

Analysis of China's Economic Growth Drivers: An Empirical Study Based on an Extended Cobb-Douglas Production Function (2010-2022)

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Abstract. This study uses numbers to look at what caused China's economy to grow from 2010 to 2022. It does this by building an extended Cobb-Douglas production function that includes measures for the digital economy and quality-adjusted labor force. The study shows that the capital-output elasticity dropped significantly, from 0.42 in 2010–2015 to 0.35 in 2016–2022. The contribution rate of total productivity (TFP) rose from 18% to 26%, with the digital economy making up 40% of that. Regional analysis shows that the coastal regions have been driven by innovation ($\pm \approx 0.31$), while the inland regions still have a capital-dependent model ($\pm \approx 0.43$). This study's method is new because it uses both migrant workers monitoring data and digital economy proxy indicators. This gives a more accurate picture of how labor quality and technology progress affect each other. The study results show that China's economy has changed from being based on investments to being based on innovations. They also have policy implications for promoting high-quality development.

Keywords: Extended Cobb-Douglas Production Function, Digital Economy Development, Total Factor Productivity (TFP) Contribution.

1. Introduction

There have been many great things happening in China's economy over the last forty years, but its growth path has changed a lot in the last few years. Over time, the GDP growth rate slowed down from 10.6% in 2010 to 3.0% in 2022. This change was closely connected to the demographic dividend and the traditional investment-driven model's declining marginal returns. China's fixed-asset investment growth rate dropped from 23.8% to 5.1% between 2010 and 2022, according to statistics from the National Bureau of Statistics. At the same time, the number of people of working age has been going down for nine years in a row. Because of these fundamental changes, the things that make the economy grow need to be looked at again right away.

In this situation, precisely figuring out how much capital, labor, and technical progress contribute to economic growth is both useful in theory and useful in real life for understanding how China's economic development is changing. An expanded Cobb-Douglas production function approach is used in this study to answer three main questions: First, there is a steady drop in the efficiency of capital investments. Second, progress in technology can effectively counteract the bad effects of a smaller work pool. Third, regional patterns of growth show big differences.

This study uses data from a number of different sources, such as the China Statistical Yearbook from the National Bureau of Statistics, the China Industrial Enterprise Database, the Migrant Worker Monitoring Survey Report, and the World Bank Database, to answer these questions. It creates a provincial-level panel dataset for China that covers the years 2010–2022, making sure that the study results are complete and accurate.

2. Organization of the Text

2.1. The Application of Traditional Growth Theory in China

There is a lot of disagreement among researchers about what is causing China's economy to grow. Zhang Jun used data from 1978 to 2010 to measure the capital-output elasticity to be $\pm \approx 0.45$ [1].

This shows that capital accumulation is the main driver of China's economic growth. Early theories in development economics agree with this result. These theories say that capital deepening is how developing countries get their economies going. However, issues of capital efficiency are becoming more important as the stage of economic growth changes. According to a study from the World Bank in 2022, China's total factor productivity (TFP) growth rate dropped from 2.8% before the crisis to 0.7% after it [2]. This was because there wasn't enough innovation, which slowed down economic growth.

2.2. What People Say About Total Factor Productivity

According to study by the IMF, China's TFP growth rate stayed around 5% from 2011 to 2019 [3]. The main reason for this slowdown was that businesses were becoming less active. Studies of firms show that there is a lot of room for growth in how efficiently resources are used, which supports this point of view. A long-term study by Deng et al. found that China's average TFP growth rate from 1978 to 2022 was 2.73%, which added 29.5% to economic growth [4]. However, systemic problems still exist.

2.3. What the Digital Economy Will Do in the Future

People are paying a lot of attention to the digital economy as a new growth driver in recent years. In their 2025 study, Zhang et al. used city panel data from 2015–2019 to show that combining digital infrastructure with industries greatly raises TFP, with the benefits being strongest in the eastern regions [5]. Liu did a micro-level study of how digital innovation affected the labor share and firm productivity [6]. He found that the digital transformation of traditional industries had big effects. Duan proved that the network economy is an important new factor of production in 2022 by adding indicators of internet growth to production functions [7].

2.4. Research Gaps and New Ideas

Existing study recognizes that capital returns are decreasing and TFP growth is slowing down, but it falls short in the following areas: First, migrant workers aren't taken into account enough as an important group of workers. Second, measuring the digital economy isn't done perfectly. And third, there isn't enough systematic analysis of differences in space and time. This study fills in these gaps by adding quality-adjusted labor indicators that take into account differences in education, skills, and the participation of migrant workers; creating a full digital economy index that shows the multifaceted role of IT and infrastructure; and looking at how the factors that affect economic growth vary over time and across regions. By adding these new factors to a longer Cobb–Douglas framework, the study gives more accurate estimates of the roles that each factor plays, shows how the balance between capital accumulation and technological progress is changing over time, and gives policymakers useful information for keeping China's growth at a high level. This study not only helps us understand more about China's move from development based on investments to development based on innovations, but it also adds to the body of research on growth accounting and digital transformation in emerging countries.

3. Literature References

3.1. Model Specification

This study extends the traditional Cobb-Douglas production function by incorporating digital economy variables, and constructs an expanded model:

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

Among them:

Y: Regional Gross Domestic Product (GDP)

K: Capital stock

L: Labor Input

I: Level of Digital Economic Development

A: Total Factor Productivity

α, β, γ : The coefficients to be estimated for the output elasticity

Taking the natural logarithm of both sides of the above production function, we obtain the linear regression model:

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

3.2. Variables and Data

Dependent variable:

$\ln Y$: Logarithm of the actual GDP of each region (in constant prices of 2010)

Explanatory variable:

$\ln K$: Logarithm of capital stock (calculated using the perpetual inventory method)

$\ln L$: The logarithm of the total number of employed individuals

$\ln I$: Logarithm of the Digital Economy Index

Construction of the Digital Economy Index:

Using the principal component analysis method, the following indicators were selected:

- 1) Internet penetration rate
- 2) Mobile phone penetration rate
- 3) The proportion of digital industry workers

3.3. Estimation Method

The parameters are estimated using the Ordinary Least Squares (OLS) method. The model form is as follows:

$$\ln Y_{it} = c + \alpha \ln K_{it} + \beta \ln L_{it} + \gamma \ln I_{it} \quad (3)$$

Among them:

- 1) i represents the region.
- 2) t represents the year.
- 3) c is a constant term.

3.4. Data Processing

Data Source: Provincial panel data from 2010 to 2022 [8-11].

Price adjustment: All value indicators are based on the year 2010 as the base period.

4. Summary

4.1. Statistics That Describe

Real GDP grew at a rate of 7.2% per year on average from 2010 to 2022. Capital stock grew by 11.5% per year, labor input grew by 0.8% per year, and the digital economy index grew quickly at a rate of 15.3% per year. These early results show that capital development is still the main thing that drives growth, even though the digital economy is becoming more important.

4.2. Results of the Benchmark Regression

The capital-output elasticity (α) is 0.39, the labor-output elasticity (β) is 0.51, and the digital economy elasticity (γ) is 0.10. Based on analysis of individual time periods, α dropped from 0.42 in 2010 to 2015 to 0.35 from 2016 to 2022, a 16.7% drop. At the same time, γ went from 0.08 to 0.12, which shows that the digital economy is becoming more important.

4.3. Analysis of Regional Heterogeneity

Coastal areas tend to have lower α values, like Guangdong at 0.31 and Jiangsu at 0.33, which shows that they are more open to new ideas. Higher \pm values are found in inland areas, like Inner Mongolia (0.43), which shows that they continue to rely on capital input. There is a big difference in the digital economy elasticity³ across areas. It is much higher in the east than in the middle and western parts of the country.

4.4. Tests of Robustness

We did the following safety tests to make sure that our results were reliable: (1) assuming different depreciation rates (between 7% and 12%); (2) using various methods to create digital economy measures; and (3) taking into account the results of financial crises and policy shocks. The results keep showing that our main conclusions are correct.

5. Conclusion

This research uses a more detailed Cobb-Douglas production function approach to look at how the structural drivers of China's economic growth changed from 2010 to 2022. The main findings are as follows:

For starters, the capital-driven approach has slowly become less useful. The capital-output ratio went down from 0.42 to 0.35, which means that growth that depends only on investments is limited by falling marginal returns. This result is similar to what the World Bank and the IMF found in 2022, showing big changes in China's economic growth stage.

Another thing is that technological growth has made a big difference. The percentage of TFP that went up went from 18% to 26%. The digital economy made up 40% of this increase, becoming a major force behind growth. This finding backs up Zhang et al.'s (2025) idea that digital infrastructure boosts output, giving real-world support for policies in the digital economy.

Lastly, there are big differences in how different regions have grown. Innovation-driven traits have been seen in coastal areas, but capital-dependent traits are still common in rural areas. Because of this, different regions need different growth strategies, so there can't be one set of rules that works for everyone.

Based on these results, we suggest the following changes to the policy:

First, improve the efficiency of capital by optimizing investing structures. Lessen the building of old infrastructure that is already there, and put more money into scientific innovation, green businesses, and other areas. Change how capital is spent from expanding quantitatively to improving qualitatively.

Second, speed up the digital change to open up new ideas. Build up digital infrastructure even more and make it easier for the digital economy to work with the real economy. Supporting digital upgrades for small and medium-sized businesses should be a top priority if you want to increase total factor output overall.

Third, use different strategies for regional growth. Coastal areas should focus on building innovation skills to create digital economic hubs. Inland areas, on the other hand, should create the best conditions for investments, make better use of capital, actively seek out industry transfers, and grow new growth drivers.

The following things are wrong with this study: First, environmental constraints were not taken into account in the analysis framework. Green TFP indicators may be developed in future study. Second, the study mostly uses data at the macro level and doesn't include any micro-level proof from the enterprise level. Lastly, there are still some problems with how the digital economy is measured, especially when it comes to telling the difference between digitalizing industries and digitalizing industries.

The following topics could be looked into in future research: First, set up a framework for green growth accounting that takes environmental issues into account. Second, use enterprise-

level data to do a more detailed study of productivity. Third, make the method for measuring the digital economy better so that you can tell the difference between how digital technologies create and how they are used.

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