Research on Economic Analysis Construction Combining Computer Technology and Mathematical Model Method

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Abstract. Econometrics has influenced the whole structure and research methods of economics. Since the late 20th century, almost all economic theories are based on mathematical models. Therefore, by studying the mathematical model of economics, we can find more economic laws and, at the same time, the development and application of computer technology provide more auxiliary methods for our analysis. This paper takes three kinds of economic mathematical models as the research object, based on computer application technology, finds out the law of research methods related to economic mathematical models, and seeks for new breakthroughs in economics.

Keywords: Economic Analysis, Economic Construction, Mathematical Model Method, Economic Model

1. Introduction

DuPont analysis is recognized as the first mathematical model for economic analysis. DuPont analysis is a comprehensive analysis of the financial situation of an enterprise by using the relationship between several major financial ratios. Specifically, it is a classic method to evaluate the profitability and return on shareholders' equity of a company, and to evaluate the performance of an enterprise from the perspective of finance\(^1\). Its basic idea is to decompose the return on net assets of an enterprise into multiple financial ratio products step by step, which is helpful for in-depth analysis and comparison of the business performance of an enterprise. This method was first used by DuPont company in the United States, so it is called DuPont analysis.

Today, many methods have been used in economic analysis, and even a econometric discipline has been developed. It specializes in the quantitative analysis model in economics, that is, the application of mathematical model analysis in economics\(^2\). The economic theories put forward after the second half of the 20th century are basically based on Econometrics, and mathematical models play a more and more important role in economics. This paper focuses on several mathematical models commonly used
in economic analysis.

2. Keynesian model

Keynesian model is an effective demand theory which Keynes made a significant correction to economics under the situation of sharp economic conflicts in the period of economic crisis. Keynes denied the theory that the say's law and market mechanism believed in by neoclassical economics can guarantee the economy to tend to equilibrium automatically. He pointed out that in terms of policy, we should give up the principle of laissez faire and implement the state's intervention and regulation of economic life; the government should take the responsibility of regulating the total social demand, use fiscal and monetary policies to stimulate consumption and increase investment, so as to ensure that the society has sufficient effective demand and full employment. Keynes made a more realistic analysis of the situation caused by the great economic crisis from 1929 to 1933. His economic theory opened up a new direction for the development of economics, and his economic policies provided a realistic way to alleviate the economic crisis[3].

Keynes called the proportion of consumption in income consumption propensity average consumption propensity refers to the proportion of total consumption in total income. That is to say, APC = C/ Y marginal propensity to consume refers to the proportion of consumption expenditure in the increased income, that is, the ratio of consumption increment to income increment.

\[ \begin{align*}
Y &= C + I \\
C &= a_0 + aY
\end{align*} \]

Among:

Y is National income;

C is National consumption;

I is National investment;

a0 is Basic national consumption;

a is National consumption tendency; a ≤ 1. The closer a is to 1, the higher the tendency of national consumption is. On the contrary, the lower the enthusiasm of national consumption is.

3. Samuelson model

The Stolper Samuelson theorem S-S - (the impact of international trade on income distribution). In the paper "protectionism and real wages" (1941), Stolper and Samuelson put forward a western economic theory about the influence of tariff on the price of domestic factors of production or the distribution of domestic income, which is called the Stolper Samuelson theorem. This theorem proves that the implementation of protectionism will improve the real remuneration of a country's relatively scarce elements. At the same time, the model answers the fairness of income distribution, that is, factor compensation. In the short term, all the factors used by the export sector are profitable, and all the factors used by the import sector suffer losses; in the long term, the factors used intensively in the production
of export products are profitable, and the factors used intensively in the production of import products are damaged\textsuperscript{[4]}.

In an article published by Stolper and Samuelson in 1941, for the first time, in the explicit expression of the general equilibrium model of two elements and two commodities, the Herschel - Olin theorem has been specifically developed. Their view is called "stolpa Samuelson theorem". According to stiesar's theorem. The tariff will not change the terms of trade. As a result, the domestic price of the imported goods will rise. Then, the rise of the domestic relative price of the goods (even whether the rise is due to the rise or fall of the tariff or some other reasons) will certainly increase the price of the relatively intensive factors of production in the production process of the goods. This theorem assumes that when the relative price of a commodity rises, it will increase the rate of return and the rate of return of the factors intensively used in the production of such commodity. Therefore, the real rate of return of the rare elements used in the production of the country will rise with the tariff.

$$\begin{align*}
Y_t &= C_t + I_t \\
C_t &= a_0 + aY_{t-1} \\
I_t &= I_0 + b(C_t - C_{t-1})
\end{align*}$$

(2)

Among:

$Y_t, C_t, I_t$ are income, consumption and investment at $t$ time point;

$I_0$ is Government expenditure on $t$ time;

On the basis of Keynesian model, it strengthens the influence of consumption on investment and then on income. In the process of solution, a second order nonhomogeneous difference equation is obtained, which has no real root and sometimes has damped oscillation solution, which exactly reflects the characteristics of economic cycle. In particular, the impact of time, currency and durable income on the economy is considered, but the impact of long-term investment consumption, such as house purchase, car purchase and credit card consumption, on the economy is not considered.

4. Sharpe model

Sharpe's single index model was put forward in 1963 by William shape, the Nobel Prize winner of economics, who published a simplified model for "portfolio" analysis\textsuperscript{[5]}. The basic idea of Sharpe's single factor model is: when the market stock index rises, a large number of stock prices in the market go up; on the contrary, when the market index falls, a large number of stock prices tend to fall.

Assume that the correlation of securities returns is for one reason only. Each security assumes a response to the pull of the market mix, with only some more and some less. When the market mix rises significantly, almost all stocks will rise with it\textsuperscript{[6]}. Although some stock prices rise more than others, when we observe the movement of stock prices over time, we can assume that the volatility of market portfolio determines all the mutual movements of stocks we see, which is actually the hypothesis of single index model. The model assumes that all elements of the covariance matrix are determined by the fact that all stocks respond to a single, common force pull.
According to this, we can use the correlation between the yield of a security and the yield of a stock index to get the following model:

\[ r_{it} = A_i + \beta_i r_{-mt} + \epsilon_{it} \]  

Among:

- \( r_{it} \) is the rate of return of I securities during the period.
- \( r_{-mt} \) is the yield of market index in the period of T.
- \( A_i \) is the intercept, which reflects the yield of securities I when the market yield is 0.
- \( it \) is related to the fundamentals of listed companies and the overall market volatility. Therefore, AI value is relatively fixed.
- \( \beta_i \) is the slope, which represents the impact of the fluctuation of market index on the stock return.
- \( \epsilon_{it} \) is the residual between the actual yield and the estimated value in the period t.

5. Summary

Mathematical model used in economic analysis has become a general method of econometrics and even the whole economics. Since the second half of the 20th century, a large number of economic mathematical models have been proposed and gradually improved in application. Economics is developing in the direction of quantification and intensification. This paper only discusses three economic mathematical models, which can not cover all the economic mathematical models. However, this paper discusses the research methods of economics, that is, finding the laws of economics from the perspective of quantitative analysis.

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