlation and show a time lag effect and negative correlation in the western region. It is found that reducing the gap in economic development between regions can improve financial development. The differences in financial scale and structure are the main reasons for the differences in financial development in various regions of China. These differences lead to uneven economic growth (Ahmad et al., 2019).

The regions where the financial system is strong and financial institutions perform efficiently, are also found to be regions where economic activities are being efficiently performed, the productive capacity of the resources is high, there are employment opportunities, and the general public has access to quality products and services. Thus, the development of the regional financial sector leads to proportional development in other economic sectors (Nasir et al., 2019). A research survey has been conducted by Zheng et al. (2020) to investigate the effects of changes in regional financial development on the regional economy and its growth. Financial and other economic organizations have been compared in terms of their policies, operations, and performance in different regions of China and it is suggested that in the regions where the financial system is showing rapid progress, there have been more opportunities for organizations performing economic activities to develop in that region. In the regions where financial institutions are showing effective performance, other economic units have an easy approach to financial resources and, thereby, other resources. In these ways, a robust regional financial system can guarantee a higher level of regional economic development.

3. Model design, data sources and research methods

The time studied in this article is from 2003 to 2018. The data used has been mainly derived from the "Statistical Yearbook" and "China Financial Yearbook" of each province. These panel data is analyzed through econometric models with a view to compare the financial and economic conditions of the four Chinese economic regions: Eastern, Central, Western, and Northeast. The time is 2003-2018 per capita GDP, financial-related ratios, and GDP Growth Rate, total capital formation, and tertiary industry's share of GDP.

An indicator proposed by Thiel in the process of analyzing the disparities in national income in 1967. The advantage of this indicator is that it has decomposability and can also compare the disparities between groups and between groups. Disparities are compared, and the contribution to the overall difference is analyzed. Therefore, this indicator is often used in research related to disparities between regions. The value range of the Theil index is generally between 0 and 1. The larger the value, the greater the difference in the study area.

To accurately reflect the disparities in economic and financial development between and within the four major economic regions of the country, this article has used the Theil index to measure the level of regional financial development disparities in each region. Let D, Z, X, and C represent the eastern, central, western, and north-eastern regions, respectively; F and P represent the balance of deposits and loans in the economic zone and the total permanent population at the end of the year; The total population, so the calculation formula of Theil index that measures the difference between regions, TBj is the total difference by regions：

$$T_{Bj} = \sum_{i}^{n} [\frac{F_{ji}}{F_{Bj}} \ln(\frac{F_{ji} / F_{Bj}}{P_{ji} / P_{Bj}})] \quad (i=1,2,3,4) \tag{1}$$

$$T_K = \sum_{i}^{n} [\frac{F_{Bi}}{F} \ln(\frac{F_{Bi} / F}{P_{Bi} / P})]$$

Decompose the Theil into the next formula

$$T_A = T_k + \sum_{j} \frac{F_{Bj}}{F} T_{Bj} \tag{2}$$

The provincial score is given by i，j is indicated regions, (j=D, Z, X, and C),

F_{ji}	=	The deposit and loan amount of each province in the j region
P_{ji}	=	The population of the province in the j-th region
F_{Bj}	=	Total amount of deposit and loan balance in region j

In the same way, when analyzing the difference between regional economy with Theil index, F and P represent GDP and the total permanent population at the end of the year. F_i and P_i represents the GDP of the i-th region and the total permanent population of the region at the end of the year. According to the empirical index model and combined with the current situation of my country's regional economic development, we establish.

Model 1:

$$Y_i = C + \alpha \mathbf{fin}_{it} + \beta I_{it} + \delta P_{it} + \varepsilon_t \tag{3}$$

Model 2:

$$TE_{it} = c + \alpha \, fin_{it} + \beta I_{it} + \delta P_{it} + \lambda y_{it} + \varepsilon_t \tag{4}$$

Model 3:

$$TF_{it} = c + \alpha \, fin_{it} + \beta I_{it} + \delta P_{it} + \lambda y_{it} + \varepsilon_t \tag{5}$$

Y denotes dependent variable which indicates economic development, economic vitality, the structure of the industry, Fin refers to financial development variables, I and p represent capital formation and FDI (both are control variables) "t" are region and year.

Y_{it}	=	lnYit Person, the variable rate of economic growth, is the per capita GDP growth rate
Str_{it}	=	The growth of the tertiary industry's share of GDP reflects the industrial structure, and the population accounts for the population at the end of the period
Inc_{it}	=	Economic vitality is the growth rate of GDP
fin_{it}	=	Financial development variable, Financial-related ratios (deposits and loan)/ yit
I_{it}	=	The investment variable I is the growth rate of total capital formation
P_{it}	=	It is the growth rate of FDI (foreign direct investment)

Granger causality test uses history to make a prediction, when Y is the cause of X, Y should change before X, to explore causal relationships. To determine which one is affected, which one is affected by others. It is a test to determine whether that the variable is stationary or not be used to make-up for the limitations of a traditional test. This paper tries to test whether there is a unit root by LLC test and ADF test. When there is no unit root, the sequence is stationary. On the contrary, the sequence has a unit root, which means that the sequence must be stationary by means of difference. If it becomes a stationary state after the K-order difference, it is represented by I(k).

Compared with a single financial institution dominated by state-owned banks in the western region, the eastern region has more diverse institutions. In the eastern region, there are not only many joint-stock banks but also many foreign banks and financial companies in the eastern region. Due to the uneven distribution of financial institutions brought about by market nature and dynamics, there are obvious disparities between regional financial resource supply and financial market competition. This study divides China's economic development into four regions: East, Northeast, Central, and West while the GDP per capita is qualified on three levels: high, medium, and low. According to the economic and financial development in the four economic regions in China, it can be found that both, economic and financial disparities shown decreasing trends. It bears to note that the financial Theil index difference between provinces and cities in the region is greater than the difference between regions, but in terms of the Theil index of the economy, the difference between regions is greater than the difference between provinces and cities in the regions. Disparities in level overall economic development in China during 2003-2018 has decreased over the years. The variance contribution rate is higher than the variance contribution rate，1/3 of the GDP growth rate per capita, 43% in the western region, The highest ratio, In the Eastern North, In northeast region 33.33%t show low-growth variation, and middle region(40%) reports high growth rate, 44.79% are of low growth rate, Eastern region(25%) shows high growth rate, 40% is with low growth rate, Western region (36.98%) is marked by a high growth rate, 26.04% is with low growth. The middle region shows a 40% high growth rate: highest in the western region. The proportion of low growth of samples in the eastern region is 40.63%. Northeast in 2015 after which the difference significantly declines. The difference between the four regions' economic growth rate is the highest level in the north-eastern region. The economic zone is the smallest in the East and the largest in the west between 2007 and 2017 since 2017, and the middle is the highest. The difference between Northeast and East regions is the lowest.

4. The analysis by Theil Index

From Figure 3, it can be found that the values of the Theil index between groups (inter-block rate of contribution), within groups (interclass rate of contribution) and overall are in a downward trend since 2003, while the total economic disparities are seen gradually decreasing since 2011. The total variation in the economic Theil index is decreasing over time, and the economic growth rate is more stable than before—the inter-block differences are higher than the inter-class difference. Figure 6 illustrates the economic Theil index, and Figure 7 shows the differences in the level of economic development of the four regions.
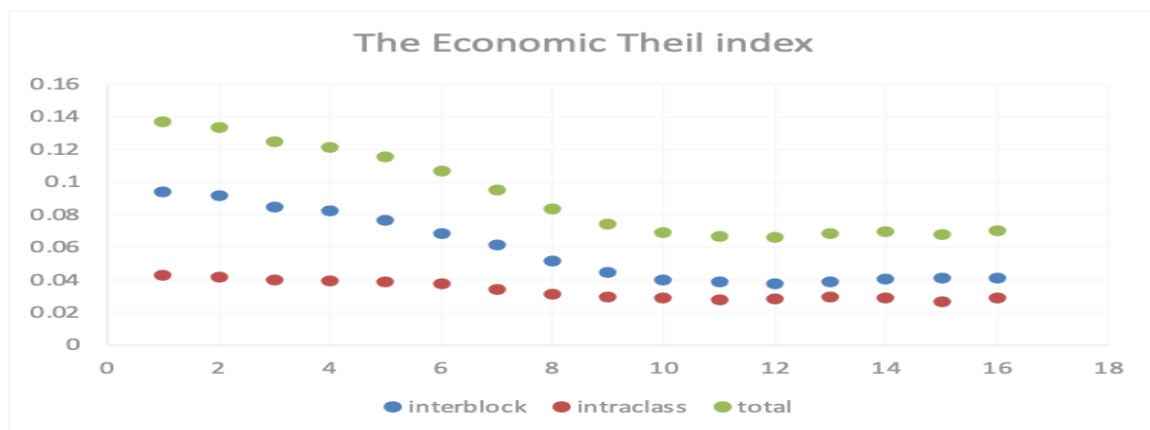
Figure 6: The Economic Theil index
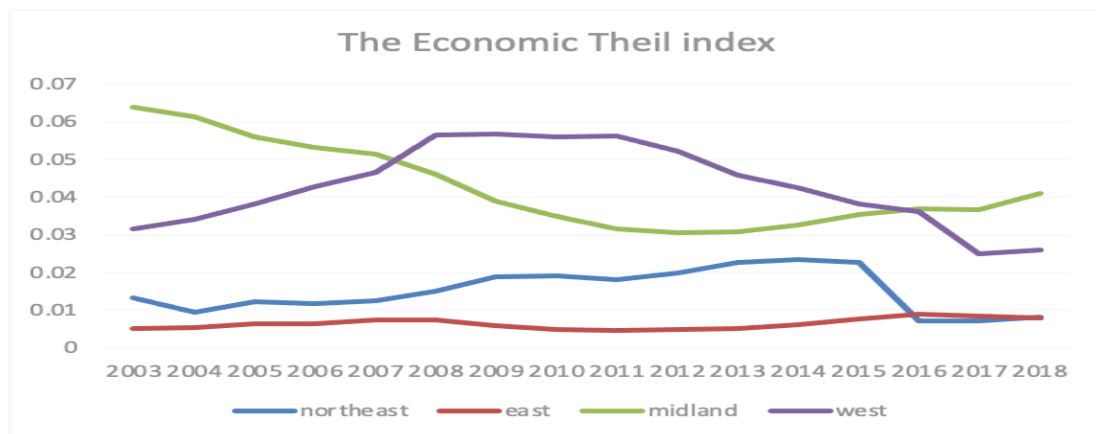**Source:** Empirical Economics Results by this survey

Figure 7: The difference in the economic development of the four regions: Theil Index (2003-2018)
Source: Empirical Economics Results by this survey

The causes of regional economic differences are export location conditions, transportation problems, population quality and population mobility, financial policy problems, and industrial structure. During 2003-2007, economic disparities in the central region are the highest, second highest for west region, followed by northeast is the third, and East reported the lowest level of economic disparity. From 2008-2016, this order is: west is the highest region, the middle is the second and the north-east is the third East remains the lowest.

In the middle region, the Theil index 2003-2018 become U graphene, since 2003 the index value decreases over time till 2012, and then increases every successive year. Since 2016, middle region shows the lowest level of economic disparities in China based on the Theil index. Between 2003 and 2017 the graph shows inverted U figure for the west region. East region reports the lowest level economic disparity. The eastern region is the lowest and the most stable area in economic growth among the four regions. Northeast China shows a significant decline since 2015. It is close to the east region since 2016. Figure 8 illustrates the economic Theil Index difference. It provides the different contribution of inter-block rate and intra-class rate in the economic Theil index. The results revealed that the contribution of inter-block rate is more than the intra-class rate in the economic Theil index.
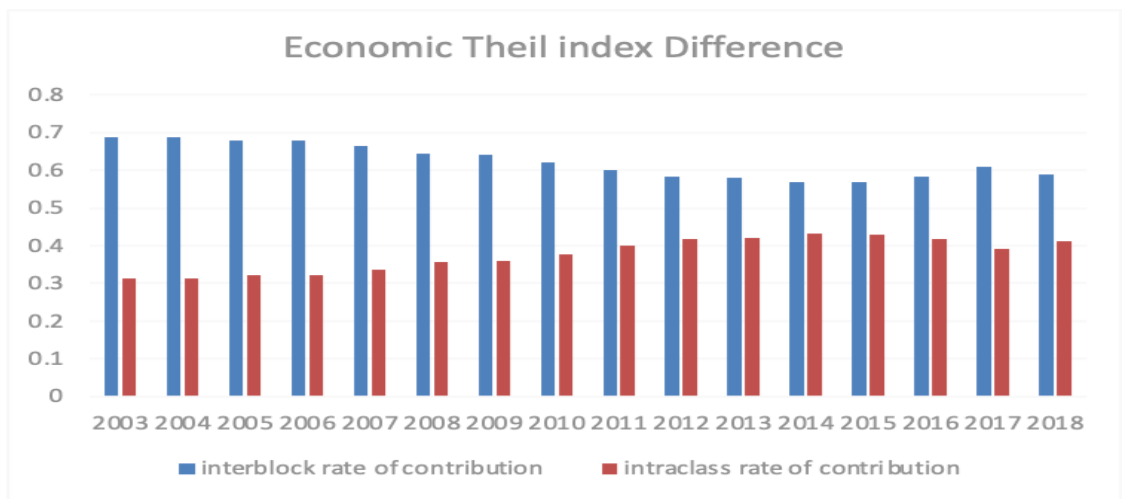

Figure 8:   Economic Theil index Difference (2003-2018)
Source: Empirical Economics Results by this survey

The difference from intra-class of the region is seen to increasingly decrease overtime from 2003 till 2014, after which is seen to increase gradually. The inter-block rate of contribution decreases from 2003 till 2014, then it is increase year by year and all three of them report a significant decline from 2003 to 2011, while the decline from 2011 to 2018 tends to be stable.

Ordering the Economic Theil Index from High to Low and divides into four regions as the whole of them lay in the regions. There are significant disparities seen in the level of economic development among the four regions. Results prove that disparities in the regional economic growth rate disparities on the Theil index in four regions are markedly noticeable. Figure 9 shows the relationship between economic Theil index and economic growth (Y).
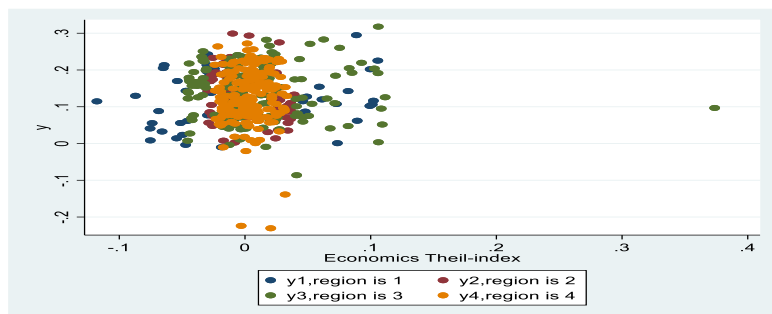
Figure 9:   The relationship between the Economic Theil Index and y
Source: Empirical Economics Results by this survey

Regional differences in financial development are explained by the financial system in China. External factors of economic policies and economic growth result in economic progress. In addition, there is still an international economic situation and other factors, or conditions are needed to stimulate financial development, such as Foreign Direct Investment or internationalization of business operations interaction (internal factors). Financial development is measured by financial-related ratios (FIR), which is the proportion of financial institutions total deposit and loan balance and GDP at the end of the year. The most important factor of financial differences in the operation within the domestic financial system. Figure 10 shows the relationship between financial Theil Index and Y, while Figure 11 shows the disparities in national financial development and Figure 12 shows the financial Theil index difference.
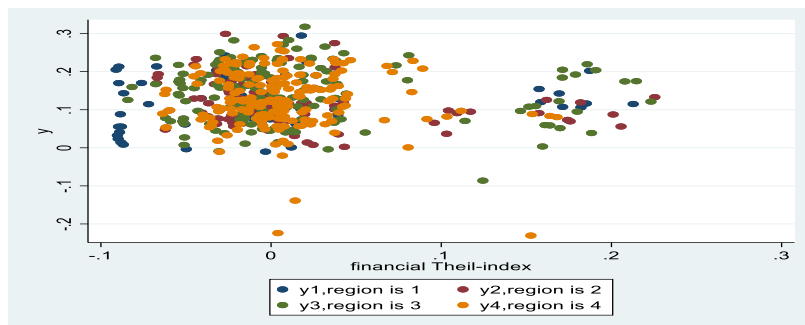

Figure 10: The relationship between the financial Theil Index and y
Source: Empirical Economics Results by this survey
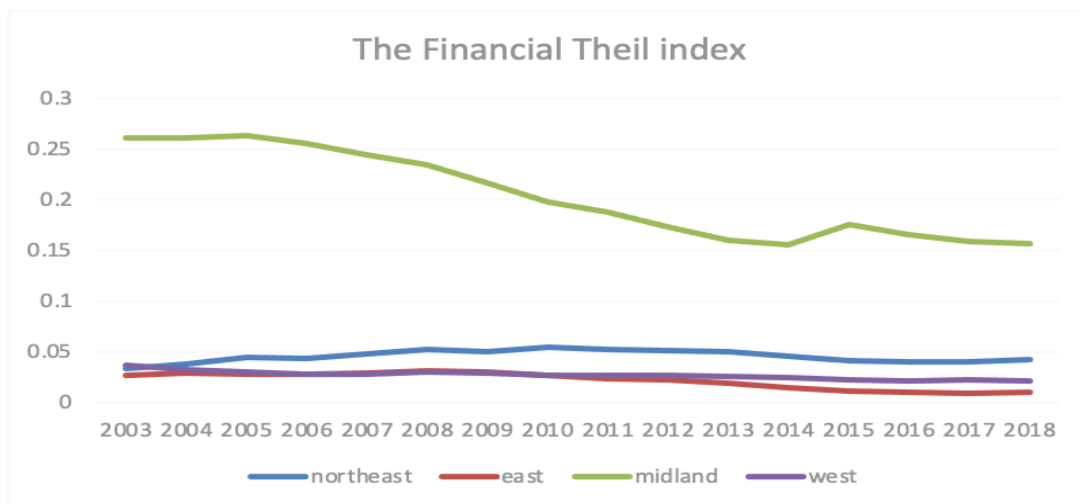
Figure 11: Disparities in national financial development: Theil Index (2003-2018)
Source: According to the constructed equation, the result is calculated.
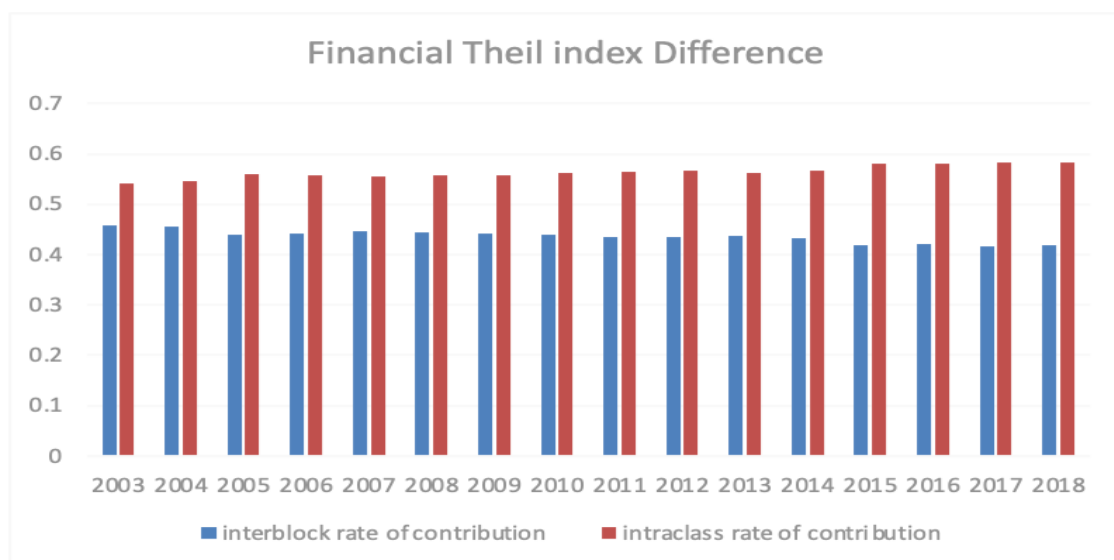
Figure 12: Financial Theil Index Difference (2003-2018)
Source: Empirical Economics Results by this survey

From Figure 2-2, it can be found that the Financial Theil index shown by the difference of all sample differences between sample groups and differences within sample groups have a downward trend from 2003 to 2018. In the middle of the period, it was generally the highest region, and the eastern region is the lowest region over the years. Theinter-block rate of contribution is lower than the intra-class rate of contribution.

The inter-block rate of contribution is lower than the intra class rate of contribution all the time in the period. Figure 13 shows the reasons for regional financial disparities.

Figure 13:   Economic development: Financial Theil Index
Source: Empirical Economics Results by this survey

5.   Empirical analysis

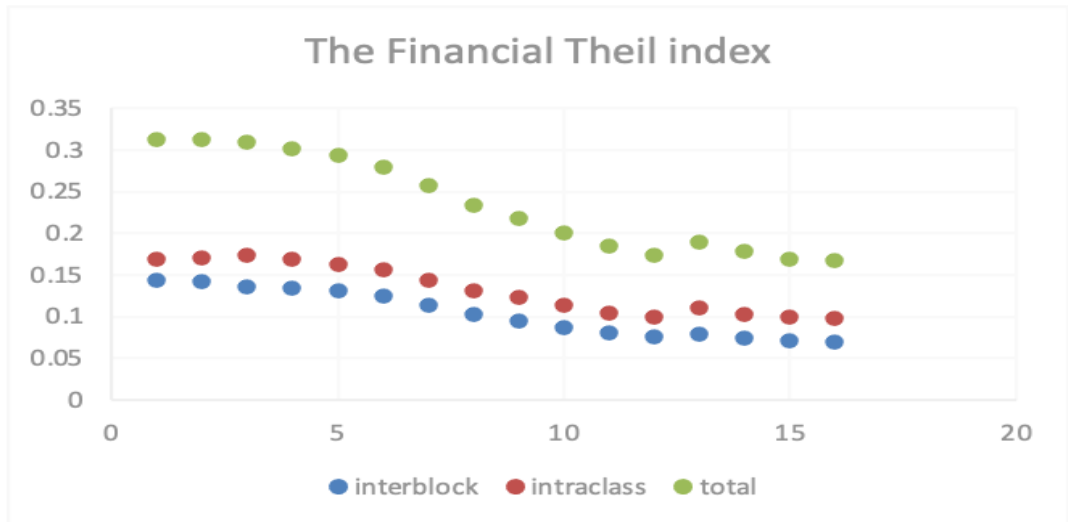Financial Theil Index (TF) and the Economic Theil Index (TE) show that the middle and northeast regions are stationary, and in the East and West regions, the first-order difference will be stationary, as there is no unit root. When the economy is shocked due to exogenous variables, the system will restore equilibrium overtime at each observation point. The samples show identical independent distribution. Each other I (0) will be stationary. The impact of any exogenous variable can only have a short impact on them, and the impact over time will gradually close to a long-term equilibrium. Table 1 and Table 2 present the unit root analysis. According to the results of the ADF and LLC tests, all variables showed obvious time trends. Both methods are used to detect variables in four regions. The results of the first-order differential show that there is no unit root, as tabulated in Table 5-1. Factors responsible for the floating of the Theil index are different from four regions. The summary of the four regions of Chins is investigated with the Granger casualty test. Figure 3 and Figure 4 Theil illustrate the results of the Granger casualty test.

Table 1: Unit Root Test Results

variable	LLC (t and P-value)				ADF Test			
	East	Central	West	Northwest	East	Central	West	Northwest
y	-8.56(0.000)	-6.39(0.000)	-8.38(0.000)	-3.75(0.001)	64.05(0.000)	33.89(0.007)	54.30(0.004)	13.49(0.036)
ET	1.27(0.899)	-3.74(0.000)	0.27(0.606)	-7.94(0.000)	12.58(0.895)	31.31(0.002)	14.18(0.942)	43.44(0.000)
Fin (FIR)	-5.86 (0.000)	-4.13(0.000)	-4.38(0.000)	-2.38(0.008)	39.98(0.005)	41.55(0.000)	39.85(0.022)	18.24(0.006)
i	-5.95(0.000)	-3.01(0.001)	-4.66(0.000)	-2.47(0.007)	51.29(0.001)	31.31(0.002)	61.37(0.000)	14.05(0.029)
p	-5.28(0.000)	-7.61(0.000)	-10.11(0.00)	-3.70(0.001)	62.15(0.002)	46.53(0.000)	94.69(0.000)	23.35(0.001)
FT	0.30(0.621)	-2.49(0.006)	-2.34(0.010)	-3.62(0.000)	6.91(0.997)	11.98(0.447)	21.74(0.594)	14.98(0.007)

Source: Empirical Economics Results by this survey

Table 2: Unit Root Test Results (1st Order Differential)

Variable	LLC				ADF			
	East	Central	West	Northwest	East	Central	West	Northeast
Y	-8.57 (0.00)	-6.39 (0.00)	-8.39 (0.00)	-3.76 (0.00)	64.06 (0.00)	33.89 (0.01)	54.31 (0.00)	13.50 (0.04)
Inc	-6.99 (0.00)	-3.55 (0.00)	-8.15 (0.00)	-3.85 (0.00)	55.08 (0.00)	21.48 (0.04)	51.23 (0.00)	12.46 (0.04)
Str	-6.57 (0.00)	-2.88 (0.00)	-9.17 (0.00)	-4.63 (0.00)	34.18 (0.00)	28.97 (0.00)	64.75 (0.00)	17.50 (0.01)
Fin	-5.87 (0.00)	-4.14 (0.00)	-4.39 (0.00)	-2.39 (0.01)	39.99 (0.01)	41.56 (0.00)	39.86 (0.02)	18.25 (0.01)
i	-5.95 (0.00)	-3.02 (0.01)	-4.67 (0.00)	-2.47 (0.01)	51.29 (0.00)	31.32 (0.01)	61.38 (0.00)	14.05 (0.03)
p	-5.29 (0.00)	-7.62 (0.00)	-10.12(0.00)	-3.71 (0.00)	62.16 (0.00)	46.53 (0.00)	94.70 (0.00)	23.35 (0.01)

Source: Empirical Economics analysis Results by this survey

Table 3: Results of Granger test

	Null Hypothesis (P-value)	East. Prob.	Middle. Prob.	West. Prob.	Northeast. Prob.
T E	P does not granger cause TE	0.6426	0.0000***	0.0001***	0.9980
	TE does not Granger Cause P	0.5815	0.0015***	0.0000***	0.4645
	fin does not Granger Cause TE	0.8629	4.E-11***	0.0003***	0.7434
	TE does not Granger Cause fin	0.4900	0.0311***	0.0004***	0.3199
	I does not Granger Cause TE	0.7015	2.E-06***	0.0847*	0.0085***
	TE does not Granger Cause I	0.0295***	0.9900	0.5326	0.3047
T F	P does not Granger Cause TF	0.7681	0.0587***	0.0636*	0.9980
	TF does not Granger Cause P	0.8280	1.E-06***	0.0000***	0.4645
	fin does not Granger Cause TF	0.0308**	0.3789	0.1045	0.7434
	TF does not Granger Cause fin	0.2592	0.0860*	6.E-06***	0.3199
	I do not Granger Cause TF	0.8765	0.1994	0.9722	0.0085***
	TF does not Granger Cause I	0.0020***	0.4575	3.E-06***	0.3047

Source: Empirical Economics Results by this survey (*** $p<0.01$, ** $p<0.05$, * $p<0.1$)

Table 4: The summary of Granger causality test

Region	causation	Granger Cause	reciprocal causation
Eastern	TE	I	
Middle	P、Fin、I	TE	P and TE
Western	P、Fin、I	TE	I and TE Fin and TE
Northeastern	I	TE	
Eastern	Fin	TF	
Middle	P	TF	P and TF
Western	P	TF	
Middle	TF	Fin	
Western	TF	Fin、I	
Northeastern	I	TF	

Source: Empirical Economics Results by this survey (*** p<0.01, ** p<0.05, * p<0.1)

When TE (Economic differentials Theil index) or TF (Financial differentials Theil index) to be the dependant variables, the results are analyzed as follow:

TE (Economic differentials Theil index):

Eastern region: (the growth rate of total capital formation) will Granger cause TE changed. For the middle and western regions, there is a reciprocal relationship found between P and TE, in that P, I and Fin caused the difference of TE. Fin is the growth rate of total deposits in local and foreign currencies of financial institutions.

North-eastern: (the growth rate of total capital formation) caused the TE to be floating.

TF (Financial differentials Theil index):

Middle and western region: the growth rate of FDI (foreign direct investment) and TF are reciprocal.

East region: Fin (the growth rate of FDI is the factor that causes TF index changed.

Middle region: TF will Granger because I changed.

Western: TF will Granger cause Granger Fin and I change.

North-eastern: I (the growth rate of total capital formation) will Granger cause TF change.

6.   Discussions, Conclusion, and Implications

The study results indicate that regional financial development has a significant positive association with regional economic development. These results demonstrate that the regions of the country where financial institutions perform their financial duties efficiently and make rapid progress, all other organizations operating in different economic sectors also show relatively higher performance, consequently making for proportional development. These results are in line with the past study of Calero et al. (2020), which investigates regional progress. This study analyses the development rate of different financial institutions and their impact on regional progress. This study suggests that in the regions where financial institutions have a variety of convenient services, the business organizations are more likely to show higher levels of operational and financial performance. These results are also supported by the previous study of Tronin et al. (2019), which analyses and compares the impacts of the performance of the financial institutions on the business effectiveness of different organizations relating to any economic sector in different regions. After an in-depth comparison, this study concludes that as financial institutions provide business organizations with financial resources, the development of financial institutions leads to economic development in that region. These results also corroborate the findings by a previous study of Wondirad et al. (2021), which demonstrates how the financial development of a region affects the economic development of that region. This study posits that as financial institutions like banks, insurance companies, and other loan companies provide financial security to organizations operating within the region, they pave a way for organizations towards economic development.

The study results reveal that regional financial development has a positive association with the overall economic development of the country. These results imply that regional financial development leads to a positive development in the operations of regional business organizations which, in turn, leads to an improvement in their performance. Improved performance of regional institutions leads to the overall economic growth of the country. These results are in line with the previous study of Qian (2018), which investigates the contributing factors to economic growth. This study examines the contribution of regional progress to the country's development in the international market. According to this study, the economic development of different regions is dependent on the service performance of financial institutions operating in the concerned regions, and the regional economic development brings about an improvement in the economic development in other regions and thus, result in a higher GDP growth rate for the country. These results are also supported by the previous study of Audretsch et al. (2021), which states that as cash is the backbone of any economic entity assuring the availability of all resources and smooth operation of economic activities, the effective performance of financial institutions brings improvement in the development of regional organizations. In the second portion of

the study, it is posited that regional economic development spreads slowly in other regions and enables the country to achieve a higher level of progress in the international market. These results are also approved by the previous study of R. Zhang et al. (2018), which states that the financial development of the regions determines the level of the economic development of that regions and that regional development brings development in the economic growth of the country.

Chinese policymakers should aim to decrease regional economic disparities, promote coordinated regional development, and reform socialist modernization as these requirements are essential for building a prosperous society in an all-around way and building a harmonious socialist society. The smallest regional economic disparities are in the East region. During 2007-2017, the West region was the largest. The differences between the four regions are obviously different. In the Theil economic index in China, the inter-block difference is larger than the intra-class (between provinces) difference, and in terms of overall financial disparities, the inter-block difference is smaller than the intra-class (between provinces) difference. China's financial development has reached a high level in comparison to other developed countries and economies of the world. Chinese policymakers should push for more financial innovation. The empirical economic results of this study, TE and TF will float with time series. As noted earlier, China's regional economic disparities are seen to be the smallest in the East. During 2007-2017, west region showed the largest economic disparity. Due to the Yangtze River Delta Integrated Economic Plan, since 2017, the middle region is experiencing the largest disparity. In North-East and East regions, the difference is smaller. The largest financial disparity is in the middle region and the smallest is in the East region. Comparing the disparity between the four regions in China, the difference between the middle and East regions is the highest since 2016. Policymakers should select the subject matter according to the point in time.

According to the unit root test, west and east regions need first-order differences to stabilize. Central and northeast regions are in obvious stationary conditions. In addition, the central and northeast parts have a steady effect. It means that the impact of any exogenous variable on them can achieve not only short-term equilibrium but also gradually reach close to long-term equilibrium with time. Moreover, it is found that the differences between the four regions are evident. Based on financial development differences, with the order going from high to low are central, northeast, west and East regions. Based on economic development differences, using the order from high to low, the results are central, northeast, west and East regions. As financial development in the central region is slow and the financial institutions in the region report smaller FDI, the total investment is small in several specific cities, and the financial activities cannot operate efficiently. Financial development measured by financial-related ratios (FIR), which is the proportion of financial institutions total

deposit and loan balance and GDP at the end of the year. The most important factor responsible for financial differences is the level of operation within the domestic financial system. The People's Bank of China should adopt specific and concrete policies, for example, the decision of the deposit reserve ratio according to the different regions implement differentiated loan and subsidy policies. Secondly, it should encourage commercial and financial institutions to proceed to the middle and west area by subsiding policy.

Based on economic development differences highlighted above, during 2003-2007, economic disparities in the central region are the highest, west is the second, northeast is the third, and East is the lowest. During 2008-2016, disparities decreased from west to the east. The most notable factors in this regard are export location conditions, transportation problems, population quality and population mobility, financial policy problems, and industrial structure. Government should prioritize the middle and western regions: there is a reciprocal relationship between P and TE, that P, I and Fin caused the difference of TE. Fin is the growth rate of total deposits in local and foreign currencies of financial institutions. North-eastern: (the growth rate of total capital formation) causes the TE to float. Between financial development and economic growth rate, there are different causalities in different areas according to the Granger test. In central and west regions, the government should address economic development difference through more FDI (foreign direct investment), higher growth rate of total capital formation and enhanced financial development. Growth rate of FDI is expected to lead to a reduction in the financial differences among regions and sub-regions. In the east region, the growth rate of FDI is the factor that causes the TF index to change, Fin (the growth rate of FDI) is the factor that causes the TF index to change. The Chinese Government should control Fin to affect the financial difference. For the Northeast region in particular, the growth rate of total capital formation is expected to result in TF change. In China, "implementation of innovation, coordination, green, open, sharing five development concepts, in order to ensure the realization of the goal of building a well-off society in an all-round way" is a complex project, which needs to be combined with national plans, for different regions, according to different times and market environments to adopt customized and responsive policy tools to achieve its economic growth and financial development objectives.

REFERENCES

Ahmad, M., Zhao, Z.-Y., & Li, H. (2019). Revealing stylized empirical interactions among construction sector, urbanization, energy consumption, economic growth and CO_2 emissions in China. *Science of The Total Environment, 657*, 1085-1098. doi:https://doi.org/10.1016/j.scitotenv.2018.12.112

Asteriou, D., & Spanos, K. (2019). The relationship between financial development and economic growth during the recent crisis: Evidence from the EU. *Finance Research Letters, 28*, 238-245. doi:https://doi.org/10.1016/j.frl.2018.05.011

Audretsch, D. B., & Belitski, M. (2021). Towards an entrepreneurial ecosystem typology for regional economic development: the role of creative class and entrepreneurship. *Regional Studies, 55*(4), 735-756. doi:https://doi.org/10.1080/00343404.2020.1854711

Bermejo Carbonell, J., & Werner, R. A. (2018). Does foreign direct investment generate economic growth? A new empirical approach applied to Spain. *Economic Geography, 94*(4), 425-456. doi:https://doi.org/10.1080/00130095.2017.1393312

Bist, J. P. (2018). Financial development and economic growth: Evidence from a panel of 16 African and non-African low-income countries. *Cogent Economics & Finance, 6*(1), 144-151. doi:https://doi.org/10.1080/23322039.2018.1449780

Calero, C., & Turner, L. W. (2020). Regional economic development and tourism: A literature review to highlight future directions for regional tourism research. *Tourism Economics, 26*(1), 3-26. doi:https://doi.org/10.1177%2F1354816619881244

Charfeddine, L., & Kahia, M. (2019). Impact of renewable energy consumption and financial development on CO2 emissions and economic growth in the MENA region: A panel vector autoregressive (PVAR) analysis. *Renewable Energy, 139*, 198-213. doi:https://doi.org/10.1016/j.renene.2019.01.010

Ibrahim, M., & Alagidede, P. (2018). Effect of financial development on economic growth in sub-Saharan Africa. *Journal of Policy Modeling, 40*(6), 1104-1125. doi:https://doi.org/10.1016/j.jpolmod.2018.08.001

Kahouli, B. (2017). The short and long run causality relationship among economic growth, energy consumption and financial development: Evidence from South Mediterranean Countries (SMCs). *Energy Economics, 68*, 19-30. doi:https://doi.org/10.1016/j.eneco.2017.09.013

Li, C., Liu, X., Bai, X., et al. (2020). Financial Development and Environmental Regulations: The Two Pillars of Green Transformation in China. *International Journal of Environmental Research and Public Health, 17*(24), 9242. doi:https://doi.org/10.3390/ijerph17249242

Mahmood, H., Furqan, M., & Bagais, O. A. (2019). Environmental accounting of financial development and foreign investment: spatial analyses of East Asia. *Sustainability, 11*(1), 13-26. doi:https://doi.org/10.3390/su11010013

Nasir, M. A., Huynh, T. L. D., & Tram, H. T. X. (2019). Role of financial development, economic growth & foreign direct investment in driving climate change: A case of emerging ASEAN. *Journal of environmental management, 242*, 131-141. doi:https://doi.org/10.1016/j.jenvman.2019.03.112

Ouyang, Y., & Li, P. (2018). On the nexus of financial development, economic growth, and energy consumption in China: New perspective from a GMM panel VAR approach. *Energy Economics, 71*, 238-252. doi:https://doi.org/10.1016/j.eneco.2018.02.015

Pan, F., & Yang, B. (2019). Financial development and the geographies of startup cities: evidence from China. *Small Business Economics, 52*(3), 743-758. doi:https://doi.org/10.1007/s11187-017-9983-2

Qian, H. (2018). Knowledge-Based Regional Economic Development: A Synthetic Review of Knowledge Spillovers, Entrepreneurship, and Entrepreneurial Ecosystems. *Economic Development Quarterly, 32*(2), 163-176. doi:https://doi.org/10.1177%2F0891242418760981

Salahuddin, M., Alam, K., Ozturk, I., et al. (2018). The effects of electricity consumption, economic growth, financial development and foreign direct investment on CO2 emissions in Kuwait. *Renewable and Sustainable Energy Reviews, 81*, 2002-2010. doi:https://doi.org/10.1016/j.rser.2017.06.009

Saud, S., Chen, S., & Haseeb, A. (2019). Impact of financial development and economic growth on environmental quality: an empirical analysis from Belt and Road Initiative (BRI) countries. *Environmental Science and Pollution Research, 26*(3), 2253-2269. doi:https://doi.org/10.1007/s11356-018-3688-1

Shahbaz, M., Van Hoang, T. H., Mahalik, M. K., et al. (2017). Energy consumption, financial development and economic growth in India: New evidence from a nonlinear and asymmetric analysis. *Energy Economics, 63*, 199-212. doi:https://doi.org/10.1016/j.eneco.2017.01.023

Sheng, M., & Gu, C. (2018). Economic growth and development in Macau (1999–2016): The role of the booming gaming industry. *Cities, 75*, 72-80. doi:https://doi.org/10.1016/j.cities.2018.01.003

Tronin, S., Rodermel, T. A., Uspaeva, M. G., et al. (2019). Formation of innovative strategies of regional economic development. *Space and Culture, India, 7*(2), 65-75. doi:https://doi.org/10.20896/saci.v7i2.457

Urbano, D., Audretsch, D., Aparicio, S., et al. (2020). Does entrepreneurial activity matter for economic growth in developing countries? The role of the institutional environment. *International Entrepreneurship and Management Journal, 16*(3), 1065-1099. doi:https://doi.org/10.1007/s11365-019-00621-5

Wang, H., & Liu, H. (2017). An empirical research of FDI spillovers and financial development threshold effects in different regions of China. *Sustainability, 9*(6), 933-948. doi:https://doi.org/10.3390/su9060933

Wondirad, A., Kebete, Y., & Li, Y. (2021). Culinary tourism as a driver of regional economic development and socio-cultural revitalization: Evidence from Amhara National Regional State, Ethiopia. *Journal of Destination Marketing & Management, 19*, 104-123. doi:https://doi.org/10.1016/j.jdmm.2020.100482

Zaidi, S. A. H., Zafar, M. W., Shahbaz, M., et al. (2019). Dynamic linkages between globalization, financial development and carbon emissions: Evidence from Asia Pacific Economic Cooperation countries. *Journal of Cleaner Production, 228*, 533-543. doi:https://doi.org/10.1016/j.jclepro.2019.04.210

Zhang, R., & Yin, H. (2018). Regional financial development, firm heterogeneity and investment efficiency. *The Journal of Asian Finance, Economics, and Business, 5*(4), 73-83. doi:https://doi.org/10.13106/jafeb.2018.vol5.no4.73

Zhang, Y., Yao, D., & Zhang, C. (2020). Bank loan versus financial lease: how do traditional and innovative approaches within the banking sector influence economic growth? A comparative analysis between the US and China. *Applied Economics, 52*(40), 4366-4383. doi:https://doi.org/10.1080/00036846.2020.1735617

Zheng, Y., Chen, S., & Wang, N. (2020). Does financial agglomeration enhance regional green economy development? Evidence from China. *Green Finance, 2*(2), 173-196. doi:https://doi.org/10.3934/GF.2020010