

# Factors Influencing Regional Economic Vitality Based on Regression Analysis

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**Abstract**—The urban economic vitality refers to capacity and potential of urban economic development. At present, Chinese cities are in a period of rapid growth, the vitality of urban economy has become a driving force for attracting talents, urban construction and sustainable regional development. Based on multiple stepwise regressions, this paper quantitatively analyzes the current regional economic vitality and future development from different regions and different perspectives. This paper models and analyzes the economic vitality of different provinces of China from six aspects: population change, corporate development vitality, regional development, regional environment, industry development, and income level. The results show the increase of urban population and population density is conducive to the enhancement of regional economic vitality, and the absorption of enterprises can drive the regional economic growth. We use propensity score matching to calculate the change of the growth rate of the number of enterprises after the implementation of the policy, and analyze the short-term and long-term effects of changes in economic policy factors on regional economic vitality. This paper quantifies the key factors affecting the survival of urban enterprises, and provides theoretical support for promoting urban economic vitality. Finally, we tested the model, verified the rationality of the results, and extended the scope of application of the model, which has certain reference value in practical applications.

## 1 Introduction

### 1.1 Background

"Vitality" refers to the level of support of a city, region or country for vital functions, ecological environment and economic society[1]. The economic vitality of a city is a comprehensive reflection of its economic development strength, radiant power, and sustainable development capabilities, as well as a true reflection of its innovation and entrepreneurship capabilities[2]. In 2004, the Organization for Economic Vitality and Sustainable Development defined economic vitality as: "The economic competitiveness and adaptability of a community, and its ability to attract private and public enterprises." Economically active communities can provide residents with satisfactory employment and other economic activities and long-term sustainable quality of life. They can identify opportunities and grasp opportunities at any time and contribute to the increase of residents' welfare. In addition, they can recognize the hard work and noble qualities of residents and businesses, thus encouraging them to innovate and participate in community activities.[3]. The regional economic vitality,

social vitality, environmental vitality and cultural vitality together constitute the entire vitality system[4].

On August 17, 2013, the state council of China released the implementation plan of the "broadband China" strategy, laying out the broadband development goals and paths in the next 8 years, which means that the "broadband strategy" has been upgraded from a departmental action to a national strategy, and broadband has become a national strategic public infrastructure for the first time. The launch of the strategy can be seen as not only a supporting policy to promote information consumption, but also an important policy measure to build "China's economic upgrade", which will become a powerful tool to drive consumption and investment.

According to Kevin Lynch, a famous American urban planning and architecture expert: "The economic vitality of a city is mainly reflected in the growth of the city, and more in the aspect of economic growth, the attractiveness of foreign capital and various production factors." Therefore, we can get that the economic vitality of the city is a dynamic concept[3]. In recent years, China has entered a stage of rapid urbanization. How cities can ensure high-quality, sustainable, and the steady development of the city has attracted people's attention. Urban vitality is an endogenous driving force for urban development. Due to differences in economic, social, natural, historical and other areas, regional development is uneven, and economic vitality also varies regionally.

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Therefore, an objective and comprehensive evaluation of regional economic vitality, exploring the reasons for such differences, and providing theoretical support for local governments to introduce preferential policies and management methods that stimulate economic vitality, are of great significance for achieving regional coordination in sustainable development.

### 1.2 Literature Review

In the past, many researchers studied the factors affecting the economic competitiveness of cities and analyzed the differences of regional economic development level based on the selected indicators, which contributed to the assessment of the economic strength of different regions. For example, Decai Tang(2019) et al. believe that the regional spatial structure is an important factor that determines the input-output efficiency of various production factors in the region and is the key to the sustainable development of the region. Regional spatial structure is an important factor affecting the input–output efficiency of various factors of production in the region and is the key to sustainable development[5]. They found that the impact of the four spatial structure indicators on the sustainable development level of the Yangtze River Economic Zone as follows: Gini coefficient of urban scale, urban primacy, regional economic linkage strength, spatial compactness. Jianhua Xu et al.(2015) used the nested decomposition of Theil Index and the Wavelet Analysis to study the economic differences between provinces and regions in China [6]. Bin Meng et al. used the data of population, land use and per capita GDP of Chinese provinces to study the differences in China's regional social and economic development with spatial analysis [7]. Shaowei Ai et al. used the indicators of economic development, residents' life and economic structure to reveal the spatial-temporal differences of county economic strength in Henan province[8]. Although these studies have explored the influence of single (class) factors or a few combination factors on economic strength, there are relatively few influencing factors selected in such studies, which requires further improvement of influencing factor indicators and innovation of research methods. In addition, there are few studies on the short-term and long-term effects of selected indicators on regional economic development. Based on the indicators and data in the statistical yearbook, this paper constructs a multi-factor model to quantify the key factors affecting the regional economic

vitality, and discusses the influence mechanism of different factors on the level of economic development.

## 2 method

### 2.1 Model Assumptions

In order to simplify the problem and avoid many factors that affect security inspection, the model established in this paper is established and implemented in a relatively ideal environment. Therefore, this paper makes the following basic assumptions, and each assumption is reasonable.

- 1.Assume the data source is reliable and accurate.
- 2.Assume that the impact of each year's indicators on urban economic vitality is lagging.
- 3.Assume that there will be no economic crisis, social unrest, etc. after 2014.
- 4.Assume that the number of companies in different regions can represent the size of their economic vitality.

### 2.2 Selection of Index and Establishment of Index System

With reference to the domestic and foreign research results on urban economic vitality[9][10], this paper mainly measures China's regional economic vitality from five factors: population change, corporate development vitality, regional development, regional environment, and income level. The principles of this paper based on the evaluation index system are as follows[11]: (1) Scientificity. (2) Feasibility.(3) Completeness. (4) Practicality. Therefore, this paper selects 7 indicators of population change factors, 58 indicators of corporate development vitality factors, 18 secondary indicators of regional comprehensive development level, 21 secondary indicators of income level, and 50 secondary indicators of regional environment, as is shown in Table 1. The research area is based on the provincial research unit. The research data comes from the website of the National Bureau of Statistics and the 2009-2017 China City Statistical Yearbook.

Considering that the provinces and cities in China have large differences in economy, population, and area, there will be deviations when using the absolute data of the selected indicators for calculation. Therefore, this paper uses the value of each indicator divided by the corresponding area to represent the level of regional development on each indicator.

**TABLE I.** INDEX SYSTEM FOR COMPREHENSIVE EVALUATION OF REGIONAL DEVELOPMENT.

First level indicator	Second level indicator
Demographic trends	Resident population (ten thousand people), the natural population growth rate (per), the proportion of urban population (%), the urban population density (people/km <sup>2</sup> ), at the end of town worker is basic medical treatment

	<p>insurance coverage number (ten thousand), the number of students in common colleges and universities (ten thousand), the total number of common colleges and universities faculty (ten thousand), the number of ordinary primary school students (ten thousand), the number of full-time teachers (ten thousand people) elementary school, health technical personnel number (ten thousand), number (assistant) practicing doctors (ten thousand), the number of registered nurses (ten thousand)</p>
Regional development level	<p>GDP (\$100 million), the GDP index (= 100) last year, the local finance general budget revenue (100 million RMB), the local finance general budget spending (\$100 million), the residents' consumption level (RMB), domestic patent applications to accept the amount of (a), the number of on-the-job worker attend endowment insurance (ten thousand), the basic old-age insurance income ratio (%), the number of registered urban unemployed (ten thousand people), the registered urban unemployment rate (%), the whole social fixed assets investment (100 million RMB), utilization of foreign capital in the whole society fixed assets (100 million RMB), the total retail sales of social consumer goods (100 million RMB), the total import and export enterprise unit seat (thousand dollars), management unit seat (thousand dollars), the total export enterprise unit seat imports (thousand dollars), the comprehensive production capacity of water supply (m<sup>3</sup>/day), the path length (km), the urban water penetration (%), city gas penetration rate (%), every ten thousand people with public transport vehicles (standard), the number of common colleges and universities (what), the average number of primary and secondary schools (people), the number of medical and health institutions (number) and the added value of primary industry (100 million RMB), the added value of the second industry (100 million RMB), the added value of the third industry (100 million RMB), the first industrial added value of index, the second industry added value index, the index of the added value of the tertiary industry</p>
Enterprise development vitality	<p>Companies with foreign investment (door), the total amount of investment of enterprises with foreign investment (millions of us dollars), agriculture, forestry, animal husbandry fishery whole</p>

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social fixed assets investment (100 million RMB), mining the whole society fixed asset investment (100 million RMB), manufacturing, the whole society fixed asset investment (100 million RMB), electricity, gas and water production and supply industry whole social fixed assets investment (100 million RMB), construction whole social fixed assets investment (100 million RMB), transportation, warehousing and postal service whole social fixed assets investment (\$100 million), information transmission, computer services and software industry whole social fixed assets investment (100 million RMB), wholesale and retail all social fixed assets investment (100 million RMB), accommodation and catering industry whole social fixed assets investment (\$100 million), financial industry whole social fixed assets investment (\$100 million), the real estate industry, the whole society fixed asset investment (100 million RMB), leasing and enterprise services all social fixed assets investment (100 million RMB), scientific research, technical services and geological exploration whole society fixed asset investment (\$100 million), water conservancy, environment and public facilities management society (\$100 million) of investment in fixed assets, residents service and other services the whole society fixed asset investment (100 million RMB), education of the whole society fixed asset investment (100 million RMB), health, social security and social welfare whole social fixed assets investment (100 million RMB)The whole society, culture, sports and entertainment (\$100 million) of investment in fixed assets, public administration and social organization whole social fixed assets investment (\$100 million), the added value of farming, forestry, animal husbandry fishery (100 million RMB), the added value of industrial added value (100 million RMB), construction (100 million RMB), wholesale and retail value (100 million RMB), transportation, warehousing, and the added value of the postal service (100 million RMB), accommodation and catering industry added value (100 million RMB), the added value of the financial sector (100 million RMB), the added value of real estate industry (100 million RMB), the added value of other industries (100 million RMB)

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Demographic trends	<p>Urban units total wages (100 million RMB), urban employment unit employment staff average wages (RMB), urban unit on-the-job worker average wage (RMB), agriculture, forestry, animal husbandry and fishery towns unit employment staff average wages (RMB), mining town unit employment staff average wages (RMB), manufacturing towns unit employment staff average wages (RMB), electricity, gas and water production and supply industry town unit employment staff average wages (RMB), the construction unit employment staff average wages in cities and towns (RMB), transportation, warehousing and postal service unit employment staff average wages in cities and towns (RMB), information transmission, computer services and software Industry town unit employment staff average wages (RMB), wholesale and retail unit employment staff average wages in cities and towns (RMB), accommodation and catering industry town unit employment staff average wages (RMB), the financial industry town unit employment staff average wages (RMB), the real estate industry town unit employment staff average wages (RMB), leasing and enterprise services unit employment in cities and towns average wage (RMB), average salary of unit employees in urban areas engaged in scientific research, technical services and geological survey (RMB), water conservancy, environment and public facilities management unit employment in cities and towns average wage (RMB), residents service and other services unit obtain employment in cities and towns staff average wages (RMB), unit employment education town average wage (RMB), health, social security and social services unit employment staff average wages in cities and towns (RMB), culture, sports and entertainment town unit employment staff average wages (RMB), public administration and social organization unit employment staff average wages in cities and towns (RMB)</p>
Regional development level	<p>Urban green space area (hectares), park green space area (hectares), number (a) total emissions, waste water park (ten thousand tons), chemical oxygen demand (cod) emissions (ten thousand tons), ammonia nitrogen emissions (ten thousand tons), sulfur dioxide emissions (tons), amount of domestic living garbage to be removed (ten thousand tons), forest land area (hectares), forest area</p>

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(hectares), plantation area (hectares), the forest coverage rate (%), the forest volume (m<sup>3</sup>)

### 2.3 Model establishment

#### 2.3.1 Negative binomial regression model

Since the dependent variable (i.e., the number of companies) in this paper is discrete count data, so we consider using a Poisson regression model or a negative binomial regression model to process the discrete count data[12][13]. Then, based on the Bayesian prior function and stepwise regression model, this paper constructs a function equation between the comprehensive evaluation index and the number of provincial enterprises, and uses the regression coefficient of each evaluation index as the weight of each index, and then calculates the provincial Economic vitality. The specific calculation steps are as follows:

**Step 1:** Verified whether the number of firms is suitable for a negative binomial regression model with looser assumptions. We use Stata for simple negative binomial regression. The 95% confidence interval of alpha is (0.0111111, 0.0174941), so the null hypothesis that the parameter "alpha = 0" (there is no excessive dispersion) can be rejected at a significant level of 0.05. Therefore, the negative binomial regression should be used. The linearized regression equation is

$$\ln[E(Y)] = \beta + \alpha_1 x_1 + \dots + \alpha_p x_p + \varepsilon$$

(1)

We used negative binomial regression to construct the functional relationship between the number of enterprises in the *i* province and various influencing factors, as shown in (2) :

$$\ln(y_i) = \alpha + \beta_1 x_{i,1} + \beta_2 x_{i,2} + \beta_3 x_{i,3} + \dots + \beta_{154} x_{i,154} + \varepsilon_i$$

(2)

That is, the functional relationship between the number of enterprises and the influencing factors is shown in equation (3):

$$y_i = \exp(\alpha + \beta_1 x_{i,1} + \beta_2 x_{i,2} + \dots + \beta_{154} x_{i,154} + \varepsilon_i)$$

(3)

Among them,  $\alpha$  represents the intercept term,  $\varepsilon_i$  represents the residual term, and  $\beta_i$  represents the regression coefficient of the *i*-th variable in the regression equation.

**Step 2:** Randomly sample the independent variable *X* based on the Bayesian prior sparse function to find the key indicators that affect the survival of the enterprise. Let  $\beta$  be the set of independent coefficients, if  $\alpha_i = 0$ , let  $\gamma_i = 0$ , otherwise let  $\gamma_i = 1$ . Then  $\gamma_i$  obeys the Bernoulli distribution of (0-1), and its probability density function can be written as:

$$f = p_i^{\gamma_i} (1 - p_i)^{1 - \gamma_i} = \begin{cases} p_i, \gamma_i = 1 \\ 1 - p_i, \gamma_i = 0 \end{cases}$$

(4)

Let  $\gamma = (\gamma_1, \gamma_2, \dots, \gamma_n)^T$ , then the probability density can be written as

$$\gamma \sim \prod_{i=1}^n (1 - p_i)^{1 - \gamma_i}$$

(5)

Among them,  $p_i$  can be determined according to the number of independent variables expected in the regression model, that is  $p_j = \frac{m}{n}$ , *n* can be the total number of independent variables ( $n = p$  in this paper), and *m* can be the expected number of independent variables ( $m = q$  in this paper). Based on the formulas (4) and (5), a priori  $\gamma$  is obtained by sampling, and the corresponding variable  $x_{ij}$  of  $\alpha_i \neq 0$  is selected according to  $\gamma_i = 1$ , so as to obtain a sample of *X*, which is denoted  $X^*$ .

**Step 3:** Construct a stepwise regression model. Use the sample variable  $X^*$  to perform negative binomial regression on the dependent variable  $y_i$  and find the regression result at the specified significance level (the significance level in this paper is 0.05), that is, the current  $X^*$  corresponding set of index variable coefficients  $\alpha^*$ .

**Step 4:** Repeat sampling enough times to ensure model convergence. We used Stata to run the program 10,000 times and 5000 times, and obtained no significant difference in the regression coefficients of each influencing factor, so the convergence was close to completion. We remove the collinearity factors, and count all regression coefficients and average them as the final regression estimation coefficient  $\bar{\alpha}_k$  of the independent variable  $X^*$ . Therefore, the function fitting relationship between the number of enterprises in each province *i* and various influencing factors is shown in (6):

$$Q_i = \exp(\bar{\alpha} + \bar{\beta}_1 x_{i,1} + \bar{\beta}_2 x_{i,2} + \dots + \bar{\beta}_{106} x_{i,106})$$

(6)

At the same time, we can measure the impact of the five first-level indicators on the number of enterprises:

$$Q_1 = \exp(\bar{\beta}_1 x_{i,1} + \bar{\beta}_2 x_{i,2} + L + \bar{\beta}_{12} x_{i,12})$$

$$Q_2 = \exp(\bar{\beta}_{13} x_{i,13} + \bar{\beta}_{14} x_{i,14} + L + \bar{\beta}_{41} x_{i,41})$$

$$Q_3 = \exp(\bar{\beta}_{42} x_{i,42} + \bar{\beta}_{43} x_{i,43} + L + \bar{\beta}_{71} x_{i,71})$$

$$Q_4 = \exp(\bar{\beta}_{72} x_{i,72} + \bar{\beta}_{73} x_{i,73} + L + \bar{\beta}_{93} x_{i,93})$$

$$Q_5 = \exp(\bar{\beta}_{94} x_{i,94} + \bar{\beta}_{95} x_{i,95} + L + \bar{\beta}_{106} x_{i,106})$$

(7)

1) The principle of propensity score matching (PSM)

Assuming that the individual  $i$  belongs to the research group, we should find an individual  $j$  belonging to the control group, and make the values of measurable variables of the two individuals as similar as possible (match). namely  $x_i \approx x_j$ . Based on the assumption that it can be ignored, the probability of individuals  $i$  and individuals  $j$  being assigned to the research group is similar and comparable. Therefore,  $y_i$  is taken as the estimator of  $y_{0i}$ , namely  $\hat{y}_{0i} = y_j$ . Therefore,  $(y_i - \hat{y}_{0i}) = y_i - y_j$  can be taken as a measure of the treatment effect of individual  $i$ . "matching estimator" is obtained by matching each individual in the study group in this way.

In general,  $x_i$  may include multiple variables. At this point, if  $x_i$  is directly used for matching. It means that data sparsity problem may be encountered for matching in high-dimensional space. For this purpose,  $f(x_i)$  is generally used to compress the information of the multidimensional vector  $x_i$  into one dimension and then match it according to  $f(x_i)$ . One method is to use vector norm, i.e. the distance function defined in vector space. Statisticians Rosenbaum and Rubin (1983) proposed using propensity score (p-score) to measure the distance. The general steps to calculate the average processing effect by propensity score matching are as follows:

**Step 1:** Selecting covariable.  $x_i$  including  $(y_{0i}, y_{1i})$  and  $D_i$  as far as possible to ensure that the negligible assumption is met.

**Step 2:** Estimated propensity score.

**Step 3:** Match the samples.

**Step 4:** Based on the matched sample, we calculated the average processing effect.

According to the matched sample, we calculate the average treatment effect. The general expression of the participants' average processing effect (ATT) estimator is:

$$\hat{ATT} = \frac{1}{N_1} \sum_{i:D_i=1} (y_i - \hat{y}_{0i}) \tag{8}$$

$N_1 = \sum_i D_i$  is the number of individuals in the study group, while  $\sum_{i:D_i=1}$  means that only the individuals in the study group are added. Similarly, the corresponding match of the treatment group can be found for each individual  $j$  in the control group. The general expression of the unattended average processing effect (ATU) estimator is:

$$\hat{ATU} = \frac{1}{N_0} \sum_{j:D_j=0} (\hat{y}_{1j} - y_j) \tag{9}$$

$N_0 = \sum_j (1 - D_j)$  is the number of individuals in the control group, while  $\sum_{j:D_j=0}$  is the sum of individuals

in the control group. The general expression of the average processing effect (ATE) estimator for the entire sample (including participants and non-participants) is:

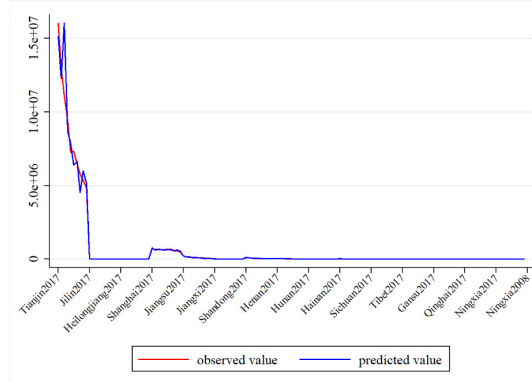
$$\hat{ATE} = \frac{1}{N} \sum_{i=1}^N (\hat{y}_{1i} - \hat{y}_{0i}) \tag{10}$$

One of the methods used to match propensity scores is k-nearest neighbor matching, which looks for the different groups of individuals with the closest propensity score. If so, it is a one-to-one match. According to the requirements of question 2, this paper divided the demonstration cities (provinces) of the "broadband China" policy in 2014 into study groups, and the cities (provinces) without implementation strategies into control groups. The study group in this paper includes individuals (provinces) : Beijing, Tianjin, Shanghai, Liaoning, Heilongjiang, Shandong, Henan, Anhui, Jiangsu, Zhejiang, Fujian, Jiangxi, Guangdong, Sichuan, Guizhou, Ningxia; Control individuals (provinces) were: Jilin, Hubei, Hunan, Hainan, Tibet, Gansu, Qinghai, Hebei, Shanxi, Inner Mongolia, Guangxi, Chongqing, Yunnan, Shaanxi and Xinjiang.

### 3 Result and Discussion

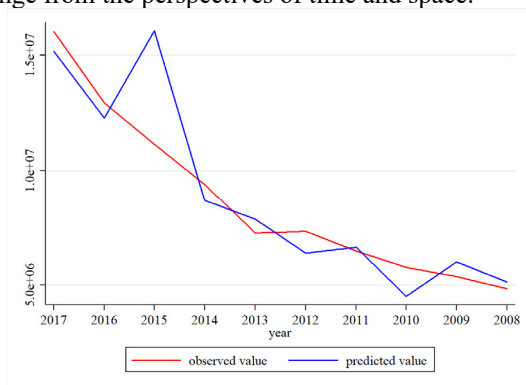
#### 3.1 Analysis of influencing factors of regional economic vitality

The regression coefficients of most influencing factors are relatively small. That is, the predictive ability of any single influencing factor is weak. So we cannot predict the number of enterprises in a province based on only a few limited factors. We will obtain the estimated number of enterprises in 15 provinces in 2008-2017 based on the model, and compare it with the actual observations. The results are shown in Fig. 1. We find that the real value and the predicted value matched accurately, indicating that the model is robust and has nowcasting ability. The resulting model exhibits a rather good fit as indicated by a significant  $R^2$  (0.953). Then, we will analyze the change trend of the number of enterprises from the two dimensions of time and space.



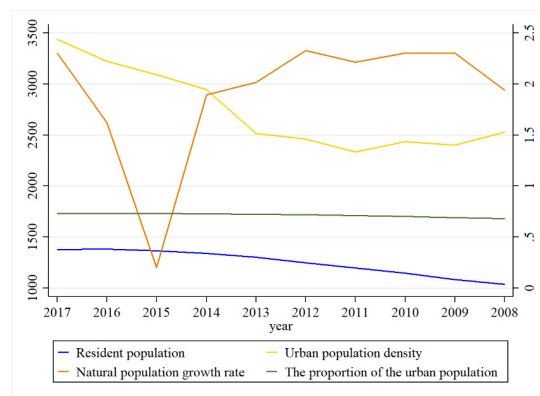
**Figure 1.** Comparison among the predicted value and the actual observed value.

Next, we show the trend of the enterprises number in Tianjin from 2008 to 2017 through Fig 2, and we take 2017 as an example to show the difference of the number of enterprises in 15 provinces in the same year through Fig. 3, and analyze the causes of the difference caused by population change trend and enterprise vitality change from the perspectives of time and space.



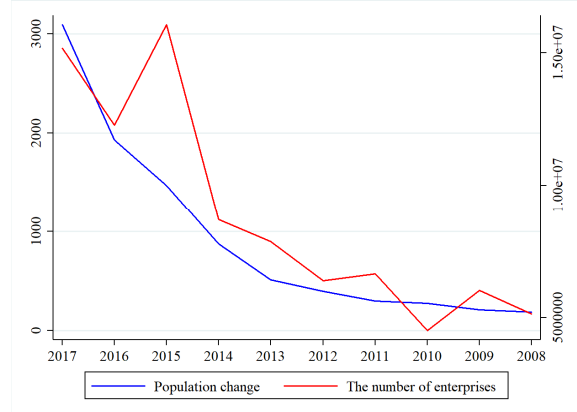
**Figure 2.** The change trend of the number of enterprises in ten years in Tianjin.

As the main participants of market economic activities, the development status of enterprises is an important indicator of regional economic strength and market competitiveness. As can be seen from Fig. 2, the number of enterprises in Tianjin continued to increase in ten years, and the growth rate of the number of enterprises accelerated after 2013, for example, the growth rate in 2014 was 29.3% higher than that in 2013. This shows that with the passage of time and social development, Tianjin's economic strength and urban competitiveness are gradually enhanced. On the one hand, Tianjin is located in the Bohai rim region, which is the region with the most intensive investment by the world's multinational companies in China. Besides, Tianjin's Binhai new area has been included in the overall development strategy of the state, so it has a strong attraction for talents and capital. On the other hand, with the continuous promotion of the enterprise system reform and the government's preferential policies, the enterprise registration has become increasingly convenient, the enterprise environment has been continuously optimized, the market vitality has been constantly stimulated, and the number of enterprises has increased significantly.



**Figure 3.** The change trend of the number of enterprises in ten years in Tianjin.

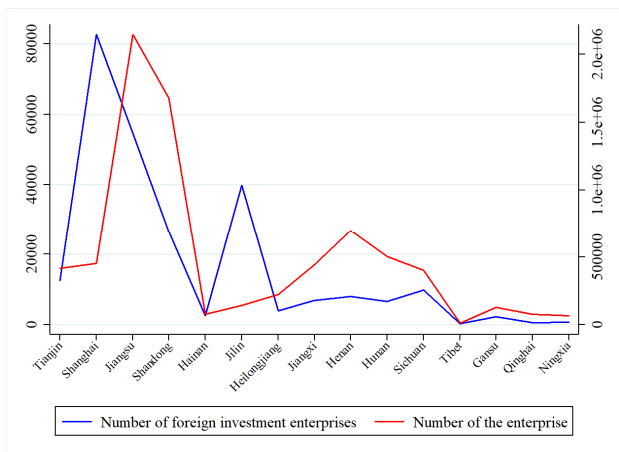
As can be seen from Fig. 3, the number of permanent residents, proportion of urban population and urban population density in Tianjin have shown an overall rising trend in the past ten years, which tends to be consistent with the changes in the number of enterprises in this period. This indicates that the increase of urban population in population change can promote the growth of enterprises to some extent. Meanwhile, in order to quantify the impact of population change on the number of enterprises, we used the model to calculate the contribution of population change factors to the number of enterprises within 10 years, as shown in Fig. 4. From Fig. 4 we can further conclude that population growth has a positive impact on the increase in the number of enterprises. The increase in population density and the increase in the proportion of urban population can reflect the region's good natural resources and strong social and economic strength, so that the region can not only reduce the loss of local population, but also absorb immigrants.



**Figure 4.** The impact of demographic changes on the number of enterprises.

We randomly selected representative provinces from the eastern, northeastern, central and western regions to observe the changes in the number of enterprises in the same year and compare the differences in the number of enterprises between regions. The results are shown in Fig. 5:





**Figure 5.** Differences in the number of enterprises between regions

On the whole, the eastern region has more enterprises than other regions, followed by the central region, and the western region has the least enterprises. This is because most of the eastern areas are coastal cities with a high degree of opening to the outside world and a strong regional comprehensive strength, attracting a large number of foreign-invested enterprises. The western region is mostly inland cities, where the information is not circulated and the influence of preferential policies is small. At the same time, we can see from the figure that the number of foreign-invested enterprises in the eastern region can bring a positive impact on the urban economic vitality, but the impact is not obvious in the northeastern region. Foreign Chambers of commerce give priority to the investment of dynamic and promising enterprises, provide them with capital and technical support, and thus promote the enhancement of local economic vitality. Therefore, in order to promote the vitality of urban economy, it is necessary to enhance the attractiveness and vitality of urban enterprises, thus providing endogenous impetus for urban development.

### 3.2 Propensity score matching

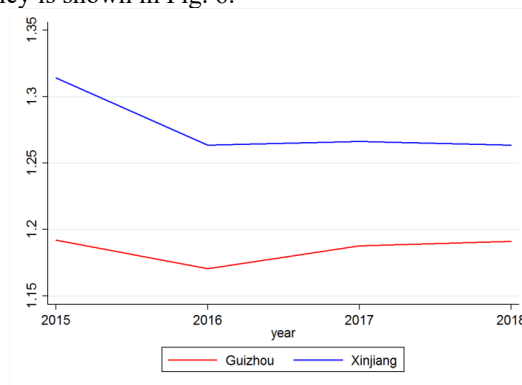
Based on the indicator system established before, we selected ten macroeconomic indicators. The inter-annual growth rate of each indicator before the implementation of the policy was taken as the covariate of this experiment to provide a basis for evaluating the tendency score of each province. Covariates included the number of enterprises in each province before the implementation of the policy, the GDP, the proportion of urban population, the average salary of employed personnel, and the unemployment rate. The dependent variables include the number of enterprises and the annual growth rate of GDP between 2015 and 2018 after the implementation of the policy, which serves as the basis for measuring regional economic vitality. The provinces in the study group were matched according to the propensity score (p-score). The matching results are shown in Table 2.

**TABLE II.** PROPENSITY SCORES FOR EACH PROVINCE

Province	p-score	Province	p-score
Tianjin	0.81667219	Hebei	0.65881218
Jilin	0.80492461	Shanxi	0.50955143
Heilongjiang	0.38376323	Inner Mongolia	0.51538331
Shanghai	0.9981389	Liaoning	0.45252904
Jiangsu	0.99410897	Zhejiang	0.80030072
Jiangxi	0.58171855	Anhui	0.61716442
Shandong	0.85993558	Fujian	0.39930929
Henan	0.69646903	Hubei	0.15666299
Hunan	0.1867521	Guangdong	0.97127943
Hainan	0.19609002	Guangxi	0.12605153
Sichuan	0.76334191	Chongqing	0.17798571
Tibet	0.00237169	Guizhou	0.58969361
Gansu	0.17547197	Yunnan	0.81176186
Qinghai	0.00476284	Shanxi	0.17121132
Ningxia	0.28903613	Xinjiang	0.55126652
Beijing	0.76747893		

Calculate the growth rates of the dependent variables of the study group and the control group in each year after policy implementation, and then analyze the short-term and long-term effects of economic policy adjustment on regional economic vitality.

When researching the impact of policy changes on the growth of the number of enterprises, this paper takes the Guizhou and Xinjiang as examples (the p-scores are 0.58969361 and 0.55126652, respectively) in the matching results to find the annual growth rate of the number of enterprises from 2015 to 2018. The comparison of the growth rate of the number of enterprises four years after the implementation of the policy is shown in Fig. 6.

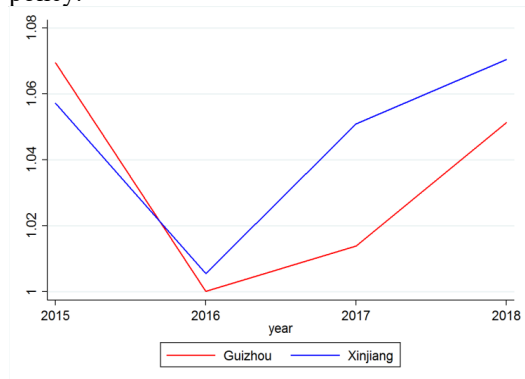


**Figure 6.** The annual growth rate trend of the number of enterprises after the implementation of the policy

It can be seen from Fig. 6 that the growth rate of the number of enterprises in Guizhou has significantly decreased from 2015 to 2016, and the growth rate of enterprises in Xinjiang has changed the same as that in Guizhou. This is because the implementation of the policy has accelerated the flow of information, and the network economy has seized the original market share of the real economy in the short term, which has limited the development of the national real economy. For example, most of the physical enterprises in demonstration areas

(such as Guizhou Province) have been impacted, and their market competitiveness has increased. Traditional enterprises are facing transformation and upgrading, and the enterprise environment is more severe, which has restrained the growth of the real economy to a certain extent. At the same time, emerging industries in the region are in their infancy, such as the information industry and high-tech industries, with relatively few new additions, so the overall growth rate of enterprises has slowed. From 2016 to 2018, the growth rate of enterprises in Guizhou has gradually increased, while the growth rate of enterprises in Xinjiang has not changed significantly. This is because, in recent years, the digital economy has become the core driving force for economic growth. The coordinated development of the Internet and the real economy is becoming increasingly apparent. The integration of the real economy and "Internet accelerated speed" has promoted the reform of traditional enterprises and the cultivation of new economic momentum. Therefore, the growth rate of the number of enterprises has increased in the long run.

Then we explore the impact of policy changes on regional economic vitality from changes in the growth rate of GDP. Fig. 7 shows the trend of the growth rate of GDP in the four years after the implementation of the policy.



**Figure 7.** The trend of annual GDP growth after the implementation of the policy

It can be seen from the figure that the growth rate of regional GDP dropped significantly from 2015 to 2016, gradually increased from 2016, and the growth rate increased year by year. This is because after the implementation of the policy in 2014, the Internet economy caused the weakening or even bankruptcy of the real economy, and macroeconomic and financial risks were exposed in the short term, resulting in the downward trend in regional economic development. And after the transformation and upgrading of traditional industries and the gradual growth of emerging enterprises, the positive effects brought about by economic policies have gradually emerged, which has strengthened regional economic vitality and accelerated urban economic development.

In summary, the long-term economic growth orientation of the macroeconomic policy in China is more obvious than the short-term economic orientation, which indicates that the macroeconomic policy goal orientation is more inclined to long-term economic growth. Changes in economic policies will make policy-beneficiated regions experience a transitional period of declining economic development in the short term. But in the long run, policy changes will bring challenges and increase opportunities. For example, it can optimize the adjustment of regional industrial structure, promote the rational allocation of resources, and reduce capacity, inventory, and deleveraging to build a sustainable, efficient, and stable new trends in economic development.

In order to test the rationality of propensity score matching, this paper separately obtains the eigenvalues of each sample under the covariate before the implementation of the policy, and compares the eigenvalues of the research group and the control group before and after matching. The calculation results are shown in Table 3.

**TABLE III.** Comparison of covariant eigenvalues before and after matching

Variable		Treated(Guizhou)	Controls(Xinjiang)
The number of the enterprise(%)	Before matching	1.2466221246	1.17863405733333
	After matching	1.2466221246	1.1689919052
GDP(%)	Before matching	1.1792	1.1472
	After matching	1.1792	1.1538
GDP index(%)	Before matching	1.0024	0.995966666666666
	After matching	1.0024	1.000
Proportion of urban population(%)	Before matching	1.0542	1.027066666666667
	After matching	1.0542	1.0234
Total wages of urban	Before	1.2178	1.209066666666667

employees per unit(%)	matching		
	After matching	1.2178	1.2126
The number of unemployed people(%)	Before matching	1.0192	1.002366666666667
	After matching	1.0192	1.0034
unemployment rate(%)	Before matching	0.9628	0.9744
	After matching	0.9628	0.9864
Investment in fixed assets(%)	Before matching	1.317	1.229366666666667
	After matching	1.317	1.28
The total amount of foreign investment in the fixed assets of the whole society(%)	Before matching	0.8458	1.055933333333333
	After matching	0.8458	0.9064
Total Retail Sales of Consumer Goods	Before matching	1.1938	1.168166666666667
	After matching	1.1938	1.1594

#### 4 Conclusion

As the main participant of market economy, the development of enterprises is an important index to measure regional economic strength and market competitiveness. Exploring the factors that influence the vitality of enterprises is of great significance to help the regional economy attract talents, urban construction and regional sustainable development. This paper constructs a negative binomial regression model to quantify the key factors affecting the survival of urban enterprises. The trend score matching method is used to calculate the change of the growth rate of the number of enterprises after the implementation of the policy. The conclusions are as follows:

First, on the whole, the eastern region has the largest number of enterprises, followed by the central region, and the western region has the smallest number of enterprises. Second, the increase of urban population can promote the growth of enterprises to some extent. Moreover, the number of foreign-invested enterprises in the eastern region can have a positive impact on the urban economic vitality, but the impact is not obvious in the northeast region. Foreign Chambers of commerce give priority to investing in dynamic and promising enterprises and provide them with financial and technical support to boost the vitality of the local economy. Therefore, in order to enhance the vitality of urban economy, we must enhance the attraction and vitality of urban enterprises, so as to provide an endogenous driving force for urban development. Third, after the implementation of a new policy (especially in the Internet economy), the real economy will weaken or even go bankrupt in the short term, exposing macroeconomic and financial risks and leading to a downward trend in regional economic development. However, in the long run, after the transformation and upgrading of traditional industries and

the gradual growth of emerging enterprises, the positive effects brought by economic policies are gradually emerging, enhancing the vitality of regional economy and accelerating the development of urban economy. In other words, the long-term economic growth orientation of China's macroeconomic policy is more obvious than the short-term economic growth orientation, indicating that the goal orientation of macroeconomic policy is more inclined to the long-term economic growth.

Based on our research, we propose three "developments" for regional economic. First, Develop the digital economy and promote scientific and technological innovation. Second, Develop foreign trade. Finally, Strength efforts to train and introduce talents. To accelerate the economic development of minority areas, the province should increase the investment in science and technology, vigorously develop the digital economy, actively promote scientific and technological innovation. The region should improve its ability to cope with environmental changes in order to adapt to the environment of economic globalization.

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