Research on the Data Growth Changes of U.S. Economy

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Abstract

This research mainly focuses on the U.S. economy, and studies the data growth changes of the U.S. economy in the fourth quarter of 2021. Because economic data is volatile. So it creates a lot of challenges. In this paper, I mainly focus on the knowledge of calculus, combined with the knowledge of economics, to study the challenges brought by solving economic problems. At the same time, it mainly studies the economy with the two formulas of unemployment rate and GDP as the main body. The unemployment rate can reflect many economic problems, such as the current state of the economy. Gross domestic product can also reflect where a country is in the economic cycle. At the same time, in macroeconomics, short-term economic fluctuations and long-term economic fluctuations are closely related. When we use calculus knowledge and economic knowledge to study what economic state this country is in, we can find corresponding methods to solve economic problems, through monetary policy or fiscal policy.

Keywords

Unemployment; GDP Growth; Okun's Law; Expansion; Recession.

1. Introduction

Economic data is ever-changing and complex, and the rapid development of these data will also bring some challenges to society. The study mainly comes from the gross domestic product of the United States in 2021. In the context of the raging new crown virus, the social environment has also undergone great changes, and at the same time, the economic growth of the United States has also changed. Combining knowledge of calculus with knowledge of economics. From the perspective of unemployment, we can clearly identify it. The state of the U.S. economy and the impact of unemployment on the economy. Through gross domestic product, we can see where the U.S. economy is in the business cycle. At the same time, combined with the knowledge of calculus, we can calculate these research results very quickly.

1.1. Changes in Economic Data

The digital transformation of society is unfolding at a pace that outstrips the development of experience-based policy, raising serious social-economic risks and commensurately significant social-economic management challenges. The data-driven economy is fundamentally different than what has come before. A renovation of our economic accounts and the formal economic models used to inform economic policy is needed, in concert with experimentation regarding the design of regulatory frameworks[1].

1.2. Scope and Context of the Study

Research data comes from real U.S. gross domestic product in the fourth quarter of 2021. Specifically, personal consumption expenditures, which account for about 70% of the U.S. economy in the fourth quarter of 2021, increased by 3.3%, boosting economic growth by 2.25 percentage points; non-residential fixed asset investment, which reflects the state of corporate investment, increased by 2%, higher than the previous The growth rate accelerated in the first

quarter; private inventory investment increased, contributing 4.9 percentage points to the economy in the quarter.

1.2.1. Project Research Scope

U.S. economic growth may have weakened toward the end of last year as a mutated strain of the new coronavirus, Ormicon, spread widely late last year, dampening consumer demand and further disrupting supply chains. U.S. real GDP grows 6.9% annualized in Q4 2021; U.S. economy grows 5.7% in 2021

1.2.2. Project Research Background

Consumers shopped early to avoid shipping delays during the U.S. holiday shopping season, spurring a surge in personal consumption spending in the fourth quarter of last year. At the same time, due to logistics disruptions and blockages caused by the new crown epidemic and surge in demand, a large number of goods that should have arrived before the holiday shopping season were delayed in delivery. Retail and wholesaler inventories surged towards the end of last year, boosting the fourth quarter of last year. The economy expanded more than expected.

1.3. The Significance of Project Research

The macroeconomic analysis method takes the entire national economic activity as the object of investigation, and studies various related aggregates and their changes, especially the changes in gross national product and national income and their relationship with social employment, business cycle fluctuations, inflation, economic relationship between growth and so on. Macro can study how the entire economy and society work, and find ways to make the economy and society run more stably and develop faster.

1.3.1. The Impact of Unemployment on the Economy

Costs to the Country-The economic costs of unemployment are probably more obvious when viewed through the lens of the national checkbook. Unemployment may lead to higher payments from state and federal governments for unemployment benefits, food assistance, and Medicaid. Unemployment is also a dangerous state for the U.S. economy. Almost 70% of what the U.S. economy produces goes to personal consumption and unemployed workers. Even those receiving government support cannot spend at prior levels. The production of those workers leaves the economy, which reduces the gross domestic product (GDP) and moves the country away from the efficient allocation of its resources. It is also noting that companies pay a price for high unemployment as well. Unemployment benefits are financed largely by taxes assessed on businesses. A high unemployment rate affects the economy in many ways. Unemployed people tend to spend less, may accrue more debt, and unemployment may lead to higher payments from state and federal governments for things like food stamps[2].

1.3.2. The Impact of Gross Domestic Product (GDP) Growth Rate on the Economy

The gross domestic product (GDP) growth rate measures how fast the economy is growing. The rate compares the most recent quarter of the country's economic output to the previous quarter. Economic output is measured by GDP. The GDP growth rate is the most important indicator of economic health. The Bureau of Economic Analysis often updates its GDP estimates as new data comes in. Those revisions impact the stock market as investors react to this new information. The GDP growth rate reveals which of the four stages of the business cycle the economy is in: peak, contraction, trough, and expansion[3].

1.4. Theoretical Basis in Research

In the research of this project, the research and analysis of The U.S Economy is mainly based on the application of theoretical knowledge of calculus. At the same time, it also combines some theoretical knowledge in macroeconomics and microeconomics to clarify the economic phenomenon of the United States.

1.4.1. Theoretical Foundations of Calculus

The content of calculus mainly includes functions, limits, differential calculus, integral calculus and its applications. Function is the basic object of calculus research, limit is the basic concept of calculus, differentiation and integration are the limit of specific form of specific process.

1.4.2. Theoretical Foundations of Micro Economic

Microeconomics is an economic theory that studies the economic behavior of a single economic unit in society and how the single value of the corresponding economic variable is determined; analyzes the economic behavior of individual economic units, and on this basis, studies the operation of the market mechanism of modern Western economic society. and its role in the allocation of economic resources, and put forward micro economic policies to correct market failures; concerned with the exchange process between individuals and organizations in society, the basic problem it studies is the decision of resource allocation, and its basic theory is through The theory that supply and demand determine relative prices. So the main scope of microeconomics includes consumer choice, firm supply and income distribution.

1.4.3. Theoretical Foundations of Macro Economic

Macroeconomics takes the activities of the general process of the national economy as the research object, and mainly examines the total level of employment, gross national income and other economic aggregates. Therefore, macroeconomics is also called employment theory or income theory. Macroeconomics studies the utilization of economic resources, including the theory of national income determination, employment theory, inflation theory, business cycle theory, economic growth theory, fiscal and monetary policy.

1.5. Article Frame

The basic structure of this paper mainly includes seven parts: abstract, introduction, research method, research results, discussion and extension, research conclusion, and references.

2. Application of Calculus in the U.S Economy

In this paper, a variety of research methods are used, and the US economic data is analyzed by these research methods, and the problems and solutions are found out. At the same time, the knowledge of calculus and the knowledge of economics are combined to solve problems together. The unemployment rate data can reflect the development of the economy. At the same time, unemployment and economic growth are closely related. When unemployment is high, the economy declines, and when unemployment is low, the economy grows. At the same time, these short-term fluctuations form an economic cycle with the constant changes in unemployment caused by prices.

2.1. Research Methods Used in the Study

In the choice of research methods, this paper mainly uses mathematical method, descriptive research, model method, survey method, literature research, interdisciplinary research method.

2.1.1. Mathematical Method

This paper uses mathematical tools to process a series of quantities of US economic data, so as to make correct explanations and judgments, and obtain the results expressed in digital form.

2.1.2. Descriptive Research

This article narrates and explains the existing phenomena, laws and theories through my own understanding and verification. Identify problems and describe phenomena through research and analysis.

2.1.3. Model Method

This paper first creates a similar model according to the main characteristics of the prototype, and then indirectly studies a description method of the prototype through the model.

2.1.4. Survey Method

This paper uses the survey method to systematically collect materials about the actual or historical status of the US economic data, and analyzes, synthesizes, compares and summarizes the large amount of data collected by the survey.

2.1.5. Literature Research

This paper uses the literature research method by reading a large number of relevant literatures in Chinese and English. Including journal literature retrieved from CNKI, as well as related Chinese theoretical books. There are also government and NGO resource repositories such as Google Scholar to find public reports and investigations. After summarizing and arranging Chinese and foreign literature, we can comprehensively summarize the research results of Chinese and foreign scholars at this stage, so as to inspire the research direction of this paper. Therefore, the literature method is the most basic and important research method in this paper.

2.1.6. Interdisciplinary Research Method

This article uses calculus and the theories, methods and results of macroeconomics and microeconomics to conduct a comprehensive study of U.S. economic data as a whole.

2.2. How Research Results are Used

Through the calculation of the unemployment rate and the country's gross domestic product, the economic situation of a country can be considered. And there is a certain correlation between the unemployment rate and the country's gross domestic product.

2.2.1. Calculation Model of Unemployment

The unemployment rate refers to the number of unemployed workers among the employed population who meet all employment conditions in a certain period of time. It aims to measure the idle labor capacity and is the main indicator reflecting the unemployment status of a country or region. Monthly changes in unemployment data can appropriately reflect economic development. The unemployment rate and economic growth rate have an inverse corresponding change relationship. In the United States, the unemployment rate is released on the first Friday of every month.

2.2.2. The Relationship between Unemployment and the Economy

Economic growth rate, unemployment rate and price increase rate are the three most important indicators that reflect the state of a country's macroeconomics, and are the main objects of modern macroeconomics research[4]. Unemployment is related to a lack of economic growth. Economic growth and unemployment are related because the two concepts are intertwined. The level of unemployment in an economy may affect the rate of economic growth, while the level of unemployment is also an indicator of the state of the economic growth of an economy[5]. This link between economic growth and unemployment can be explained in terms of the necessary output of services provided by employees needed to sustain an economy and to promote economic growth. When there is a high level of unemployment, the level of output also decreases due to the reduction in the number of workers contributing to the output. This correlation can be drawn from the fact that the level of unemployment is highest during periods of economic downturns. The opposite is in the case where there is a boom, or period of growth, in the economy[6].

When the actual unemployment greater than natural unemployment, the economy is in the recession. When the actual unemployment smaller than natural unemployment, the economy is in the expansion.

2.2.3. The Relationship between GDP Growth Rate and Economic Cycle

GDP and the business cycle are dependent on each other, and are a reflection of the nation's economic health.

A gross domestic product is principally the total of all the goods and services which have been produced within a nation's borders in one accounting year. The common formula for GDP goes as follows: C + G + I + NX. Where C is the private consumption and spending, G is the government spending, I is the spending for business and NX is the difference between imports and exports. On the whole a GDP provides a great overview and indication of the production, spending and income earning capacity of the economy.

The 4 business cycles include the following: Slump, Recession, Recovery, Boom. The economy of each and every nation goes through these changes continually, and there is no economy that has not experienced this cycle. These cycles are triggered by several factors such a lack of resources, laws, foreign policy, politics, war, economic health of the private sector, etc. The factors may affect the economic situation either collectively in individually. The change of cycle in a negative gear indicates that the balanced equilibrium of the economy has been disturbed and the economic machinery is not functioning in proper manner, and there is need for change.

2.2.4. Okun's Law

Okun's Law is an empirically observed relationship between unemployment and losses in a country's production. It predicts that a 1% increase in unemployment will usually be associated with a 2% drop in gross domestic product (GDP). Okun's Law looks at the statistical relationship between GDP and unemployment. Okun's Law can also be used to estimate gross national product (GNP). In Okun's original statement of his law, an economy experiences a one percentage point increase in unemployment for every three percentage point decrease GDP from its long-run level (also called potential GDP). Similarly, a three percentage point increase in GDP from its long-run level is associated with a one percentage point decrease in unemployment. Potential GDP is the level of output that can be achieved when all resources (land, labor, capital, and entrepreneurial ability) are fully employed.

One of the simplest forms uses the formula: U = a + b x G. Where U represents the change in the unemployment rate between one quarter and the next, G represents the growth in real GDP for that quarter, and b represents Okun's coefficient, or the slope of the relationship between GDP growth and unemployment[7].

3. Discussion and Extension

Analyze U.S. economic data from both long-term and short-term economic perspectives. The short-term economy is relatively volatile and volatile. The long-term economy is relatively stable. But the short-term economy also has a certain impact on the long-term economy.

3.1. Short-term Economic Volatility

In the short term, due to changes in aggregate supply and aggregate demand, there will be two phenomena of expansion and recession.

3.1.1. Expansion

The economy is moving out of recession. Money is cheap to borrow, businesses build up inventories again and consumers start spending. GDP rises, per capita income grows, unemployment declines, and equity markets generally perform well[8].

3.1.2. Recession

Economic growth begins to weaken. Companies stop hiring as demand tapers off and then begin laying off staff to reduce expenses[8].

3.2. Long-term Economic Stability

Long run aggregate supply is only affected by time, quantity of resources, quantity of resourcesThe main aim of the real economy is to make the country rich and economically stronger in the long run.

3.3. The Effect of Short-Term Volatility on Long-term States

Short-term fluctuations tend to develop toward long-term equilibrium[9]. When the educational investment is high, so that the subjective process dominates, the volatility has a positive effect on the long-term growth trend; on the contrary, when the natural process dominates, the volatility has a negative effect on the average growth.

4. Diagram Example

$$U = U(t) = \frac{5\cos\frac{2t}{\pi}}{2+\sin\frac{2t}{\pi}} + 6 \qquad 0 \le t \le 25$$

Fig 1. Schematic diagram of the formula for calculating the unemployment rate

$$G = G(t) = 5\cos\left(\frac{2t}{\pi} + 5\right) + 2 \qquad 0 \le t \le 25$$

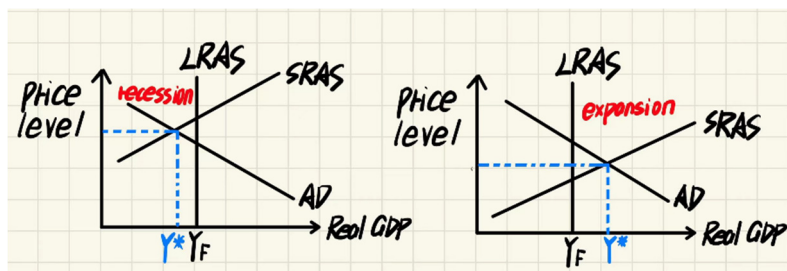**Fig 2.** Schematic diagram of the formula for calculating the GDP growth rate

Fig 3. Schematic diagram of short-term economic fluctuation model
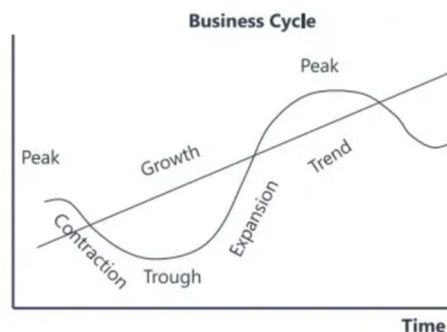

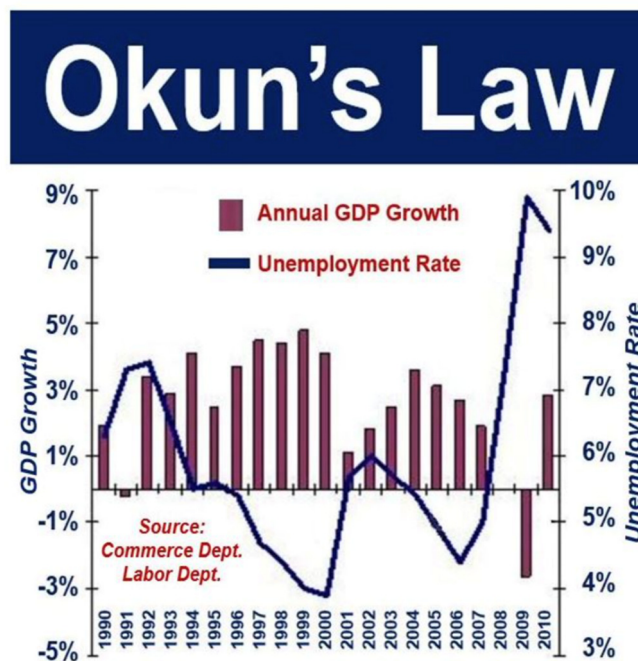**Fig 4.** Schematic diagram of the economic cycle

Fig 5. Schematic diagram of Okun's law

5. Analysis Conclusion

Economic equilibrium is a state in a market-based economy in which economic forces – such as supply and demand – are balanced. Economic variables that are in equilibrium are in their natural state assuming no impact of external influences. There are three policies to bring the economy back to long-term equilibrium, one is the monetary policy, and the other is the fiscal policy and the exchange rate market.

5.1. Monetary Policy

Monetary policy is a set of tools that a nation's central bank has available to promote sustainable economic growth by controlling the overall supply of money that is available to the nation's banks, its consumers, and its businesses. The U.S. Treasury Department has the ability to create money, but the Federal Reserve influences the supply of money in the economy, largely through open market operations (OMO).

The goal is to keep the economy humming along at a rate that is neither too hot nor too cold. The central bank may force up interest rates on borrowing in order to discourage spending or force down interest rates to inspire more borrowing and spending[10].

5.1.1. Ways to Get Back to Equilibrium from Recession

Decrease required reserve ratio, decrease discount rate, and buy bonds.

5.1.2. Ways to Get Back to Equilibrium from Expansion

Increase required reserve ratio, increase discount rate, and sell bonds.

5.2. Fiscal Policy

Fiscal policy refers to the use of government spending and tax policies to influence economic conditions, especially macroeconomic conditions, including aggregate demand for goods and services, employment, inflation, and economic growth.

Fiscal policy is often contrasted with monetary policy, which is enacted by central bankers and not elected government officials[11].

5.2.1. Ways to Get Back to Equilibrium from Recession

Implement expansionary fiscal policy.

5.2.2. Ways to Get Back to Equilibrium from Expansion

Implement contractionary fiscal policy.

References

[1]   D. Ciuriak. THE ECONOMICS OF DATA: IMPLICATIONS FOR THE DATA-DRIVEN ECONOMY (2018).

[2]   S. Simpson. The Cost of Unemployment to the Economy (2022).

[3]   K. Amadeo. What Is the US GDP Growth Rate? (2022).

[4]   Y. Zhu. China's Macroeconomic Realities: The Interrelationship Between Economic Growth Rate, Unemployment Rate and Price Increase Rate. Quantitative Economics Technical Economics Research (3), 4. (1996).

[5]   S. Corgi. The Relationship Between Unemployment and Economic Growth. (2021, June 21).

[6]   E. Ejim. What Is the Relationship between Economic Growth and Unemployment? (2022).

[7]   W. Kenton. Okun's Law. (2021).

[8]   D. Liberto. Expansion. (2021).

[9]   K. Chen, Z. Yan, & L. Gong. How do short-term economic fluctuations affect long-term growth trends? (2012).

[10] THE INVESTOPEDIA TEAM. Monetary Policy. (2021).

[11] A. Hayes. Fiscal Policy. (2021).