



Analysis on the Factor Contribution of Regional Economic Growth Under the Internet Economy Take the Data of Hubei Province from 2010 to 2020 as an Example

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Abstract. As China's economy has entered the stage of high-quality development from the stage of high-speed growth, the Internet is becoming the engine of new economic development. Its deep and wide application provides a strong driving force for the growth of regional GDP. Based on the time series data of Hubei Province from 2010 to 2020, this paper constructs Cobb-Douglas production model, systematically analyzes the factor contribution rate of capital, labor and Internet to regional economic growth in Hubei Province, and puts forward some suggestions for the further economic development of Hubei Province in the Internet era.

Keywords: Internet economy · Cobb-Douglas production function · Factor contribution rate · Hubei province

1 Introduction

Since 2010, the global Internet industry has entered a period of rapid development. According to the data of Internet World Statistics (IWS), the number of global Internet users continued to grow from 2011 to 2020. By June 2020, the number of global Internet users had reached 4.648 billion, accounting for 59.6% of the world population. Information systems are interconnected to form a global Internet. The rapid development of the Internet has brought new impetus to the economic growth of various countries. Especially in recent years, the cross penetration of mobile Internet and all walks of life has deeply affected the mode of economic development of our country. At present, China's economy has entered the stage of high-quality development from the stage of high-speed growth. With the accelerated integration and penetration of the Internet industry into various industries, on the one hand, China's traditional industries have accelerated their upgrading and radiated new vitality. The rapid growth of Internet economy has also played an obvious pulling role in the real economy. On the other hand, the continuous integration of Internet, Internet of things, cloud computing, big data, 5g and other new technologies has promoted the vigorous development of a number of new business forms based on Internet technology. With the rapid development of digital economy and e-commerce, a large number of electronic platforms and online trading channels

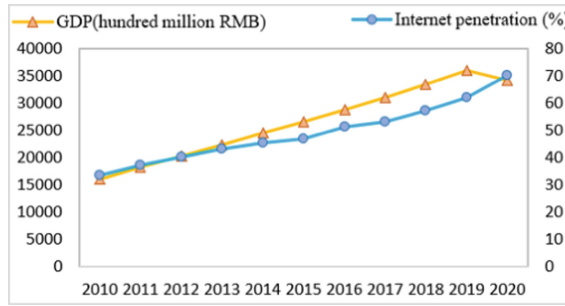


Fig. 1. Dynamic changes of Internet penetration and GDP growth in Hubei Province.

are emerging, the scale of online services is expanding, and the situation is richer. The Internet is becoming the engine of new economic development. Its deep and wide application has provided a strong driving force for the growth of regional GDP. Taking the economic data of Hubei Province in recent 11 years as an example, it can be seen from Fig. 1 that there is a similar growth trend between the GDP and Internet penetration of Hubei Province, which shows an obvious positive correlation between the two.

The development of the Internet has driven the development of new business forms, which not only improves the residents' Information Consumption Willingness, but also promotes the transformation and upgrading of the industry (Li Haijian, 2014). Han Xianfeng et al. (2019) incorporated the Internet into the analysis framework of improving regional innovation efficiency, which macroscopically proved the important role of Internet development in promoting regional economic growth. Luo min et al. (2015) analyzed the demand-oriented Internet business model and found that the mode of economic growth in the Internet era has changed from Smith growth to Schumpeter growth. Through the existing research, we can understand the impact path of Internet development on economic growth from macro and micro perspectives. However, there are few literatures to explore the role of Internet development on economic growth from the perspective of factor contribution rate. Based on this, this paper studies the efficiency of input factors by constructing Cobb Douglas production function and based on the time series data of Hubei Province from 2010 to 2020. By analyzing the factor contribution rate of capital, labor and Internet, this paper provides an empirical reference for how to realize the healthy growth of regional economy under the Internet economy.

2 Research Method

2.1 Model Construction

Cobb Douglas production function is a classical model to study the economic contribution of production factors. Based on the traditional C-D function model, this paper introduces the Internet as an independent element and constructs an extended C-D production function as follows:

$$Y = AK^\alpha L^\beta I^\gamma \quad (1)$$

In the above formula: Y is economic output, K is capital factor input, L is labor factor input, and I is the development of the Internet. A is the technical coefficient, i.e. total factor productivity (TFP). α is the output elasticity of capital, β is the output elasticity of labor force, γ is the output elasticity of the Internet.

Take logarithms on both sides of function (1) and convert it into linear equation:

$$\ln Y = \ln A + \alpha \ln K + \beta \ln L + \gamma \ln I \quad (2)$$

Function (2) can alleviate the influence of heteroscedasticity. In addition, the double logarithm linear model is helpful to better study the contribution rate of each factor input to the total output value.

2.2 Calculation Method of Contribution Rate

The contribution rate is an indicator used to analyze the degree of action of various factors in economic growth, from which the contribution rate of factors to economic growth can be obtained (Yang Zhirong et al. 2009). The calculation formula is as follows:

$$E_K = \alpha \times \frac{\frac{\Delta K}{K}}{\frac{\Delta Y}{Y}} \times 100\% \quad (3)$$

$$E_L = \beta \times \frac{\frac{\Delta L}{L}}{\frac{\Delta Y}{Y}} \times 100\% \quad (4)$$

$$E_I = \gamma \times \frac{\frac{\Delta I}{I}}{\frac{\Delta Y}{Y}} \times 100\% \quad (5)$$

According to the Solow residual value calculation method, the sum of the contribution rate of each factor input to economic growth is 1, so the contribution rate of other comprehensive production factors can be calculated:

$$E_T = 1 - E_K - E_L - E_I \quad (6)$$

In the above formula, E_K , E_L , E_I and E_T respectively represent the contribution rate of capital, labor, Internet and other comprehensive production factors to the economy.

3 Empirical Analysis Based on Cobb-Douglas Model

3.1 Data Source and Variable Description

1. Economic growth level (Y). In order to accurately measure the regional economic growth, this study uses the actual GDP of Hubei Province from 2010 to 2020 as the index to measure economic growth. The data comes from the Hubei Statistical Yearbook (2010–2020), which takes 2020 as the base period for adjustment, and the unit is 100 million yuan.
2. Capital factor input (K) in this paper, the perpetual inventory method is used to calculate the capital stock, and the calculation formula is:

$$K_t = I_t + (1 - \delta)K_{t-1} \tag{7}$$

In the above formula, K_t and K_{t-1} respectively represent the stock of capital in period t and period $(t - 1)$, and I is the investment of fixed assets in period t . The unit is 100 million yuan. δ Is the geometric depreciation rate.

Based on the research of Zhang Jun et al. (2004), the depreciation rate is taken in this paper $\delta = 9.6\%$. The capital stock K_0 of the base year is estimated by dividing the total investment in fixed assets in 2010 by 10%.

3. Labor force (L). The labor force is measured by the number of employed people in Hubei Province at the end of the calendar year, and the unit is 10000. The data comes from Hubei Statistical Yearbook (2010–2020).
4. Internet development level (I). This paper takes the Internet penetration rate as an indicator to measure the level of Internet development. The data comes from CNNIC’s statistical report on China’s Internet development over the years.

3.2 Descriptive Statistics

Table 1 presents the descriptive statistical results of the main variables. From 2010 to 2020, the average real GDP of Hubei Province is 2644.354 billion yuan, the minimum value is 1596.76 billion yuan in 2010 and the maximum value is 3592.283 billion yuan in 2019. Overall, the regional GDP of Hubei Province has increased year by year. In these 11 years, the average value of capital investment in Hubei Province was 11227.89 billion yuan, with a median of 10741.4 billion yuan, and the capital stock was relatively sufficient. From 2010 to 2020, the median number of employed people in Hubei Province was 36.45 million, with a minimum of 32.61 million and a maximum of 36.92 million. In general, labor input has changed little over the years. The average Internet penetration rate of Hubei Province in these 11 years is about 49%, and the median is 46.8% in 2015. Nationwide, the average Internet penetration rate in these 11 years is about 51.1%, with a median of 50.3%. In comparison, the development of Internet in Hubei Province is lower than the national average.

3.3 Multiple Linear Regression Analysis

According to the time series data of Hubei Province from 2010 to 2020, with the help of SPSS 22.0 software, multiple regression analysis of Eq. (2) is carried out by using ordinary least squares (OLS). The regression results are shown in Table 2.

Table 1. Variable definition table.

| | Observations | Mean | Median | Maximum | Minimum | Std. Dev. |
|---|--------------|----------|----------|----------|---------|-----------|
| Y | 11 | 26443.54 | 26601.06 | 35922.83 | 15967.6 | 6797.023 |
| K | 11 | 112278.9 | 107414 | 153907.3 | 82004 | 25412.78 |
| L | 11 | 3606.682 | 3645 | 3692 | 3261 | 123.6872 |
| I | 11 | 49.01818 | 46.8 | 70 | 33.3 | 11.01833 |

Table 2. Production function estimation results.

| Variable | Intercept | LNK | LNL | LNI | Adjusted R-squared | F-statistic |
|-----------------------------|-----------|----------|---------|----------|--------------------|-------------|
| Parameter | C | α | β | γ | | |
| Unstandardized Coefficients | -21.537 | 0.617 | 2.580 | 0.879 | | |
| Standardized Coefficients | | 0.507 | 0.338 | 0.723 | 0.995 | 636.474 |
| t-Statistic | -8.398 | 3.990 | 9.830 | 5.566 | D.W. = 1.921 | |

It can be seen that the t statistics of each parameter of the model results are greater than 2, indicating that the significance test is passed. The goodness of fit $R^2 = 0.996$, and Adjusted R-squared is 0.995, indicating that the degree of fit of the model is high, and the development of capital, labor and Internet can better explain the regional economic growth. The F value of the regression equation is 636.474 and the p value corresponding to the F statistic is 0.0000, indicating that the model has passed the overall significance test, that is, the development of capital, labor and Internet has a significant impact on economic growth. The DW value of the model is 1.921, which is ideal and meets $d_U < DW < 4 - d_U$, indicating that the model does not have first-order autocorrelation. It is reasonable for the model to study the contribution rate of Internet development to economic growth. Comprehensive analysis shows that the overall fitting of the model is good.

Therefore, the expression of the relationship between economic output and input of each factor can be obtained as follows:

$$\ln Y = -21.537 + 0.617 \ln K + 2.58 \ln L + 0.879 \ln I \tag{8}$$

According to Eq. (8), the output elasticity of capital, labor and Internet development are 0.617, 2.580 and 0.879 respectively. The elasticity coefficient of labor force is the largest, indicating that when all other input factors remain unchanged, every 1% increase in labor input can drive the regional economic growth by 2.58%. It can be seen that the economic growth of Hubei Province is sensitive to the changes of labor factors. The elasticity coefficient of capital stock is the smallest, indicating that the transformation effect of capital investment in Hubei Province is not ideal. Therefore, Hubei Province should improve the utilization efficiency of invested capital and give better play to the role of capital factors in promoting regional economic growth.

$(\alpha + \beta + \gamma)$ is the reward index of economies of scale. According to the regression result of Eq. (8), the sum of α , β and γ is greater than 1, indicating that the current economic growth of Hubei Province is increasing returns to scale (Xun Wenhui 2013), and the economic development trend is good.

3.4 Factor Contribution Rate Analysis

Through calculation, from 2010 to 2020, the average annual growth rate of GDP in Hubei Province is 7.215%, the average annual growth rate of fixed asset investment is 6.1%,

the average annual growth rate of labor input is 1.152%, and the average annual growth rate of Internet penetration is 7.122%. According to formula (3) (4) (5) (6), combined with the output elasticity of various factors obtained by regression, the contribution rate of capital, labor, Internet and other comprehensive production factors to the economy in the calendar years 2010–2020 can be calculated, as shown in Table 3.

As can be seen from Table 3, the contribution rates of various factors in Hubei Province fluctuated greatly from 2010 to 2020, and the data were abnormal. This was closely related to the outbreak of COVID-19 at that time. Therefore, the outliers of this year are excluded for later research, and the contribution rate of various factors to economic growth in other years is drawn, as shown in Fig. 2. After excluding outliers, it can be calculated that the average contribution rates of capital, labor and Internet to the economy in Hubei Province over the years are 48.578%, -12.097% and 68.507% respectively, as shown in Table 4. It can be seen that the rapid development of the

Table 3. Contribution of various factor inputs to economic growth in Hubei Province from 2010 to 2020.

| | Contribution rate of capital investment | Contribution rate of labor input | Contribution rate of Internet development | TPF contribution rate |
|-----------|---|----------------------------------|---|-----------------------|
| Year | EK (%) | EL (%) | EI (%) | ET (%) |
| 2010–2011 | 16.366 | 15.644 | 75.993 | -8.003 |
| 2011–2012 | 26.943 | 10.338 | 62.612 | 0.106 |
| 2012–2013 | 37.198 | 3.809 | 66.696 | -7.703 |
| 2013–2014 | 44.763 | -3.561 | 48.278 | 10.520 |
| 2014–2015 | 50.114 | -25.459 | 34.472 | 40.872 |
| 2015–2016 | 58.429 | -23.694 | 104.984 | -39.719 |
| 2016–2017 | 64.665 | -22.718 | 36.674 | 21.379 |
| 2017–2018 | 66.810 | -29.880 | 85.251 | -22.180 |
| 2018–2019 | 71.911 | -33.353 | 101.605 | -40.163 |
| 2019–2020 | -46.863 | 431.424 | -190.869 | -93.692 |

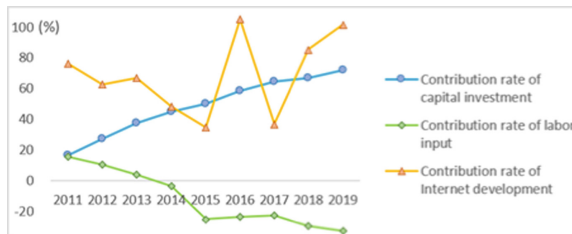


Fig. 2. Changes in the contribution rate of various factors in Hubei Province over the years.

Table 4. Average contribution rate of each element.

| | Output Elasticity | Average annual growth rate (%) | Average contribution rate (%) |
|----------------------|-------------------|--------------------------------|-------------------------------|
| Economic growth | | 7.215 | |
| Capital investment | 0.617 | 6.100 | 48.578 |
| Labor input | 2.580 | 1.152 | -12.097 |
| Internet development | 0.879 | 7.122 | 68.507 |

Internet in recent years has made a prominent contribution to the economic growth of Hubei Province.

As can be seen from Fig. 2, the contribution rate of capital to economic growth continued to increase from 2010 to 2019, and the data reached 71.911% in 2019. This means that fixed capital investment has always been an important driving factor for the economic development of Hubei Province. However, from the data of the output elasticity of factors, the output elasticity of capital is the lowest, which means that the input-output ratio of capital factors is relatively lower than that of other factors, and the transformation effect of capital input is not ideal. This shows the necessity of changing the economic growth model in Hubei Province. In the next development, Hubei Province should strive to transform from scale expansion economy to intensive economy, explore new economic growth points, and give better play to the role of capital investment in promoting regional economic development.

In addition, in Fig. 2, we can also see that the contribution rate of labor force to economic growth is decreasing year by year, and the average contribution rate of labor force from 2010 to 2019 is -12.097%. Since 2010, China's population age structure has changed, the demographic dividend has gradually decreased, and the labor cost has increased. These factors have weakened China's original advantage of labor resources. At the same time, with the change of China's economic development model, the contribution rate of labor input to economic growth in Hubei Province has decreased, which has been negative in recent years. Based on the above conclusions, Hubei Province should pay attention to improving the quality of labor force and make the labor force play a better role in promoting economic growth by improving the quality of talents.

As can be seen from Fig. 2, in most years, the role of Internet development in promoting economic growth is higher than that of capital and labor. In terms of the average contribution rate, the average contribution rate of Internet development from 2010 to 2019 reached 68.507%, higher than the other two factors. This means that in recent years, Hubei Province has better combined with the development of the Internet in the process of economic development. The Internet not only promotes the innovation of traditional economic model and industry, but also becomes the engine of new economic development, providing an important driving force for the economic growth of Hubei Province.

4 Conclusion and Enlightenment

Using the time series data of Hubei Province from 2010 to 2020, this paper constructs Cobb Douglas production model, systematically analyzes the factor contribution rate of capital, labor and Internet to regional economic growth in Hubei Province, and obtains the following conclusions:

- (1) The sum of the elastic coefficients of the three elements is greater than 1, which means that the current economic development of Hubei Province is in the stage of increasing returns to scale.
- (2) From the perspective of output elasticity, the output elasticity of labor force is the highest, which is far greater than the other two factors. However, from the perspective of factor contribution rate, it is just the opposite. The contribution rate of labor force to economic growth is the lowest, even negative in most years.
- (3) With China's economy changing from high-speed growth stage to high-quality development stage, the contribution rate of capital investment to the economic growth of Hubei Province has continued to increase in recent years, while the contribution rate of labor force to its economic growth shows a downward trend and reaches a negative value. Therefore, on the one hand, Hubei Province should continue to pay attention to the contribution of material capital stock to economic growth. On the other hand, it is necessary to improve the quality of talent training, introduce effective science and technology human capital policies, and attract high-quality talents to gather in Hubei, so as to provide solid talent support for new economic growth.
- (4) In recent years, the contribution rate of Internet development to the economic growth of Hubei Province has been at a high level. It can be seen that the mutual integration and wide application of Internet and all walks of life have greatly promoted the economic development of Hubei Province. In the follow-up development of Hubei Province, further efforts should be made to continue to give full play to the role of Internet technology in promoting the regional economy and cultivate and develop strategic emerging industries.

References

1. Han X, Song W, Li B (2019) Can the Internet become a new driving force for the improvement of China's regional innovation efficiency. *China Indust Econ* 7, 119–136
2. Li H, Tian Y, Li W (2014) Internet thinking and traditional enterprise reengineering. *China indust Econ* 10, 135–146
3. Luo M, Li L (2015) Business model innovation in the Internet Era: from the perspective of value creation. *China Indust Econ* 1, 95–107
4. Xun W, Wang Y (2013) Study on the contribution of land factors to industrial development in the revitalization of old industrial base in Shenyang. *China Popul Resour Environ* 23(S1), 63–65 (2013)

5. Yang, Z, Jin, X (2009) The impact of land input on economic growth based on panel data -- a case study of Zhejiang Province. *Resour Environ Yangtze River Basin* 18(5), 409–415
6. Zhang J, Wu G, Zhang J (2004) Estimation of China's inter provincial physical capital stock: 1952–2000. *Econ Res* 10, 35–44

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