

Analysis of FDI Difference in Guangdong Province Based on Theil Index

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Abstract: Studying the differences of FDI within Guangdong province is of great significance to guide the rational distribution of foreign investment and narrow the gap between cities. In this paper, Guangdong province is divided into five regions, and then the panel data from 2011 to 2020 to process the Theil index of FDI regional differences in the five regions, which can calculate and analyze intra-regional and inter-regional differences. The results show that the overall difference of FDI in Guangdong province is on the rise, but the contribution rate of regional difference to the overall difference is large, and far greater than the contribution rate of regional difference. At the same time, the regional differences are also increasing year by year. Based on this, this paper puts forward some suggestions, such as overall development of the whole province, speeding up inter-regional industrial transfer and factor flow, giving full play to the radiation role of core cities, guiding the rational distribution of foreign investment, so as to narrow the regional differences.

1. Introduction

Foreign direct investment plays an increasing role in promoting industrial development and economic growth in Guangdong Province and has become an important source of economic transformation and upgrading in Guangdong Province. According to statistics from the Development and Reform Commission of Guangdong Province, about 3,000 new overseas investments were made in 2018, and 145.09 billion yuan of foreign investment was utilized, and the scale is at an all-time high record. The growth rate was 4.0 percentage points higher than that of the whole country, ranking the first in China. It can be seen that FDI plays an important role in promoting economic development. After entering WTO, China has accelerated the pace of integrating into the world economy. Meanwhile, foreign investment makes Guangdong smoothly enter the middle stage of industrialization and the later stage of heavy industrialization and service, making it become a manufacturing base and service base with global influence. However, with the development of economy, the gap between regions in Guangdong Province is inevitable, and many problems also appear, especially the unbalanced development between provinces or cities, which has a great impact on the regional distribution of FDI and has become an important obstacle and bottleneck for the coordinated development of Guangdong Province. The analysis of the regional

differences of FDI distribution and its evolution in Guangdong Province is helpful to solve the problem of FDI imbalance, so as to play the role of FDI in promoting the coordinated development and high-quality development of Guangdong Province, and at the same time provide scientific basis and decision-making reference for the balanced coordinated development of regional economy.

2. Literature Review

With the unbalanced economic development of various regions in recent years, scholars have conducted extensive research on regional differences through different methods. Some scholars mainly studied regional differences through the Gini coefficient, for example, Fang et. [1] studied the spatial imbalance of regional patent efficiency in Guangdong Province. For example, Chen Jinghua et. [2] used the Dagum Gini coefficient decomposition method to identify regional differences and sources of OFDI reverse spillover efficiency. Other scholars, such as Sun Liangyuan et. [3] reflected the overall regional economic differences in Guangdong province through the coefficient of variation variation, weighted coefficient of variation variation, Gini coefficient, concentration index and other indicators, and concluded that the regional economic differences in Guangdong were the most prominent in China through horizontal and vertical comparison. Many studies have shown that FDI has regional differences, for example, Zhou et. [4] used static panel and spatial econometric model to point out that FDI has obvious regional characteristics in the national distribution, and high-growth regions will drive the development of surrounding areas. That is, the analysis of regional FDI differences is conducive to playing the radiation role of high-growth areas. Zhao et. [5] constructed the Malmquist model to analyze the regional distribution differences of FDI TFP, and pointed out that the focus dimension of FDI investment location selection is gradually changing to FDI smart power jointly promoted by multiple indicators. Existing studies have achieved fruitful results, but there are still the following shortcomings.

First, it is common for the existing studies to use the Gini coefficient to analyze the differences and causes of FDI in Guangdong Province, but the Theil index is rarely used to analyze the differences. Second, most studies focus on the analysis of FDI and the Pearl River Delta region, and the systematic analysis of regional differences in the whole Guangdong province is rare. Therefore, in order to make up for the shortage of existing literature, based on the above literature review, this paper studies the specific situation of FDI distribution in the five economic regions of Guangdong Province, examines the regional differences of FDI in Guangdong since 2011 through panel data, and analyzes the key factors of regional differences of FDI by means of Theil index decomposition. The regional difference and evolution trend of FDI distribution in Guangdong are obtained. This will not only help solve the problem of FDI imbalance, but also help other provinces and cities to accurately locate and mislocate development when introducing FDI, and narrow the regional gap. So as to achieve the coordinated development of regional economy, the coordinated development of internal and external sources of economy, change the growth mode, improve the ability of independent innovation, improve the momentum of development, and construct multiple social and economic goals of "harmonious Guangdong" [6].

3. Analysis of Current Situation of FDI in Guangdong Province

Guangdong Province is a region with a high degree of economic development and opening to the outside world in China, and it has a strong attraction for foreign investment in terms of policy support and resource endowment. According to the relevant data from 2011 to 2020, analyzing the FDI stock and increment, details and trend can be saw the following Table 1 and Figure 1:

Table 1: Overall changes of FDI in Guangdong Province from 2011 to 2020

	FDI(US\$10,000)	Increase over last year (\$10, 000)
2011	3469238	1009138
2012	3499424	30186
2013	3631343	131919
2014	4305905	674562
2015	5611000	1305095
2016	8577477	2966477
2017	7308672	-1268805
2018	7419677	111005
2019	7891201	471524
2020	7189951	-701250

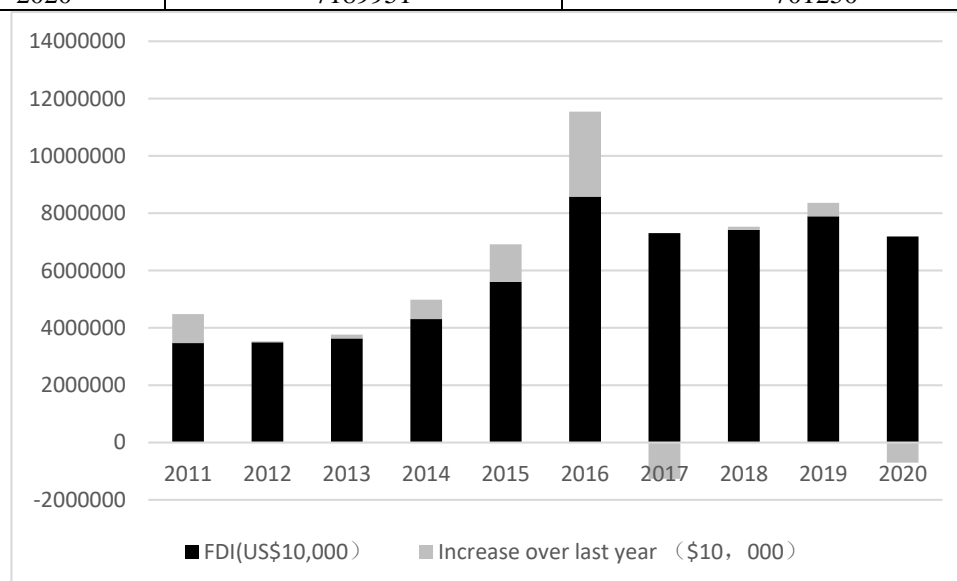


Figure 1: Overall Changes of FDI in Guangdong Province in 2011 in 2020

As shown in Table 1 and Figure 1, the total amount of FDI in Guangdong Province has shown an increasing trend in the past decade. From the perspective of annual FDI growth, the total FDI from 2011 to 2016 maintained growth in the whole province, and the growth rate accelerated. Among them, FDI increased the most in 2016, with a total increase of USD29, 664.77 million. However, from 2017 to 2020, under the influence of domestic and foreign environmental changes, the total amount of FDI showed a downward trend, or even showed negative growth. From 2011 to 2015, with a relatively stable international environment and supportive domestic policies, the total amount of foreign direct investment not only expanded year by year, but also increased year by year. In 2016, the total growth reached the maximum value of \$29664.77 million. However, in 2017, the total amount of foreign investment in Guangdong Province declined, opening a large gap from the previous year, and in 2018, the decline was reduced, and the total amount of foreign investment rebounded. However, in 2019, due to the impact of the epidemic, coupled with the impact of the trade war and the countercurrent of globalization, FDI in Guangdong Province also showed an overall decline. This is mainly because of the epidemic, the domestic demand and supply of Guangdong Province have been seriously affected, and there are some problems in the economic fundamentals. In order to avoid the spread of the epidemic, a comprehensive lockdown of the nationwide economy was carried out, which also shows that the economic development of Guangdong Province has entered a new stage.

4. Analysis of Differences in FDI in Guangdong Province

4.1. Research Method and Sample Selection

Theil index can quantitatively describe the equilibrium of economic development and income distribution [7]. The Theil index was first used to analyze income differences between countries. On this basis, GDP is proposed as an indicator to measure regional economic development. The Theil index can be decomposed into differences between groups. The Theil index is decomposed into T and used as the weighting coefficient, as in the following formula:

$$T = \sum_n \frac{GDP_n}{GDP} \ln \left(\frac{GDP_n/GDP}{FDI_n/FDI} \right) + \sum_n \sum_m \left(\frac{GDP_{nm}}{GDP_n} \right) \ln \left(\frac{GDP_{nm}/GDP_n}{FDI_{nm}/FDI_n} \right) \sum_n \left(\frac{GDP_n}{GDP} \right) = T_b + T_w \quad (1)$$

According to the degree of economic development, Guangdong province is divided into five regions, that is, $n=5$, and m represents the provinces within the region, GDP_{nm} and FDI_{nm} mean the total GDP and FDI of m province in region n . T_b is expressed as the inter-regional difference, T_w is the difference within the region. Theil index can decompose the regional differences of FDI in Guangdong Province within and between groups respectively, so as to measure the economic differences among the five major urban agglomerations and analyze the reasons for the differences. When the Theil index is greater than or equal to 0, the smaller the absolute value is, the smaller the regional difference will be; otherwise, the larger the regional difference will be.

This paper selects the GDP and FDI actual use amount of each prefecture-level city in Guangdong Province from 2011 to 2020 as sample data. The GDP of prefecture-level cities is from Guangdong Statistical Yearbook 2020, and the actual amount of FDI is from the Statistical Yearbook of each prefecture-level city over the years. It should be pointed out that since 2018, the total amount of foreign direct investment in each city of Guangdong Province has been recorded based on RMB data, and for the convenience of calculation, it is converted as USD 1 = RMB 6.3605 in 2018. In terms of economic region division, Guangdong Province is divided into five different regions [8], as shown in Table 2.

Table 2: Division of economic region

Economic region	Regional prefecture-level cities
Pearl River Delta Economic Zone A	Guangzhou/Shenzhen/Foshan/Dongguan
Pearl River Delta Economic Zone B	Huizhou/Zhuhai/Zhongshan/Jiangmen/Zhaoqing
Eastern Region	Shantou/Shanwei/Chaozhou/Jieyang
Western Region	Zhanjiang/Maoming/Yangjiang
the mountain area of Guangdong	Shaoguan/Heyuan/Meizhou/Qingyuan/Yunfu

4.2. Results and Analysis of Regional Differences of FDI in Guangdong Province

The Theil index of FDI in each economic region of Guangdong Province is calculated by applying the formula, which is specifically reflected in the following Table 3 and Figure 2.

According to the trend and degree of their development, we analyze the differences from three aspects: overall differences, inter-regional differences and intra-regional differences.

Table 3: Static decomposition of regional differences in FDI in Guangdong Province from 2011 to 2020

Year	The overall difference	Differences between regions	Differences within the region	Proportion of differences between regions	Proportion of intra-regional differences
2011	0.598	0.526	0.071	88.00%	12.00%
2012	0.574	0.517	0.057	90.07%	9.93%
2013	0.615	0.554	0.061	90.05%	9.95%
2014	0.699	0.602	0.098	86.06%	13.94%
2015	1.131	0.857	0.274	75.79%	24.21%
2016	1.533	0.984	0.548	64.22%	35.78%
2017	1.412	0.854	0.558	60.46%	39.54%
2018	1.321	0.857	0.464	64.87%	35.13%
2019	1.397	0.908	0.489	64.97%	35.03%
2020	1.272	0.920	0.352	72.30%	27.70%

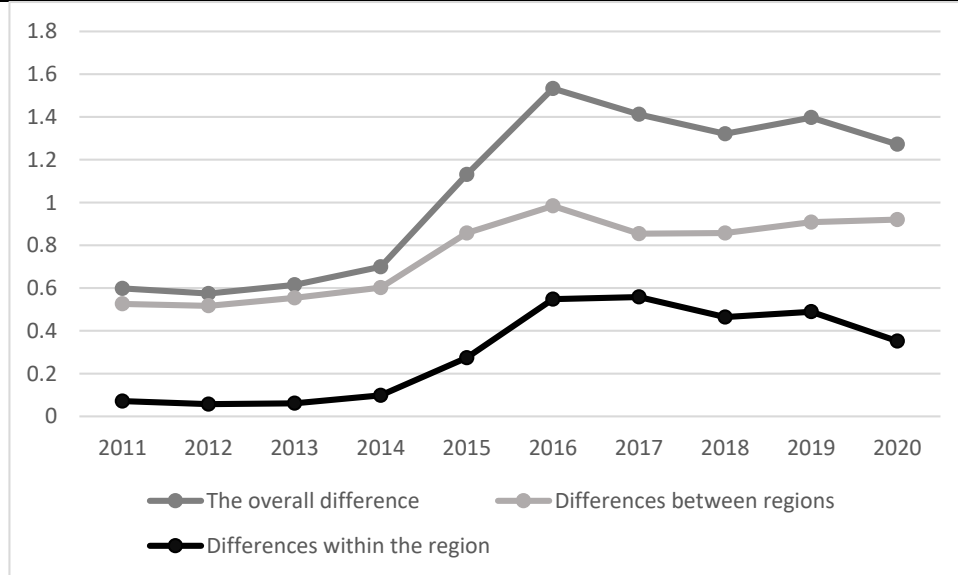


Figure 2: Trend chart of the Theil index

4.2.1 Overall difference comparison

From 2011 to 2016, the growth rate of Theil index showed a linear growth trend, and gradually exceeded 1 until reaching the maximum of 1.533 in 2016, which indicates that the distribution of FDI in Guangdong Province is becoming larger and larger. Between 2014 and 2018, the data showed an inverted 'v'. It is worth mentioning that after 2014, the overall difference of Theil index is always higher than 1, that is, the increase in the size of FDI and total FDI in Guangdong Province in the past decade has led to an increasing gap in the distribution of FDI. By 2019-2020, the gap had narrowed again. From the theoretical analysis, multinational enterprises usually consider three factors in their foreign investment, among which location advantage, determines the way enterprises choose foreign investment. At the same time, some scholars have pointed out that the industrial structure is also one of the location factors for FDI to enter China's first-tier cities [9]. Compared with other economic and hardware and software conditions for the subsequent development of enterprises in the region, FDI can more intuitively observe the development of foreign investment in a region, and the good development of FDI enterprises in the past in the city can play a good demonstration and incentive role, which is the so-called "scale effect." Due to the unbalanced

economic development of different cities, they will have different ability to attract foreign capital. For example, Guangzhou, Shenzhen and Dongguan in the Pearl River Delta are close to Hong Kong and Macao, and are greatly radiated by the economies of Hong Kong and Macao. Secondly, they have an economic base that other cities do not have, and these places are gathering places for migrant workers and have a large labor force. Therefore, compared with other regions, it has a great advantage in attracting foreign capital, resulting in an increasing gap. However, due to the policy incentive of integrated development of regions, the gap has narrowed in the two years.

4.2.2 Comparison of regional differences

From the perspective of inter-regional differences and their proportion, the Theil index has always remained above 0.5. This reflects that the difference of FDI in Guangdong Province is more obvious among regions. The rise and fall trend is consistent with the overall difference trend, and the contribution rate to the overall difference reaches the maximum from 2011 to 2013, accounting for about 90%. In 2016, the Theil index of interregional difference reached the maximum of 0.984, which is also the maximum in recent years. Through the analysis, this kind of difference is caused by the unbalanced distribution of FDI between the two regions of the Pearl River Delta and the eastern and western regions and the northern mountainous areas, which also leads to the expansion of the overall difference. This is mainly because: external hardware conditions, local governments in the Pearl River Delta use foreign capital taxes to build better public infrastructure, while the economically backward areas in the eastern, western and northern mountainous areas cannot be compared with other regions in the Pearl River Delta in terms of GDP, infrastructure, supporting industries, labor market and other aspects. Therefore, the agglomeration effect of FDI in the Pearl River Delta will be further enhanced, and this stage will continue until the negative external effect of agglomeration appears. The marginal benefit of spatial investment around the Pearl River Delta is relatively high, which makes foreign direct investment spread to the surrounding areas. The invisible hand of the market can only change the marginal benefit of spatial investment through time. This will accelerate the inflow of foreign direct investment into the less developed regions around the Pearl River Delta, thus narrowing the regional gap.

4.2.3 Intra-regional comparison

From the perspective of the difference and contribution rate within the region, the overall trend is a gradual increase. From 2014 to 2016, the intra-regional variance rapidly expanded to 39.54%, and then fell back after reaching the highest level in 2017. In 2011, the inter-regional variation of Theil index was 88% and the intra-regional variation was 12%, and by 2020, the contribution rate was 72.3% and 17.3%. Among the five regions, the Pearl River Delta region has a small contribution to the total amount of foreign direct investment, while the eastern and western regions have a small contribution, and the mountain region has a high proportion of contribution. In the past decade, the difference of foreign capital distribution in the Pearl River Delta region is relatively stable, and the difference between the eastern and western regions has been improved, but the northern mountainous area shows unbalanced foreign capital distribution. This may be the relatively developed cities such as the Pearl River Delta. The relatively stable distribution of foreign capital in recent years is related to the path dependence of foreign capital entry. Under normal circumstances, the distribution pattern of foreign direct investment in the Pearl River Delta region is in a relatively stable state and will not change greatly. Compared with the areas outside the Pearl River Delta, such as the two regions and the mountainous areas, because the respective cities are in different stages of economic development, various favorable or unfavorable factors are greatly unstable, so the inflow of foreign capital will be easily reallocated, resulting in the overall increase of intra-regional

differences, and the FDI differences within each economic region are also different.

5. Conclusion and Policy Recommendations

5.1. Conclusion

From the above analysis, we draw the following three conclusions:

5.1.1 The Overall Difference in FDI Has Gradually Narrowed in Recent Years

The overall difference of FDI in Guangdong Province from 2011 to 2020 shows an unstable state. Affected by the combined factors, the Theil index of the overall difference has remained at a level greater than one after 2014. However, from 2019 to 2020, the difference showed a trend of narrowing. On the premise of entering a new stage of development, Guangdong province has continuously carried out structural adjustment and industrial upgrading, and the hardware and software conditions in all aspects have been improved, which has effectively changed the spatial layout of FDI, and the overall difference has gradually narrowed, making the overall difference of FDI in the five economic regions enter a new stage.

5.1.2 The Intra-regional Variation Shows an Upward Trend and Contributes More to the Overall Variation

The intra-regional difference of FDI in Guangdong Province has been increasing since 2014, and the speed of the expansion of the difference has been faster and faster. In addition, with the promotion of "One Belt and One Road" and the Guangdong-Hong Kong-Macao Greater Bay Area strategy, Guangzhou and Shenzhen in the A zone of the Pearl River Delta have become important hub cities and the core engines of the Bay Area economy [10]. With huge market development potential, they have laid a material foundation for attracting high-quality foreign investment, which cannot be imitated and surpassed by other cities. This is another strong example of the uneven distribution of FDI in Guangdong Province.

5.1.3 The Contribution Rate of Inter-regional Differences to the Overall Difference is Large

Through the above empirical analysis and combined with the existing literature research, it is found that although Guangdong province is a large and strong economic province, its GDP has maintained the first place in terms of China's GDP for many consecutive years in recent years. The economic development level of cities in Guangdong Province is relatively stable in spatial distribution, but there are large spatial differences. At present, there is a huge gap between the five economic regions in terms of economic base, geographical location and resource endowment, while the location selection of FDI in the host country is affected by the needs of the local labor market, trade barriers, economic development degree and other factors [11]. Therefore, at the level of economic development, convenient transportation modes will better attract foreign investment. Because foreign capital is dominated by labor-intensive industries and the demand for labor is also large, the Pearl River Delta of Guangdong province is the area where migrant workers gather, which has good conditions to attract foreign capital. This also makes the difference in attracting foreign capital obvious, resulting in the difference rate between regions has been maintained at a high level. The study found that this difference is mainly caused by the huge inter-regional difference between the Pearl River Delta and the northern mountainous areas.

5.2. Suggestion

Based on the existing problems, we propose the following suggestions accordingly:

5.2.1 Guiding the Rational Distribution of Foreign Investment

We should actively guide the distribution and investment of FDI in Guangdong province through the government and market make a great difference together [12]. As a pioneer and leader of reform and opening up, Guangdong province has superior resource endowment conditions, and benefits from regional policies such as the establishment of special economic zones and coastal cities, so the capital flow is relatively frequent. Therefore, in order to promote the harmonious development of Guangdong province's economy, it is necessary to properly guide the capital flow of Guangdong province and reduce the overall gap. The difference between different provinces is inevitable, which is not only in line with the law of economic development, but also a general phenomenon of provincial development. In the face of reasonable differences, policy is an important endogenous variable that can be effective in facilitating the efficient allocation and distribution of resources. This is to make full use of the macro-control function of Guangdong Province, that is, according to the actual situation and comparative advantages of different county units, the guidance of different levels, regions and categories. According to local conditions, we should make precise policies, relying on the Guangdong-Hong Kong-Macao Greater Bay Area and other national strategic development opportunities, which can radiate to the whole region to drive the overall FDI development. At the same time, adopting differentiated support policies from different angles and intensity, and coordinating with the tracking and feedback of policy implementation will help to better guide the rational allocation of foreign capital, so as to narrow and optimize the gap of FDI in Guangdong Province.

5.2.2 Accelerating the Factors Flow and Industrial Transfer

Based on the marginal industry transfer theory of Xiaodao Qing, Guangdong province should reasonably transfer the "sunset industries" that no longer have local advantages, so that Guangdong's production factors can be used more effectively. At the same time, we should actively develop domestic rare resources such as land and minerals. Give full play to the advantages of the east and the west regions, attach importance to FDI, strengthen the reasonable adjustment of the industrial structure, and promote the overall coordinated development of Guangdong Province. Grasping the advantages brought by economic globalization, the opportunities created by economic globalization for the development of the eastern region are reflected in the following aspects: in terms of investment. The industrial targets of foreign direct investment are more diversified and tend to be emerging industries, creating conditions for higher-level strategic coupling. For example, according to their own industrial positioning, cities in the northern mountainous areas can attract similar industrial clusters, improve infrastructure, optimize the business environment, strive to develop industries with superior resources, and attract FDI inflows. Secondly, the resources of a single city are limited. Through holistic planning, each has its own unique development strategy to achieve a sustainable development path. Finally, Guangdong province should strengthen the connection and overall planning and coordination of the system, guide the innovation resources of the Pearl River Delta to the east and northwest of Guangdong, and promote the development of the eastern, western and northern mountainous areas with external forces. That is, by accelerating the industrial transfer between the economically developed areas in the Pearl River Delta and the less developed areas in Guangdong, the eastern northwest and the growth pole, the strengthening effect is transformed into the entire spatial spillover effect, guiding the orderly flow of human resources.

At the same time, we can transfer of material resources, financial resources and high and new technology to the less developed areas, which consolidate the economic development foundation of backward areas.

On this basis, the coordinated development of the Pearl River Delta, the east and the west regions and the mountainous areas in the north of Guangdong has established a strategic mechanism system of regional coordinated development, and reduced the regional economic development differences in different spatial scales. This will help promote complementary advantages and organic integration among cities and provide a demonstration role for the rest of the country.

5.2.3 Building a "multi-core-network" model

In order to narrow the gap between the regions, we must make full use of the radiation effect of the central cities and establish a spatial pattern of "multi-core-network". We will accelerate the construction of "one nuclear area, one Belt", adopt targeted policies to complement each other's advantages, guide the rational distribution of industries to build a world-class metropolitan circle, optimize the east and west economic belt. Guangzhou and Shenzhen are the core of the economic development of Guangdong Province, but their leading influence of the surrounding areas is not significant, so it is difficult to form an important mode for the development of other cities in Guangdong province. Therefore, it is necessary to continuously promote and coordinate the economic development of different regions to avoid vicious competition and homogeneous development. It is significant to optimize the spatial development structure of the regional economic development system to cultivate more potential core cities. Finally, the regional economic structure and spatial layout and development pattern of "multi-core-network" will be formed. Under this development mode, core cities can play a positive technology spillover role to form a new pattern of multiple development axes and core nodes to drive the coordinated development of regional economic space, thus narrowing the differences within the region.

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