ISSN:2790-1661 Volume-14-(2025)

The Analysis of Business Cycle Facts in the United States

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Abstract. This research uses the HP filter to analyze the cyclical fluctuations of variables such as GDP, consumption, investment, and wages in the US economy, thereby revealing the characteristics of the US business cycle. Investment is the most volatile and highly sensitive to economic cycle changes; wages are lagging and may intensify stickiness during recessions; consumption and investment fluctuate with GDP simultaneously, and were severely impacted during the pandemic. Based on this, the article puts forward policy suggestions, including guiding investment behavior, implementing employment protection measures, and establishing a flexible economic monitoring system. The research results indicate that the business cycle in the United States has a complex dynamic mechanism. Future research should broaden its scope to draw more universal conclusions.

Keywords: Macroeconomic variables, Business cycle, HP Filter Method, Volatility.

1. Introduction

The business cycle is a fundamental aspect of economic activity, characterized by the alteration between contraction and expansion and the comovement of economic variables [1]. Based on a theoretical article, the analysis of business cycle facts can help economists make informed investment decisions and time the business decisions accordingly [2]. Crucially, the business cycle can decide the success of a business by affecting its profitability [3]. Thus, in the United States, it is significant for policymakers, businesses, and investors to understand the business cycles. Over the past few decades, the US economy has experienced multiple business cycles, each with its unique characteristics. Some expansion periods were strong and long-lasting, leading to economic growth and prosperity. For example, the technology boom in the late 1990s brought about a period of rapid expansion, accompanied by increasing productivity and IT investment [4]. On the other hand, contraction periods led to economic recessions, causing large-scale unemployment and economic hardship, as witnessed during the Great Recession of 2008 because of World War Two [5]. In the United States, numerous institutions, websites, and researchers regularly study the country's business cycles at fixed intervals, such as NBER. These existing research reports offer substantial theoretical data support for current research efforts Based on theoretical and empirical research evidence, several economic variable data will be selected and make an examination. The economic variables are consumption, investment, and wage. Therefore, this study aims to explore the current status of the US business cycle and propose some relevant recommendations and solutions based on the economic situation. This leads to the following research questions: What are the characteristics of the economic variables? What is the relationship between these variables and GDP? What are the important manifestations of business cycles in special periods? How is the United States different from other economies? What relevant solutions can be provided based on the research results?

2. Literature Review

Nowadays, numerous scholars have conducted systematic research on these three variables-consumption, investment, and wage. The research reports have provided a great deal of reference materials and inspiration. Overall, the business cycle in the United States is determined by monitoring the economic downturn that begins from the peak of the cycle and the end of the downturn at the trough of the cycle [6]. For consumption, it is a significant driver of the business cycle [7]. In the United States, consumption is a crucial economic variable that has an impact on the growth of gross domestic product [8] since it is a large proportion of GDP, and then the economic growth will be

affected by its contribution [9]. Regarding investment, it also shows a distinct pattern of fluctuations, making it another key factor that influences GDP performance [10]. In comparison to consumption, investment tends to respond more slowly over time [10]. However, a forward-looking nature is a key feature of investment growth, which can not only meet current demands but also prepare for future opportunities [10]. The last variable is wage. The real GDP provides a unified perspective for observing economic activities. It quantifies the total value (i.e., total output) created by the economy over a certain period of time, as well as the total remuneration paid for creating these values (i.e., total wage). In the United States, wage is a procyclical variable which means wages will fluctuate with GDP [11]. When there is an increase in GDP, personal income tends to increase as well.

3. Methodology

In this research, all data were sourced from the FRED (Federal Reserve Economic Data) database. This study selected variables such as GDP, consumption, investment, and wages over a period from 1990 to 2023. It is worth noting that these data are secondary data that have been officially compiled and released, and their reliability and availability provide a solid foundation for subsequent analysis. During the data collection process, the time series data of the required variables were first retrieved and downloaded through the FRED platform. Then, these data were preliminarily cleaned and processed to eliminate potential errors or missing values. Next, the HP filtering method was used to process and analyze the data. Hodrick-Prescott Filter is a data-smoothing technique [12] that can effectively separate the long-term trend components of the time series data, thereby more clearly revealing the internal laws of the business cycle.

The specific steps of the data analysis are as follows: First, the original data undergoes a stationarity test to ensure the reliability of the subsequent analysis. Then, the HP filtering method is applied to decompose the data, obtaining the trend component and the cyclical component. Finally, the focus is on the cyclical component, where detailed chart drawing and statistical analysis are conducted to deeply interpret its fluctuation characteristics, cycle length, and amplitude changes, ultimately revealing the dynamic evolution patterns of the United States business cycle. All of these steps were conducted in STATA.

4. Results and Discussion

Here are some discussions. Firstly, it is the total output. After applying the HP filter, the potential growth trend in the GDP data was stripped away, highlighting the nature of cyclical fluctuations. The 'HP filtered cycle' chart shown in Figure 1 provides a valuable perspective for in-depth analysis of the cyclical dynamics of the studied economic sequence.

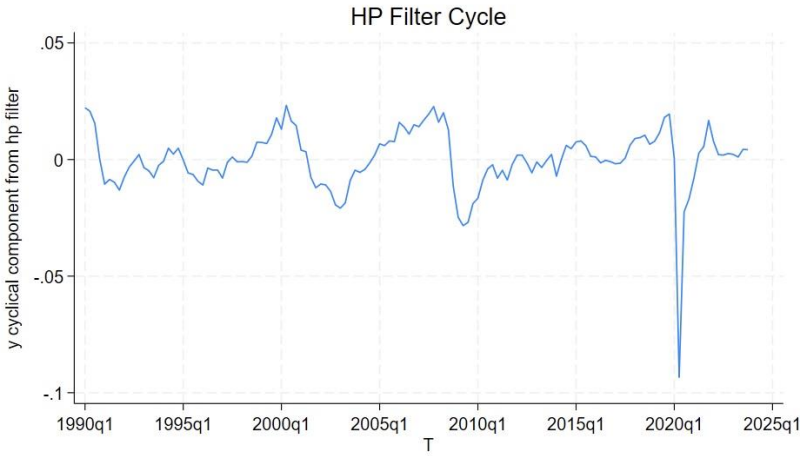

Figure 1. Filter Cycle

This Figure presents the cyclical components after being processed by the HP filter over the period from the first quarter of 1990 to the first quarter of 2025. In this chart, the vertical axis quantifies the amplitude of the cyclical components, while the horizontal axis precisely marks the quarterly time nodes. First, the visible cyclical peaks and troughs in the chart intuitively depict the ups and downs of economic activities, confirming the inherent volatility characteristics of the economic system. From the chart, it can be concluded that the fluctuations in US economic activities are not irregular but present a series of distinct and clearly defined cyclical peaks and troughs. The back-and-forth movement of these peaks and troughs shows the growth and shrinkage cycles of economic activities and strongly supports the idea that the economic system has built-in volatility. Then, the sharp decline in 2020 is a particularly notable feature in the chart. This "cliff-like" plunge coincided with the global outbreak of the COVID-19 pandemic. It directly reflects the devastating impact of this unprecedented external shock on the country and the global economy, bringing an end to the economic expansion in the United States, and a sharp decline in expenditures on goods and services [13]. And GDP has experienced an astonishing decline [13]. Meanwhile, it profoundly highlights the inherent vulnerability of the modern, highly interconnected, and complex economic system when facing a large-scale public health crisis. This event has also become a critical juncture for testing economic resilience and policy response capabilities.

The following statistical summary table(Table 1) further quantifies the characteristics of these cyclical fluctuations.

Table 1. ychp Summary

variable	Obs	Mean	Std.dev.	Min	Max
ychp	136	3.03e-11	.0133262	-.0933619	.0232401

With a mean close to zero (3.03e-11), indicating that the variable fluctuates around its long-term trend value. However, its standard deviation is 0.0133, with a minimum value of -0.093 and a maximum value of 0.023, which reveals that although the cyclical components fluctuate around the mean, the fluctuation amplitude is relatively significant, not insignificant. This further confirms the real existence of economic cyclical fluctuations and their undeniable influence.

Secondly, there are some discussions about consumption. Figure 2 displays the cyclical components of output and consumption sequences.

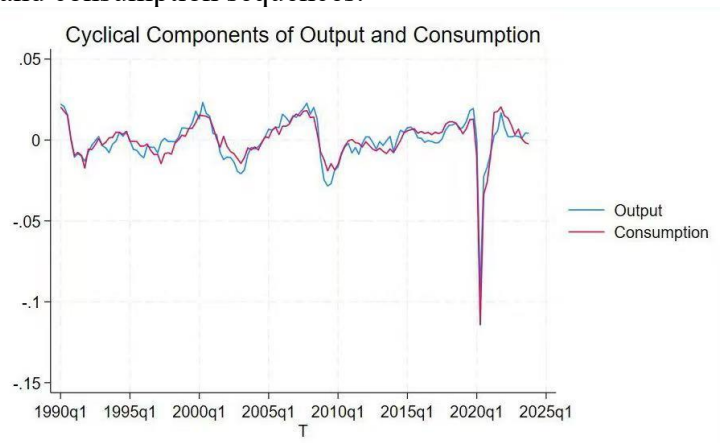

Figure 2. Output and Consumption Cycles

A notable feature from this figure is that consumption is pro-cyclical. From the figure, the deviation of consumption from the trend is positively correlated with the deviation of real GDP from the trend. Consumption is also a coincident variable, changing simultaneously with GDP. Another significant feature is that the amplitude of cyclical fluctuations in consumption has exceeded that of output in multiple periods, revealing the high sensitivity of consumption behavior to economic cycles. Particularly in the first quarter of 2020, the consumption line showed a sharp and deep decline, which closely aligns with the reality of widespread social isolation, business activity stagnation, and a sudden drop in consumer confidence caused by the global COVID-19 pandemic. This sharp downturn not only directly led to a significant contraction in GDP for the quarter but also highlighted the crucial

influence of consumption fluctuations on the overall economic cycle trajectory, as a core component of final demand. This confirms the dual role of consumption as a "stabilizer" or "amplifier" in the economic system, depending on the specific stage of the economy.

Table 2 provides a more precise quantification of the cyclical component of consumption (variable "cchp").

Table 2. cchp Summary

variable	Obs	Mean	Std.dev.	Min	Max
cchp	136	4.12e-11	.0138691	-.1141846	.0204461

Its standard deviation is 0.013891, revealing the degree of dispersion of the cyclical component of consumption around the mean. Notably, the maximum positive value is much lower than the minimum negative value, which may imply that consumption shows a stronger contraction tendency during economic downturns, suggesting an asymmetric response mechanism of consumer behavior in different economic environments.

Understanding the intrinsic mechanism of consumption fluctuations has two key entry points. The first one is the special position of durable consumer goods in the total consumption structure. Durable consumer goods (such as automobiles, home appliances, large furniture, etc.) play an unique role in the consumption basket [14]. These goods typically have high value, long service life, and the characteristic of being postponable [15]. Therefore, consumers' purchase decisions for such goods are highly dependent on their current and expected future income levels, the availability of credit, and confidence in the macroeconomic outlook. During periods of increased economic uncertainty or expected income decline, consumers tend to postpone the purchase of durable consumer goods as a buffer, which leads to a significant increase in the volatility of total consumption. Conversely, during economic booms and high confidence, the purchase of durable consumer goods may experience a pulse-like growth. At the same time, government policies, as significant exogenous variables influencing the macroeconomic environment, play a crucial role in shaping consumer behavior and cannot be overlooked. Whether it is the adjustment of tax policies, the tightness or looseness of monetary policies, or the completeness and payment levels of the social security system (such as unemployment benefits, pension systems), all have an impact on residents' disposable income, wealth expectations, and risk aversion tendencies at different levels. For instance, income tax cuts can directly boost residents' gross income and stimulate consumption [16]. Finally, there is a research finds that consumption fluctuations in China are greater than output fluctuations which is the same as in the US [17]. It also adds an important country-specific perspective to the discussion. Part of the explanation is the relatively high proportion of durable goods in Chinese residents' consumption and the relatively limited support for consumer credit in the early development stage of the financial service system, which makes consumers more sensitive to income fluctuations.

Then, it is an investment. The picture reveals the dynamic evolution of the cyclical components of output and investment in the macroeconomy.

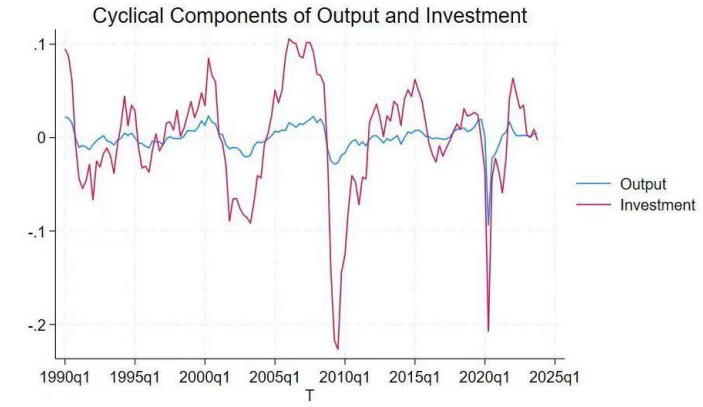

Figure 3 Output and Investment Cycles

From the figure, it can be observed that investment changes are closely linked to overall economic activities, and they usually move together, even though the size of their changes can be very different. Through the diagram, the amplitude of investment fluctuations has significantly exceeded that of output in several periods, which profoundly reveals the high sensitivity of investment in the economic system. Investment behavior not only reacts quickly to the economic cycle changes but also has amplified fluctuation, becoming one of the important sources of economic fluctuations. In 2020, because of the global COVID-19 pandemic, the cyclical component of investment showed a sharp and significant negative deviation, with the decline being much more severe than the fluctuations of output in the same period. This phenomenon not only closely aligns with the significant decline in GDP during the same period but also deeply confirms the key transmission mechanism and amplifier role of investment in economic cycle fluctuations. The drastic adjustment of investment behavior, whether due to an active contraction strategy based on pessimism about future economic prospects or a passive reduction caused by credit market freezing and soaring financing costs, directly or indirectly drags down the overall economic output, highlighting the core position and influence of investment in the evolution of the economic cycle. It can be said that the heat or cold of investment activities largely determines the temperature of the economic cycle.

The statistical summary Table 3 provides a quantitative description of the cyclical component of investment (variable name "ichp").

Table 3 ichp Summary

variable	Obs	Mean	Std.dev.	Min	Max
ichp	136	1.93e-10	.0601726	-.2265123	.1057619

Its standard deviation is as high as 0.0601726, which quantifies the volatility of investment. Combined with the significant difference between the minimum (-2.265123) and the maximum (0.1057619), it can be concluded that although the long-term trend of investment may be relatively stable, its short-term fluctuations are extremely significant and wide-ranging. This volatility not only reflects the frequency and extent of adjustments in investment decisions made by economic entities when facing uncertainty, but may also contain the combined influence of multiple economic factors such as information asymmetry, adjustment costs, external shocks, and the financial accelerator effect.

The underlying deep causes that drive the cyclical fluctuations in investment can be mainly summarized into two categories. Initially, unforeseen events can significantly affect investment strategies and market volatility [18]. These events, also known as event risk, can include global events, policy shifts, and unexpected disruptions [19] that impact economic stability, trade, and financial markets [20]. The COVID-19 pandemic is a typical example. These events often directly or indirectly alter the fundamental aspects of the economy, forcing investors to re-evaluate risks and returns, thereby triggering sharp adjustments in investment behavior. The latter, namely investor sentiment, is more subtle. A research emphasizes the crucial role of investor sentiment in the formation of investment decisions [21]. Investor sentiment, also known as market sentiment [22], is the general perception or attitude that investors hold towards a particular security or the entire financial market [23]. It is a collective psychological state that diffuses throughout the market and is difficult to quantify completely, its fluctuations can significantly affect market confidence, thereby changing investors' assessment criteria for risks and returns, and ultimately leading to adjustments in investment portfolios and changes in investment flows. This emotional decision-making, called "animal spirits," helps explain how people make financial choices during tough economic times or uncertainty [24], and it's crucial for understanding why investments can be so unpredictable, especially the big swings that can't be fully explained by basic economic factors. Consumer confidence will be influenced by the animal spirits. When optimism prevails, even if the fundamental information does not undergo fundamental changes, it may stimulate enterprises to expand production capacity, increase research and development investment, and even undertake riskier project investments; conversely, the spread of pessimism may trigger enterprises to postpone or cancel investment plans, even if the future outlook may not be as gloomy as expected.

Finally, Das [25] conducted a study on the Indian economy and found that investment indeed exhibited a feature of fluctuating in the same direction as GDP, that is, it was cyclical. However, the amplitude of its fluctuations was significantly greater than that of GDP. This finding is consistent with the United States, jointly pointing to the macro phenomenon that the volatility of investment is generally higher than that of output.

The last variable is wage. The following graph is figure 4.

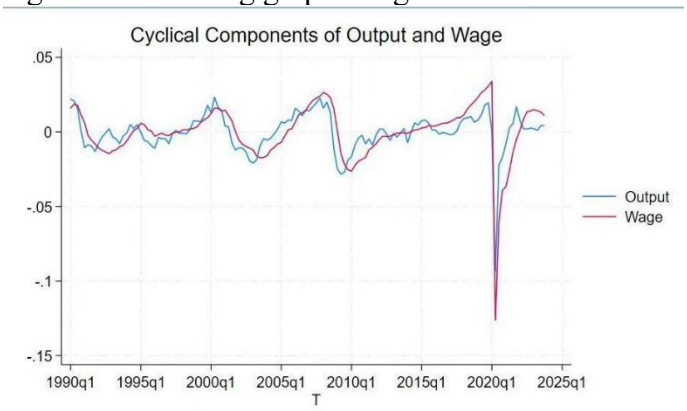

Figure 4 Output and Wage Cycles

The wage series exhibits the inherent procyclical nature. More importantly, the information revealed by the chart also indicates that wages are a lagging variable, meaning that their response to economic cycle changes is not immediate but has a certain time delay. Like consumption and investment, the amplitude of the cyclical fluctuations in wages shows a significant tendency to exceed those of output over multiple observation periods. This phenomenon is not a simple linear relationship but deeply reflects the complexity of the labor market and its dynamic characteristics in interaction with the macroeconomy. During the COVID-19, there was a severe impact on economic activities, causing a sudden contraction and a sharp decline in output. At the same time, the cyclical components of wages also showed a steeper and more significant negative deviation, clearly indicating the huge impact that wages have under economic downward pressure. The significant decline in wages, whether through layoffs, reduction in working hours, or nominal wage freezes, directly reflects the cost adjustment strategies of enterprises in the face of reduced demand and operational difficulties.

From the wchp Summary Table, the standard deviation is 0.018166. The minimum value is -0.1262023, and the maximum value is 0.033926. These two extreme values depict the extreme range of wage periodic fluctuations and reveal the potential extreme fluctuation intervals.

Table 4 wchp Summary

variable	Obs	Mean	Std.dev.	Min	Max
wchp	136	-2.45e-11.018166 -.1262023.033926	.018166	-.1262023	.033926

The "wage stickiness" theory is one of the core concepts for understanding the cyclical fluctuations of wages. It is also a crucial factor that makes wages a lagging variable [26]. Wage stickiness typically refers to the phenomenon where nominal wages or real wages adjust relatively slowly or with insufficient amplitude in response to economic changes [27]. This stickiness may stem from various factors, including the efficiency wage theory where companies avoid reducing wages easily to maintain employee loyalty and productivity, long-term labor contracts that limit changes; minimum wage laws; the influence of trade unions in discussions; and challenges in coordination due to uneven information. Wages decline slowly during recessions and tend to rise later on, often with a lag, thus resulting in complex and non-synchronous cyclical fluctuations of wages with output.

Furthermore, a research findings on the UK provide a valuable regional perspective for understanding the dynamic relationship between wages and output [28]. This study indicates that in the specific economic structure, labor market system, and macroeconomic policy environment of the UK, the growth of output often leads to an increase in wages and salary levels. This finding is not contradictory to the wage stickiness theory; instead, it reveals another aspect of the wage response mechanism to output changes. This is consistent with the situation in the United States.

Based on the above analysis, the following policy recommendations are proposed: Firstly, given the high volatility of investment, policymakers should pay more attention to guiding investment behavior through structural reforms and a stable macro environment, avoiding excessive investment fluctuations due to policy uncertainty or short-term shocks. Consider implementing more targeted tax incentives to smooth the investment cycle, especially during economic downturns. Secondly, considering the lagging nature of wages and its possible intensification of stickiness during economic downturns, the government should closely monitor the dynamics of the labor market and promptly introduce employment protection measures, such as unemployment insurance subsidies and training programs, to cushion the impact of wage decreases on residents' consumption capacity and living standards, and prevent it from evolving into a long-term structural unemployment problem. Finally, considering the special fluctuation patterns observed during the COVID-19 pandemic, policymakers need to establish a more flexible economic monitoring and early warning system, so that in the event of future uncertain shocks, they can more quickly and accurately identify abnormal fluctuations in key variables and take effective hedging measures.

5. Conclusion

In conclusion, through rigorous empirical analysis, this study has revealed a series of insightful findings. Among them, investment volatility exhibits the most significant characteristics among various economic variables, highlighting its core position and sensitivity in the macroeconomic dynamics. Particularly noteworthy is the lagging nature of the wage variable, which provides a new perspective for understanding the complex interaction between the labor market and the overall economic cycle. It is especially important to note that the global pandemic of COVID-19 has had a profound impact on the economic structure. During this period, the volatility of all examined variables, except for investment, reached historic lows. This phenomenon not only reflects the economic resilience under specific shocks but may also reveal the potential effects of certain structural changes or policy interventions. Based on these preliminary conclusions, this study believes that future academic exploration should aim to expand the research scope and extend the time series of the examination to obtain more universal and robust conclusions.

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