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## Tactical Asset Allocation Model under Changing Macroeconomic Regimes in China

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# **Tactical Asset Allocation Model under Changing Macroeconomic Regimes in China**

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**Doctorate of Advanced Professional Studies in Applied  
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by

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**April, 2023**

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## Abstract

The traditional regime-based asset allocation model originated from Merrill Lynch in 2004. These categories of model explore the relationship between macroeconomic variables and asset returns. they point out that there are categories of assets with relatively excellent performance in different regimes of the economic cycle, so an investor should allocate different categories of assets in different economic regime. However, due to special political and economic system of China, regime-based allocation model in China often has confused results. To study how to allocate assets when economic cycle changes, this paper studies how to optimize the method of regime-based asset allocation model to improve the effectiveness and practical value of its application in China's capital market.

Methodologically, firstly, this paper takes indicators of economic growth and inflation rate as standards to divide economic regimes, such as GDP/PMI/CPI. Secondly, considering the actual situation of China, this paper chooses 3% as the threshold for CPI inflation, 6% and 50 as the threshold for GDP and PMI growth rates, respectively, to divide the economy into four regimes. Thirdly, this paper utilizes the corresponding tactical asset allocation theory to study the expected return rates of stocks, bonds, commodity and cash under different economic regimes, and compares the level of yield.

Results illustrate that taking the comprehensive PMI index and CPI index as the two-dimensional indicators of economic cycle are better than those of taking the growth rate of industrial added value or GDP as the dimensional indicators of economic cycle, both in terms of the degree of matching with the theory of asset allocation model and growth rate of the total net value of the optimal investment strategy. This paper also compares the optimal asset in different economic regimes in China and US, the results shows that cash and bond return are the main reason of differences. The main underlying reason is that China is an emerging market while the United States is a mature market, and the economic cycle and interest rate of emerging markets like China is relatively weak.

Finally, considering the defects of traditional regime-based asset allocation model, especially the obvious shortage of China's economic data statistics, the original model can only represent the current economic state with lagging historical data. Therefore, this method is difficult to predict the changes of the economic regime. Therefore, this paper utilizes a simple M-logit model to predict the future economic regime through historical economic data, and then carries out asset allocation based on the forecasted economic state. The research results show that the asset allocation results combined with HP filter and M-logit forecasting model have higher rate of return.

**Key words:** economic regime; tactical asset allocation model; economic forecast

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# Tactical Asset Allocation Model under Changing Macroeconomic Regimes in China

## 1. Introduction

A traditional asset allocation model includes strategic asset allocation and tactical asset allocation. Strategic asset allocation can often obtain higher returns through long-term passive investment, which is the most important source of portfolio returns. Tactical asset allocation often utilizes re-balance strategies based on economic regimes, which are called regime-based asset allocation model.

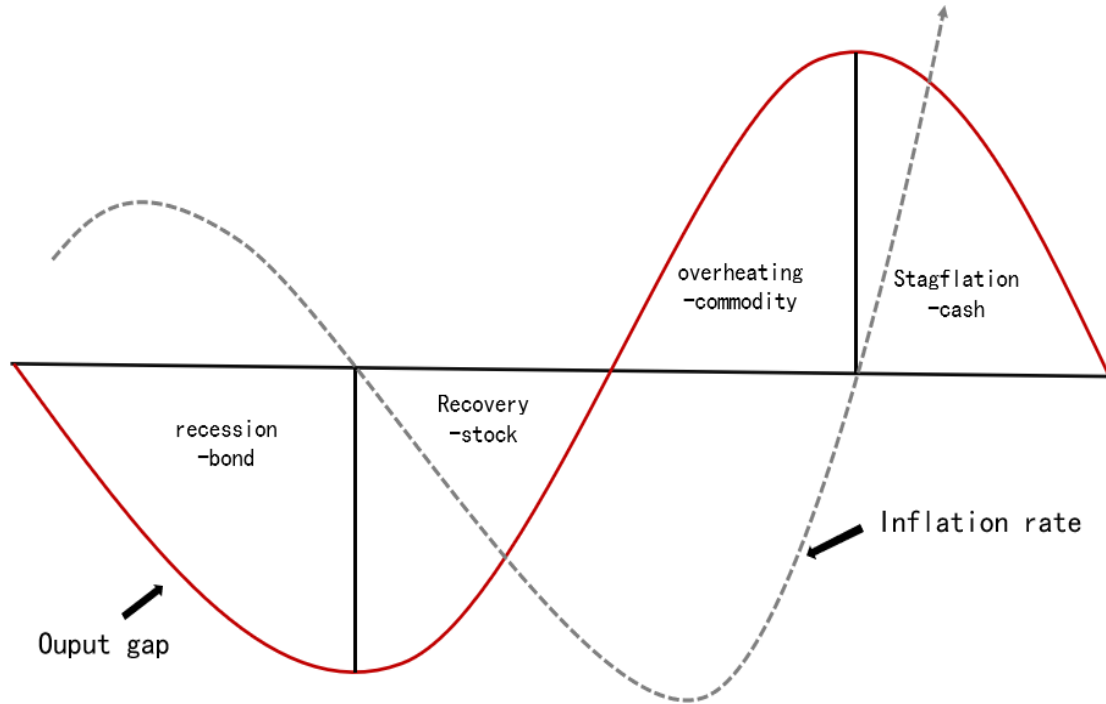
The traditional regime-based asset allocation model originated from the investment clock of Merrill Lynch proposed by Merrill Lynch in 2004. Merrill Lynch Investment clock model explores the relationship between macroeconomic variables and different asset returns. It points out that there are categories of assets with relatively excellent performance in different regimes of the economic cycle, so it puts forward the allocation of assets from the perspective of the economic regimes. According to the direction of the economic development trend and the direction of inflation, the economic cycle is divided into four regimes, namely, recession, recovery, overheat and stagflation. And finally, ML clock model demonstrates the assets with the highest income and asset allocation strategy, which is illustrated in Table 1.

*Table 1: Economic Status and Corresponding Optimal Assets of Merrill Lynch Investment Clock Model*

<b>Economic regimes</b>	<b>Economic growth</b>	<b>Inflation</b>	<b>Optimal asset</b>
<b>recession</b>	Down	Down	Bond
<b>recovery</b>	Up	Down	Stock
<b>overheat</b>	Up	Up	Commodity
<b>stagflation</b>	Down	Up	Cash

Source: The Investment Clock: Making Money from Macro

*Figure 1: Economic Regimes and Optimal Asset*



Source: The Investment Clock: Making Money from Macro

In China, more and more attention has been paid to the research of regime-based asset allocation models, and scholars continue to test the effectiveness of similar models. However, based on previous studies, traditional regime-based asset allocation models often do not have strong effectiveness in asset allocation. Some of results are even confused. The main reason is the division of China's economic regimes is difficult (Shen and Siu, 2012). In view of the above situation, based on previous studies, this paper uses the regime-based analysis framework to customize the rules of state division, so that its division rules are more in line with the China's economic operation. In each economic division regime, this paper observes the performance of major categories of assets and make reasonable explanations. At the same time, the performance of various assets in each regime is analyzed to judge the effectiveness of economic state division. Finally, after scientifically and reasonably predicting the benefits and risks of various assets, the final asset allocation is obtained by using the quantitative forecasting model.

Specifically, with reference to the experience of Dustmann et al. (2009) and BNY Mellon Asset Management (2011), this paper also defines the economic status based on economic growth and inflation. After defining economic regimes, this paper utilizes corresponding tactical asset allocation theory to study the expected return rates of stocks, bond, commodity and cash under different economic systems. Then, this paper formulates

tactical asset allocation strategies based on the economic regime according to the following processes: (1) determine the investment objectives according to the risk return ratio in different economic regime (Tokat et al., 2007); (2) Selecting assets; (3) Establishing long-term strategic asset allocation; (4) Formulating tactical asset allocation; (5) Implementing rebalancing strategy; (6) Reviewing long-term objectives and asset expectations (Vorlow, 2017). The results show that the performance of strategy portfolio is better than that of a single index in terms of both cumulative return and Sharpe ratio, and results of robustness test are strong, which fully demonstrates the effectiveness of this tactical asset allocation strategy.

On this basis, this paper makes 3 important improvements innovations: Firstly, this paper attempts to use a variety of methods to define economic regime. In addition to the commonly used quarterly data based on GDP growth rate and CPI year-on-year growth rate, this paper also uses monthly industrial added value and monthly PMI to define the economic cycle, and tests the asset allocation model based on the newly defined economic regime. The results show that the innovation model based on monthly comprehensive PMI and CPI is the most effective.

Secondly, this paper attempts to compare the return rates of assets in different economic cycles between China and the United States and explores the reasons for the differences.

Thirdly, this paper constructs a logit model to forecast economic regimes, which is also the most important innovation of this paper. This paper argues that, most asset allocation model based on the economic regime has significant defects in defining economic regimes. That is no matter what methods we use to define economic regime, we can only use lagged data, because the economic data release of China is lagging.<sup>1</sup> Therefore, the traditional model assumes that the economic state is continuous and does not change between the two periods. However, with the macroeconomic adjustment to the potential hub, the cyclical economic fluctuations have accelerated significantly, and the recent COVID-19 has exacerbated the fluctuations. In this case, using the economic data of the previous period to represent the current economic state may ignore the transformation of economic state, especially in the period of rapid transformation of economic state.

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<sup>1</sup> For example, when we need to study asset allocation in January 2022, we are unable to obtain economic data for January in advance (the Bureau of Statistics release the data for January in Feb). Therefore, we have to use lagged data of December and even November 2021 to represent economic regime of Jan 2022 (this is because the December data release date is also after January 15th), resulting in too much data lag.

Therefore, a possible improvement is to predict the current economic state according to the existing historical data, and then select the asset category according to the predicted economic state. This paper uses M-logit regression model to predict the economic state of the next period, and carries out asset allocation test based on this.

The structure of this paper is arranged as follows: the first part is the introduction, which introduces the background, basic result and innovation of this paper. The second part is a literature review, which discusses the previous scholars' findings on the regime-based tactical asset allocation model. The third part is the method and data of this paper. The fourth part is the results of the traditional model, including the results of the traditional regime-based tactical asset allocation model based on gdp/cpi. And the three main innovations of this paper: further inspection based on pmi/industrial added value, comparison between China and the United States. The fifth part is the asset allocation model based on prediction. This part first introduces the method and results of predicting the next economic state based on logit model, and allocates assets based on the results. The sixth part is the conclusion of this paper.

## **2. Literature Review**

### **2.1 The Phenomenon and Reasons of Economic Regime**

Economic regime, is originally used to describe the regular and continuous economic fluctuation phenomenon in modern society. Different schools of western economics have different definitions of economic cycle. Among them, the definition given in measuring the economic cycle published by Mitchell and Burns in 1946 is typical and widely accepted. They believe that in all countries dominated by industrial enterprises or commercial enterprises, there will be a cyclical pattern of economic fluctuations, and this pattern has constant regularity. The specific manifestations of this law are as follows:

This cycle of economic fluctuations is composed of four regimes, including expansion regime, recession regime, stagflation regime and recovery regime. Second, each complete cycle of this cyclical economic fluctuation pattern has different time intervals, and each regime in each cycle cannot summarize a similar structure. Third, every 4 regime cycle of this cyclical economic fluctuation pattern is a complete economic cycle unit, and an economic cycle unit cannot be divided into smaller economic cycle units (Zhao, 2018; Prabheesh et al., 2020).

Generally speaking, the economic characteristics in the period of recovery and overheating are as follows: part of the investment will increase continuously with the continuous acceleration of economic growth, and the affected output will also increase. At the same time, the market demand will be more vigorous, the enterprise profits and production value will increase with it, the social employment rate will increase, and people's income and consumption capacity will also increase to varying degrees. Of course, at this regime, Inflation is also common (Duarte et al., 2020). Relatively speaking, in the period of stagflation and recession, the economic characteristics will be as follows: some investment will continue to decrease with the continuous deceleration of economic growth, market demand will shrink, social commodity production and corporate profits will continue to decline, the employment rate of residents will decline relatively, and the income and consumption levels will be reduced to varying degrees. Deflation also often occurs in this period (Liu et al., 2019).

Finally, scholars find that the change of economic regime is driven by economic cycle. Prabheesh et al. (2020) mentioned that the economic cycle is an inevitable joint product in the process of economic development. He believes that the economic cycle needs to be divided artificially and reasonably: boom period, overheating period, recession period and recovery period. The concept of "creative destruction" put forward by him shows that liquidation and redistribution in the period of economic recession are crucial to the long-term development of the economy and an important link in the process of economic evolution. The author believes that the necessary liquidation and redistribution during the economic recession can enable the market to successfully achieve the survival of the fittest. This is conducive to the improvement of economic level, and the company can achieve better development in the future recovery period. Therefore, on the whole, the economic recession is very important in the whole economic cycle. There are different explanations about the measurement and rotation of the economic cycle. Cavallari et al. (2021) believes that the division and emergence of economic cycles come from the role of economic shocks. This effect will change the total demand and supply. Specifically, first of all, at the market level, under economic shocks, the equilibrium point of social demand and supply is broken. With different types of economic shocks, the degree of movement of demand and supply curves in the market is also different, thus forming different economic cycles. Secondly, on the other hand, at the national level, under the economic shock, the country needs to adopt different economic policies and economic means to carry out macro-control, which affects the economic trend, and then affects the economic cycle. Liu

et al. (2019) argues that when the economy reaches the turning point of the economic cycle, the situation will become more complex. At the time point of transformation between different regimes, more problems will be exposed. This uncertainty will run through every node. They believe that the main reason is that the changes in the economic cycle stem from the relationship between the interacting industries.

## **2.2 Asset Allocation Based on Economic Regime**

Asset allocation model is to allocate different weights to different asset classes according to certain criteria and principals. The method of quantitative asset allocation originates from the mean variance model proposed by Markowitz (1952). The mean variance model takes the mean value of the rate of return as the expected rate of return of assets, and regards the variance as the risk of investment. It calculates the optimal allocation weight of various assets through mathematical methods and optimization algorithms, in order to maximize the return of the portfolio at the same risk level. Black and Litterman of Goldman Sachs put forward the famous Black - Litterman model in the field of asset allocation. On the basis of Markowitz's original framework, the subjective views of investors on the return of assets are added, and the Bayesian reasoning method is used as the alternative variable of Markowitz's expected return on assets to estimate the posterior return on investment. Compared with Markowitz's mean variance model framework, the return on asset allocation based on black Litterman model has higher stability (Drobetz, 2001).

Vandell et al. (1989) initially proposed an asset rotation strategy based on economic regime. Later, a large number of scientists studied market-based asset allocation strategies. Breen et al. (1990) used the short-term interest rate as the market timing standard to test the rotation between risk weighted assets and risk-free assets. In addition, Hansen (2010) find through research that the timing of appropriate conversion between bonds and stocks is related to the business cycle, that is, when the bottom of the cycle comes, it will turn from bonds to stocks, and when the peak of the business cycle comes, it will turn from stocks to bonds. Liu et al. (2019) finds that investors' prediction ability is the basis of effective market timing method. They also argue that the vast majority of the fund's past investment income can be determined by the allocation of different forms of large-scale assets, and the allocation of large-scale assets is the decisive factor for the fund income difference between different funds, while the above average income obtained by the fund almost completely depends on how to allocate large-scale assets. Based on the above

research, Flint (2019) summarized the relationship between business cycle and return on investment, and divided it into four regimes: the first and second regimes of the rise of economic return on equity are the best. Due to the acceleration of interest rate rise, stock returns are suppressed, which represents the third period, in which the cash return reaches the peak. In the fourth regime, the economic situation in this regime has changed significantly, the interest rate has decreased, and the return of bond investment is the best, among which long-term bonds get the best return. So far, the relationship between business cycle and large-scale asset allocation has become clearer.

Considering the duration of each economic cycle, Martin (2006) shows that the impact of business cycle on large categories of assets is not the same in duration. When the economy starts to decline, bonds are the most sensitive of all assets, followed by stocks and commodities. Zhao (2019) also found that the model can achieve excess returns, but evaluating the inflection point signal is the key to the success of the model. According to the research of Dufresne et al. (2019), the return rate of assets is different in different economic states. Therefore, an important problem is to select asset categories according to the macroeconomic state (Dufresne et al., 2019). The basic assumption of this theory is: The development level of production factors and production technology determines the long-term development trend of the economy, and the regular movement of economic output level and money supply level away from the equilibrium state makes the medium and short-term economy show cyclical fluctuations.

In the asset allocation model, Merrill Lynch Investment clock is an asset rotation allocation strategy proposed by Merrill Lynch (2004). Merrill Lynch Investment clock is a system framework that connects the rotation of large categories of assets, industry cycle and macroeconomic cycle. Merrill Lynch Investment clock uses the two different dimensions of inflation and economic growth in the macro economy to divide the whole economic cycle into four different quadrants, corresponding to four different regimes of a complete economic cycle: economic recession and the decline of inflation level correspond to the regime of economic recession; Economic growth and the decline of inflation level correspond to the recovery regime of economic level; The rise of economic growth and inflation corresponds to the overheating regime of the economy; Finally, the slowdown of economic growth and the rise of inflation level correspond to the stagflation regime of the economy. The high return of the portfolio can be achieved by configuring different asset classes at each regime.

When the economic environment experiences stagflation, recession, recovery and overheating, the main assets allocated to the portfolio are cash, bonds, stocks, commodities and other major asset categories. When the economy falls into recession, economic growth stagnated, consumers continued to reduce spending, and the level of inflation is further restrained by overcapacity (Erdemlioglu et al., 2019). At this time, the profitability of the enterprise becomes weak, and the actual return on investment decreases. The central bank will adopt loose monetary policy and active fiscal policy to deal with this situation, such as reducing interest rates and tax burden to restore the expected economic growth. This series of measures will inevitably greatly reduce the actual return on investment. At this regime, due to the decline of real yield, bonds are a better investment choice. In the regime of economic recovery, loose and active policies will exert an impact, and the growth of economic level will continue to accelerate until the growth rate gradually approaches the long-term growth trend (Hadhri and Ftiti, 2019). On the other hand, inflation will continue to decline. At this regime of the economic cycle, the price level is low, the production cost of enterprises is also at a low level, and the purchasing power of the market begins to increase, which further promotes the increase of enterprise profits. The reduction of enterprise costs and the increase of actual profits have promoted the development of enterprises. The central bank will maintain a loose policy and a low interest rate monetary policy. Stocks will be the best investment category. When the economy enters the overheating regime, the economic growth slows down, the production capacity approaches the constraint value, and the inflation level rises day by day. Market demand is strong, enterprises reduce product inventory, and commodity production gradually cannot keep up with the growth rate of consumption (Fan and Chen, 2010). The continuous increase of fixed asset investment continues to drive the growth of enterprise profit level, but it gradually slows down in the later regime. The acceleration of economic activities has further promoted the high level of inflation. Although prices and interest rates are already rising, the growth of production level and profit level will exceed the growth of prices and interest rates. The Central Bank of China tightened monetary policy and raised interest rates in an effort to restore economic growth to the scope of sustainable development. At this regime, commodities will be the best asset choice. During the stagflation period, the economic growth rate began to decline, and the inflation level will continue to rise. At this time, the development of productivity is weak, the demand is gradually declining, on the other hand, the cost of enterprises is gradually rising. The increase of profits by raising product prices, costs, wages and prices continue to rise, and eventually the growth of enterprises and social economy stagnates or declines, while the unemployment rate rises.

At this regime, the central bank tightened monetary policy. In this regime, cash is the best asset investment choice (Qin et al., 2013).

Based on the above researches, scholars of developed economy often use the output gap (the difference between actual output and potential output) to measure the degree of economic output deviating from equilibrium, and use the expectation of inflation to measure the degree of money supply deviating from equilibrium (Tang et al., 2007). Through the above corresponding indicators, the U.S. economic trend can be divided into several complete cycles, each cycle includes four regimes, namely, recovery regime, overheating regime, stagflation regime and recession regime. Each regime rotates in turn, forming a complete economic cycle (Bae et al., 2014). After identifying different regimes of the economic cycle, scholars also believe that if different categories of assets are allocated at different regimes of the economic cycle, the excess return on investment can be obtained by comparison. The conclusion is that if we need to maximize the return on investment, we need to allocate different types of assets in different economic regimes. For example, the results of Merrill Lynch believe the best allocation in the recession regime is bonds, the best allocation in the recovery regime is stocks, the best allocation in the overheating regime is commodities, and the best allocation in the stagflation regime is cash (Guidolin et al., 2007). Since the arrangement of the optimal assets at each regime of the cycle is just a diagonal of the table, later generations also call it the diagonal of the optimal strategy of Merrill Lynch Investment clock.

*Table 2: Classical Theory of Regime-Based Asset Allocation*

Regime	Asset allocation and performance
Recession	Bond > Cash > Stock > Commodity
Recovery	Stock > Bond > Commodity > Cash
Overheating	Commodity > Stock > Cash > Bond
Stagflation	Cash > Commodity > Bond > Stock

### **2.3 Asset Allocation Based on Economic Regime in China**

The relevant research literature of regime-based asset allocation model in China is popular after the 2008 financial crisis. Since the 2008 financial crisis, the investment risk related to continuous and violent macro economy fluctuations grows quickly, therefore, some investors have realized the importance of identifying the economic cycle and

studying the relationship between the economic cycle and the return of major assets. As a new research area in China, capital market asset allocation and regime-based asset allocation model have attracted the attention and research of a group of Chinese researchers (Ge and Yuan, 2022).

Bonatti and Fracasso (2013) is one of the earlier studies to apply the regime-based asset allocation model theory to China's capital market. This study uses the original theory of the regime-based asset allocation model for reference to discuss the impact of economic cycles on the securities market and the industrial allocation effect of economic cycle division. It also puts forward the basic research idea of using the year-on-year growth rate of China's industrial added value and the year-on-year growth rate of CPI as two-dimensional indicators to divide the different regimes of China's economic cycle, which lays a foundation for subsequent research. At the same time, the study believes that there is a very obvious cyclical phenomenon in China's economy, and a large class of asset allocation strategy with the best yield can be found in the four different regimes of the economic cycle. This conclusion is similar to the original theory of the regime-based asset allocation model.

Lu (2010) systematically introduced the application of the regime-based model in asset allocation. The investment model not only plays an important role in the allocation of large categories of assets, but also contributes to the industry selection of asset allocation. In the period of economic recovery, we should choose industries with good growth; When the economy is overheated, we should pay attention to value investment and choose cyclical industries; For the stagflation period, investment should be cautious, and the focus should be more on some defensive industries; Finally, in the recession, we should invest in industries that have both growth and defense. Su and Lu (2011) made relevant adjustments to the cycle period of the regime-based asset allocation model. In their view, stagflation is not a necessary regime for a complete economic cycle, and stagflation itself is a special phenomenon in China. Guided by traditional economic theories, they eliminated stagflation from the economic cycle. At the same time, adjust the cycle of the regime-based asset allocation model, establish a new typical cycle, and make a reasonable arrangement for the economic cycle. Therefore, this not only removes the contradiction between the regime-based asset allocation model theory and the traditional theory, but also expands the application scope of the theory, which also makes it more perfectly fit the application in China's capital market.

In terms of selected indicators when dividing economic regimes, it is often difficult to use monthly research because China's economic data has a short statistical history and serious missing values. However, Zhao (2012) and Gu (2014) extended the model to monthly earlier. Zhao (2012) divided the economic cycle with the year-on-year growth rate of industrial added value and the year-on-year growth rate of CPI as two-dimensional data, and tested the change of investment return rate of major categories of assets in the economic cycle from 1995 to 2009. The conclusion is that the regime-based asset allocation model conforms to the actual situation of China's economic capital market, that is, the best investment objects in the recovery, overheating, stagflation and recession are stocks, commodities, cash and bonds respectively. Gu (2014) used the monthly industrial added value and monthly CPI added value from 2002 to 2012 as two-dimensional indicators to divide China's economic cycle, and accurately calculated and analyzed the yield of four types of assets in each regime of China's economic cycle. The test result is that the regime-based asset allocation model has the same conclusion about the performance of assets in different economic cycles except that bond yields perform best in the recession, The asset performance of the other three cycle regimes is different from that of China.

Other scholars have found that the comparison results between China, a developing economy, and the United States, a typical developed economy, are significantly different. For example, Gao (2015) used the regime-based asset allocation model to analyze China's macroeconomic indicators and pointed out the differences between mature economies and macroeconomic indicators. He summarized the economic characteristics from China's practical application. At the same time, he proposed that it should follow the example of ML company to express and divide the different regimes of China's economic cycle by using the leading and lagging indexes of the macroeconomic prosperity index of the National Bureau of statistics. On this basis, it puts forward the view that China's economic cycle has rotation. In addition, by optimizing the mean variance model, combined with the theory of regime-based asset allocation model and Monte Carlo, it can promote the further optimization of asset allocation. His demonstration results on the use of macroeconomic boom index to divide the different regimes of the economic cycle laid a theoretical foundation for a series of subsequent researchers studying the division of China's economic cycle. On the basis of previous research, Zhou (2018) used the leading index and lagging index of the macroeconomic prosperity index as two-dimensional indicators to divide the different regimes of the economic cycle, introduced the new variable of M2 same ratio

growth rate, and re divided the different regimes of China's economic cycle from January 2007 to December 2017 as three-dimensional indicators. At the same time, the original economic regime of regime-based asset allocation model is extended to six regimes: early recovery, late recovery, overheating, stagflation, early recession and late recession. After testing, it is found that the optimal asset allocation strategy of the six regime regime-based asset allocation model is significantly better than the traditional four regime investment clock optimal asset allocation strategy.

Therefore, according to the above existing research and analysis, this paper obtains the following two research implications:

Firstly, researchers pay more attention to selecting different indicators representing economic growth and inflation to investigate the return on assets in different economic states, and we can compare them with results of traditional research. According to previous studies, this paper believes that using industrial added value (IAV) /CPI or PMI/CPI is more appropriate, and it can be compared with overseas classical models.

Secondly, researchers pay more attention to how to allocate assets in different economic states, but they pay little attention to the switching of economic states, that is, previous studies are more based on the assumption that the economic cycle will not change significantly. In fact, we can find that the change of economic state is frequent in China, especially after COVID-19. Therefore, when studying economic state and asset allocation, there are two key problems: one is to predict the next economic state, and the other is to allocate assets according to economic state. Therefore, the empirical study of this paper is also divided into two parts: one is what assets should be allocated in different economic states; The second is the transformation of economic state.

### **3. Methodology and Data**

#### **3.1 Methodology**

This paper mainly utilizes methods of literature analysis, quantitative analysis and case study.

(1) Literature analysis: Scholars have done a lot of research on the relationship between economic regime and asset prices. This study summarizes the previous research results by combining the literature. On this basis, this paper studies the relationship between economic regime and asset price performance under China's unique economic

and financial environment. Finally, the corresponding tactical asset allocation strategy is formulated and back tested according to the changes of economic environment.

(2) Case analysis and international comparison method: This paper studies the performance of asset prices in different economic regimes by comparing the results of China with that in the United States. By comparing the performance of different assets in different countries under different economic regimes, this paper analyzes the impact of macroeconomic environment on asset price performance. Finally, single-scenario case will be extended to multiple cases, and statistically significant conclusions can be reached.

(3) Quantitative analysis method: firstly, this paper defines economic regimes based on economic growth and inflation index of China, secondly, this paper summarizes the annual frequency of different economic regimes from 2007 to 2022. Then this paper aims to statistically study the return of stocks (both small and large enterprises), bonds (Treasury bonds and corporate bonds), commodity and cash. Finally, this paper predicts economic regimes statistically and constructs portfolio accordingly.

Regression and time series models: Based on the definition of the economic regimes above, logit model with lag variables, will be applied in this article to predict the transition of economic states. First of all, an integer of 1-4 will be assigned to the corresponding economic regimes of recovery, overheating, recession and stagflation. Then, economic regime (ER) as a dependent variable will be defined. This paper will select several lag economic indicators to predict the economic regime (ER), for example, variables in the first month of 2020 can be used to predict the economic regime (ER) in the second month of 2020. Combining the literature, this paper will try to use a large number of economic indicators as independent variables, and finally select a suitable set of leading indicators to construct a Logit regression model under the principle of minimizing the Schwarz Information Criteria (SIC). In this way, this paper can filter variables that have limited contribution to the empirical likelihood or only affect several variables, so that the selected model can reflect the stable relationship between selected variables.

### **3.2 Data Selection and Sample of This Paper**

If we want to study the effectiveness of regime-based allocation theory applied to China's capital market, the first step is to divide the clock economic cycle belonging to China according to the research method of asset allocation model. According to traditional research methods, the asset allocation model divides the economic cycle into four regimes,

namely depression, recovery, prosperity and stagflation. The theoretical basis for dividing these four cycles is the level of economic output and inflation.

This paper adopts three methods to measure economic output. The first method is based on the traditional GDP growth rate, since GDP is quarterly data, the model can only be studied using quarterly data. Secondly, this paper collects the year-on-year growth rate of industrial added value from 2007 to 2022. It is worth noting that, first of all, this data is generated by comparing the data of the same period last year, so it has the conditions to find macroeconomic fluctuations. However, the year-on-year growth rate of industrial added value released by the China Bureau of statistics has certain particularity. Due to the influence of the Chinese traditional festival Spring Festival, the year-on-year growth rate of industrial added value in January and February cannot better reflect the actual situation of the economy, that is, the data has obvious seasonal characteristics. This paper uses the previous research methods for reference, through HP Filtering Method (setting  $\lambda=12$ ) filtering out its seasonal characteristics and the impact of economic fluctuations, we can get the growth rate of industrial added value excluding economic fluctuations. CPI is year-on-year. Third, this paper adopts the monthly data based on the comprehensive PMI and CPI index.

After obtaining the distribution of different regimes of the economic cycle, if we need to further test the effectiveness of the regime-based asset allocation model applied to the matching degree of China's capital market and the optimal investment strategy, we need to find sample indicators in China's capital market that can also represent the performance of bond market, stock market, commodity market and cash market. Based on the previous research methods, this paper selects the Treasury bond yield as the bond market yield, the Shanghai Shenzhen 300 index (HS300) as the stock yield, the monthly yield of the South China commodity index as the commodity yield, and the 7-day Shanghai interbank offered rate (SHIBOR) as the cash yield.

Specifically, this paper adopts the Shanghai Stock Exchange national debt index as index of bonds, which is based on all fixed interest rate national debt listed on the Shanghai Stock Exchange as a reference, and then weighted on this basis. The index has been released since January 2, 2003 as the starting date, and the base date is December 31, 2002. The base point is 100 points, and the index code is 000012. The calculation method of Shanghai stock exchange treasury bond index is to assign the weighted comprehensive price index formula, and the weighting method is to use the weight of the issuance of

treasury bonds. This index has a good response to the fluctuation of the whole bond market in China, so it can be used as an indicator of the price change of the bond market in China.

The commodity adopts south China commodity index, which is a price index organized and compiled by South China futures index and mainly used to describe the price rise and fall of commodities. It is the earliest descriptive index of commodities in China, and has been released since June 1, 2004. The South China commodity index is usually selective when compiling the index. Its target range is those highly representative commodities of the three exchanges with good liquidity in a large range, mainly covering energy, chemical, metal products and agricultural products, so as to compile the index. The South China commodity index fully takes into account the characteristics of the futures market. When determining the main contracts, the main basis is the contract position, and excludes the forward premium of those contracts. In this sense, the South China commodity index can accurately reflect the return of long-term commodity investment

The cash yield adopts the Shanghai interbank offered rate, which mainly refers to the interest rate of short-term borrowing and lending of funds between different financial institutions within the industry. As the core interest rate of the money market, the interbank offered rate reflects the price level of funds in the borrowing market, and it can represent the typical interest rate in the large-scale financial market. It can respond to the money market accurately, sensitively and timely, and accurately reflect the relationship between the supply and demand of funds in the whole financial market for a period of time. When this interest rate continues to rise, the market demand reflected by it is that the demand for funds is too strong. At this time, the market is likely to have a decrease in liquidity. Since October, 2006, with the advent of Shibor (Shibor refers to Shanghai interbank offered rate). For the Central Bank of China, this is an important part of the benchmark interest rate system that it will build in the next step.

The variables used in this paper, their according definition and data sources are as follows:

**Table 3: The Definition and Source of Variables in This Paper**

Variable	Definition	Source
PMI	Purchasing Managers' Index	National Bureau of Statistics
PMI_1	Purchasing Managers' Index with 1 Lag Period	National Bureau of Statistics
CPI	Consumer Price Index	National Bureau of Statistics
GDP	Gross Domestic Production	National Bureau of Statistics
IAV	Industrial Added Value	National Bureau of Statistics
M2	Money Supply Growth Rate	National Bureau of Statistics
INV	Growth rate of fixed asset investment	National Bureau of Statistics
CONSUM	Growth rate of total retail sales.	National Bureau of Statistics
EXP	Monthly export growth rate	National Bureau of Statistics
HS300	HS300 Index Yield, a common used stock index of China	WIND
Bond	Interest rate of 10-year treasury bond.	WIND
Commodity	Monthly yield of NH commodity futures index, a common used commodity index.	WIND
SHIBOR	Shanghai Interbank Offered Rate, a common used yield rate of Interbank market	WIND

The data of this paper is all from public databases. Among them, macroeconomic data such as economic growth and inflation is gained from China's National Bureau of Statistics, while price data of assets such as stocks, treasury bonds and commodities come from the Wind database, a commonly used database in China. Using these data, we can define the macroeconomic regimes and study the performance of asset prices under different macroeconomic environments.

## **4. Results of Regime-Based Asset Allocation Model**

### **4.1 Economic regime Division of Chinese Market -- A Simple Model Based on GDP/CPI (Quarterly)**

In order to describe the economic growth and inflation situation in the Chinese market, this paper first selects two simple indicators, namely, the year-on-year GDP (constant price) and the year-on-year CPI. The reason for choosing year-on-year is to exclude the seasonal effect, and the reason for choosing unchanged price is to eliminate the impact of inflation. The reasons for choosing these two indicators are that they are relatively simple and commonly used, and that the data quality is high, which can represent

the state of China's economy and is suitable to be tested as a benchmark model.

After collecting the original data, the data is first processed by frequency matching. Considering that this paper focuses on quarterly data, for the year-on-year CPI of the current month, the quarterly average is adopted, and for the year-on-year GDP of the current quarter (constant price), the frequency of the original data remains unchanged.

Secondly, according to the changes of the two indicators, the economic cycle is divided. Since the above indicators are positive all the year round in China, the purpose of dividing the period cannot be achieved only by the absolute positive and negative of the indicators. This paper considers the relative strength of indicators to judge the period.

In terms of economic growth threshold, if the GDP growth rate during this period is higher than 6%, this paper believes that the economy is in a regime of good development, and if GDP growth rate is lower than 6%, it is considered that the economic growth rate is not up to standard. The reason for choosing the indicator of 6% is because the long-term growth rate of the Chinese economy is around 6% during the last 20 years (Lin et al., 2020), and the Chinese government often uses 6% as an important reference in its work goals. The People's Bank of China also proposed in its 2016 working paper that the potential economic growth rate of the Chinese economy is around 6%.

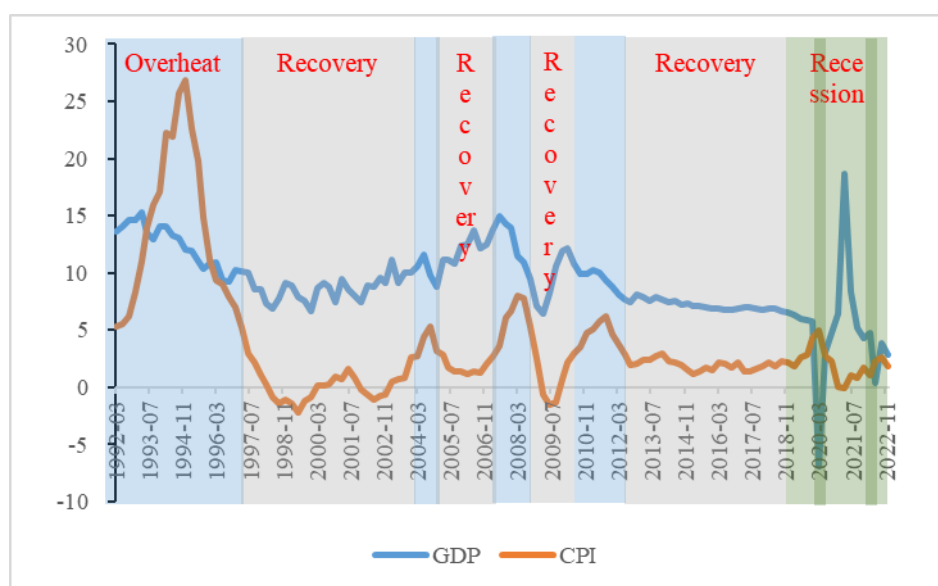
In terms of inflation and price threshold, this article believes that if the CPI during this period is higher than 3%, it is in the inflation regime, and if the CPI is lower than 3%, it is in the deflation regime. The reason for choosing the indicator of 3% is because in the annual work target of the Chinese government, 3% is an important dividing line. According to statistics, out of the 22 annual government work goals since 2000, 3% of the CPI targets have appeared 12 times.

That is, by comparing the relationship between GDP and 6%, as well as the relationship between CPI and 3%, we can obtain four quadrants. If the indicator exceeds the threshold, it is assigned as 1, indicating more than threshold, while the obtained value is negative, which is assigned as -1, indicating less than threshold. Therefore, we can use ordinal pairs, such as (+1,+1), to describe the economy and inflation during a period. When the first number represents the economic situation and the second number represents the inflation situation:

The frequency and proportion of each economic state of the Chinese market obtained according to the above method are shown in Figure 2, and the relationship with

the year-on-year ratio of GDP in the quarter and CPI is as follows:

**Figure 2: Regime Division in China Based on Quarterly GDP and CPI**



The analysis in Table 4 shows that, according to the definition of the method in this article, 65% of the time the Chinese economy is in a "recovery" state, 22% of the time is in an "overheat" state, and the frequency of the reception and stagflation states is relatively low. This is because Chinese economy has maintained a relatively high growth rate over the past 30 years, so in most cases, the economic growth rate has exceeded the threshold of 6%. In this situation, the frequency of two states, "overheat" and "recovery", is the highest. In terms of inflation, China experienced relatively severe inflation in the early 1990s and the financial crisis, while most of the other times it was in a "Goldilocks" state, resulting in the highest frequency of "recovery" states. Finally, due to the selection of quarterly data, this article avoids the problem of rapid cyclical changes to some extent.

**Table 4: Frequencies of Each Economic Regime**

	Recession	Recovery	Overheat	Stagflation
Frequency	6	39	13	2
Percentage	10%	65%	21.7%	3.3%

Considering that the assets include stocks, bonds, commodities and cash, this paper selects the following assets as representatives, namely, the Shanghai Shenzhen 300 (HS300) index represents stocks, the China Securities all bond index represents bonds, the South China composite index represents commodities, and the China Securities monetary fund index represents cash. Considering that this paper focuses on quarterly data, each index is averaged on a quarterly basis. Since each index has existed for a short time, the

part with data from 2007 to 2022 is taken as the research object of this section. The performance of each asset is shown in the figure below.

According to our division of economic cycles in the previous section, we can further analyze the changes in the yield of the above assets. First, the yield of various assets in each quarter can be calculated according to the index, and then the yield of each asset in each period can be averaged according to the period division, which can roughly describe the performance of each asset in different periods, as shown in Table 5 below:

***Table 5: Asset Performance in Each Economic Regime:***

Regimes	Stock	Bond	Cash	Commodity
Recession	-0.24%	<b>1.05%</b>	0.72%	-4.64%
Recovery	<b>2.31%</b>	0.82%	0.62%	1.88%
Overheat	0.85%	1.46%	0.50%	<b>3.80%</b>
Stagflation	<b>1.72%</b>	1.58%	0.77%	0.85%

Table 5 shows that the best performing asset during the “recession” period is Bond, the best performing asset during the “recovery” period is stock, the best performing asset during the “overheat” period is commodity, and the best performing asset during the stagflation period is also stock. Compared with traditional theory of Merrill Lynch Clock Model, we find that in addition to the relatively good performance of China's stock market during the stagflation period, the performance results of Chinese assets in other situations are basically consistent with theory.

Considering the reasons behind the phenomenon, this paper argues that, in the recession period, economic growth is slow, and lower commodity prices lead to lower inflation. At this time, the economic development is sluggish, and the central bank promotes economic development by reducing short-term interest rates. Therefore, bonds are the best investment assets. In the recovery period, the loose monetary policy of the central bank in the previous period continued to take effect, driving rapid economic growth. However, because the production capacity of the economy has not yet reached the maximum level, and there is idle capacity in the economy, the inflation level is still falling further. At this time, stocks are the best investment choice. During the period of economic overheating, economic growth slowed down, social capacity constraints became prominent, and inflation began to rise. At this time, although there is a certain profit growth in investing in stocks, a large number of bonds sold at this regime will lead to a reduction in the valuation of stocks, so commodities should be invested at this regime. In

the stagflation period, economic development is slow, but inflation continues to rise. At this regime, the stock return is low, and the optimal investment asset should be cash or bonds (Massimo et al., 2008). Table 5 summarize the different economic states and corresponding optimal investment assets proposed by regime-based asset allocation model in China.

## 4.2 Comparison Between China and the United States

In order to compare performance of the Chinese market with US, this paper uses the year-on-year (constant price) data of GDP in the current quarter and the year-on-year data of CPI of US. All data are from Fed and Bloomberg. The definition of each economic regime is similar with above Chinese approach. When CPI of US is higher than threshold of 2%, we consider the economy is under inflation. The reason why 2% of CPI is a threshold is that: Since the early 2000s, clear statements of FOMC participants' inflation preferences have become more common and specific. At a meeting in September 2006, Bernanke stated that he believed the consensus inflation target for 2000-2007 or 2008 was 1.5-2%, and by 2009, the consensus seemed to have risen to 2%. In January 2012, FOMC officially established a clear target of 2% in its announcement. Therefore, setting the inflation threshold to 2% is reasonable.

The frequency and relative proportion of each economic state of the U.S. market are obtained, as shown in Table 6.

*Table 6: Frequencies of Each Economic Regime of US*

	Recession	Recovery	Overheat	Stagflation
Frequency	34	42	22	26
Percentage	27.4%	33.87%	17.74%	20.97%

According to table 6, the frequency of recovery in the U.S. market is the most, its proportion is 33.9%; while the frequency of overheat is the least, its proportion is 17.7%. Compared with the Chinese market, the frequency of the four economic states is relatively average. This is mainly because the United States is a mature economy, and the economic growth fluctuates around the growth center, while China is an emerging economy, and the growth center moves down in a long cycle, which is also the main difference in the asset allocation models of China and the United States. Of course, the various regimes of economic development will occur in sequence, but when the cycles and frequencies of economic growth and inflation are different, there may also be cases where the economic state does not appear according to the theory, which may be caused by the superposition of

a variety of short-term factors. However, because we are concerned about the relationship between long-term economic development trends and asset allocation, the model also has a certain reference.

Considering the validity of data and the selection of indicators in previous studies, we use the quarterly average of the following four indicators to calculate the quarterly yield, which represents the quarterly yield of U.S. stocks, bonds, commodity and cash respectively.

This paper uses analysis of variance (ANOVA) to test whether there is a difference in the monthly average return of different economic states for different types of assets. Among them, the average monthly returns of stocks and cash are significant under the significance level of 99.9%; The monthly average yield of commodities is significant under the significance level of 99.5%; The monthly average yield of bonds is significant under the significance level of 90%. This shows that there are significant differences in the monthly average yield of the four assets in different economic states.

After calculation, the yield of different assets in the four regimes is shown in the table below. The black bold font indicates the yield of the asset with the highest yield in each economic state.

*Table 7: Asset Performance in Each Economic Regime in US*

Regimes	Stock	Bond	Cash	Commodity
Recession	<b>2.06%</b>	0.99%	0.38%	-1.0%
Recovery	<b>4.48%</b>	0.88%	0.28%	2.56%
Overheat	<b>4.10%</b>	1.03%	0.65%	1.50%
Stagflation	-0.59%	0.84%	<b>0.87%</b>	0.24%

Compared with traditional theories. During the period from 1992 to 2022, the asset with the highest yield during the recession is Stock, and the assets with the lowest return are commodities. However, the theoretical highest return of asset of Merrill Lynch Clock model should be Bond. In the recovery period, the asset with the highest yield is stocks, which is in line with the prediction of Merrill Lynch clock model. During the period of economic overheating, the asset with the highest yield is also stocks, while according to Merrill Lynch clock model, the asset with the highest yield should be commodities. During the stagflation period, the asset with the highest yield is cash, which is also in line with the highest asset predicted by Merrill Lynch clock model. Therefore, the actual situation in the recovery and stagflation period is in line with the prediction of the traditional theoretical

model, and the assets with the highest yield in other economic states are different from the theoretical model.

The asset allocation model of this paper is different from the traditional regime-based asset allocation model of Merrill Lynch to some extent. The main difference is that the returns on cash and commodities are relatively low, while the returns on stocks are significantly higher.

The reason may be that the decline of inflation leads to the failure of the traditional economic state model (Bae et al., 2014). Since the sub-prime mortgage crisis in 2008, the global monetary overspread has led to a flood of liquidity. In the period of abundant liquidity, the importance of inflation on the economy has declined. In the economic state model, economic growth and inflation are the most important prediction indicators. When the status of inflation declines, the effectiveness of the economic state model is also challenged.

In addition, the less and less obvious economic cyclical fluctuations may also be an important reason for the failure of the economic regime model. Looking at the output gap data of the United States since 1950, the output gap of the United States has shown a fluctuating downward trend in the long term, which is not in line with the cyclical rise and fall of the economy proposed in the economic state model. It is generally believed that the more and more gentle economic cycle is related to the liquidity released by the central bank. Now the adjustment mechanism of the global central bank, especially the mechanism of using money to adjust, is becoming stronger and stronger. Many times, it is very successful to adjust the economic cycle through the release of liquidity. Therefore, the fluctuation of the economic cycle is becoming more and more gentle, resulting in less and less impact of the economic cycle on Asset Pricing (Massimo et al., 2007).

That is to say, when the economy is in a state of low inflation and declining growth rate for a long time, the era of low interest rates also comes. Just like the quantitative easing era in the United States after 2008, the volatility of holding cash and fixed income assets is relatively low, and the coupon is also close to zero, resulting in sustained low yields for Cash and Commodities after financial crisis. In the context of low inflation and rampant liquidity, the US stock market has consistently performed well, making stocks the optimal choice for most economic conditions, especially in period after financial crisis.

Comparing the situation of China and the United States with the traditional Merrill Lynch clock model, we can find that the conclusion of the optimal choice of Chinese market is consistent with the conclusion of US in the period of recovery. In the recovery period, stocks performed better than bonds and bonds performed better than cash, both in line with the situation in the United States, but commodities performed slightly worse than stocks and better than bonds, which is inconsistent with theory. During the recession period, the performance of all assets conforms to the research conclusion of Merrill Lynch model in China, however, the tests of US in recent years is different overall. In the overheat period, the performance of commodities is better than that of cash, which is in line with the theory. In the stagflation period, commodities perform better than cash, which is in line with the theory, but stocks perform better than other three categories of assets, which is inconsistent with the theory.

### **4.3 Monthly Data Based on Industrial Added Value/CPI**

Due to data limitations, research based on GDP can only be conducted at the quarterly level. In US research, when dividing the US economic cycle, researchers usually use the output gap to describe economic growth, and CPI index to describe the level of inflation. Different from the situation in the United States, China has no unified index to measure the economic output gap. In order to conduct more frequent research to support the previous research conclusions and refer to the definition of output gap, this article uses monthly Industrial Value Added (IAV) data to represent economic growth. The threshold for dividing economic states in this part is similar to the quarterly data using GDP in the previous section: if the growth rate of industrial added value (IAV) is greater than 6%, it is considered that the economic growth rate is higher, and vice versa, it is lower; If the inflation indicator CPI growth rate is greater than 3%, it is considered that there is inflation, otherwise there is no inflation.

After summing up the duration of the above different economic regimes with simple statistics, we can observe the proportion of each economic regime in the total economic cycle. The results show that the year-on-year growth rate of industrial growth value in the current month and the year-on-year growth rate of CPI in the current month adjusted by HP filter method are two-dimensional indicators.

The frequency of each economic regime in China is similar to the results obtained by using the GDP-CPI index. The recovery period still has the highest frequency of occurrence, accounting for 45.95%, while the stagflation period only accounts for 4.32%,

as the lowest proportion. The overheating period accounts for 25.95%, and the recession period accounts for 23.78%.

Therefore, this paper believes that the economic cycle divided by the above method is basically effective and is basically similar to the situation of Merrill Lynch clock model.

**Table 8: Asset Allocation Model Based on IAV/CPI (Monthly Data)**

	Frequency	Stock	Bond	Cash	Commodity
Overheating	25.95%	0.44%	0.18%	0.10%	<b>0.52%</b>
Stagflation	4.32%	<b>0.50%</b>	0.25%	0.14%	0.43%
Recovery	45.95%	<b>0.38%</b>	0.13%	0.12%	0.34%
Recession	23.78%	-0.46%	<b>0.24%</b>	0.12%	-0.63%

By observing Table 8, we can find that in the recovery phase of the economic regime, the major asset category with the highest return rate is stocks. Its average monthly return rate reaches 0.38%; The asset class with the second-highest yield is commodities, with an average monthly return of 0.34%. In contrast, the average returns on bonds and cash are relatively low, at 0.13% and 0.12%, respectively. It can be seen that stocks are the optimal investment during the economic recovery regime.

In the overheating regime of the business cycle, commodities are the assets with the highest yield. Its average monthly yield reached 0.52%. Next is stock, with an average monthly return of 0.44%. The average returns on bonds and cash are relatively close, at 0.18% and 0.10%, respectively. It can be seen that stock and commodity are still the main investment targets during the overheating regime of the economy. Besides, the return on commodities is better.

In the stagflation regime of the business cycle, the average return of the four types of assets is different, and the average monthly return of bonds and cash are relatively stable, 0.25% and 0.14% respectively. It can be seen that bond and cash have strong stability. But similar to the previous text, the average return on stocks is 0.50%, becoming the dominant investment target during the stagflation regime.

In the recession phase of the business cycle, the average return rate of stock and commodity showed significant negative growth, respectively -0.46% and -0.63%. In contrast, bond yield better than cash, with an average monthly return rate of 0.24%. It can be seen that, in economic recession, bond is the main hedging investment target.

To test whether the return rates of the four categories of assets calculated in Table 8 have significant differences in different regimes of the economic cycle, this paper uses the one-way analysis of variance (ANOVA test) to test them respectively. The test results show that most of the return rates of assets are significantly different in different economic cycles. The statistical value of F of bond is 6.20, which is greater than that of F in  $\alpha=0.01$ . The critical value under the condition of 0.01 is 4.87 and the p value is less than 0.01. Therefore, it can be considered that different regimes of the economic cycle have a significant impact on the yield of bond at the 99% confidence level. The statistical value of F of stock is 2.05, which is less than that of F in  $\alpha=0.05$ , whose critical value under the condition is 3.07 and the p value is greater than 0.05, so it can be considered that different regimes of the economic cycle have no significant impact on the yield of bond. The statistical value of F of commodity is 5.23, which is greater than that of F in  $\alpha=0.01$ . The critical value under the condition of 0.01 is 4.94 and the p value of 0.0079 is less than 0.01. Therefore, it can be considered that different regimes of the economic cycle have a significant impact on the yield of commodity at the 99% confidence level. The statistical value of F of cash is 1.05, which is less than that of F in  $\alpha=0.05$ . The critical value under the condition of 0.05 is 2.99 and the p value of 0.3895 is greater than 0.05. Therefore, it can be considered that different regimes of the economic cycle have no significant impact on the yield of cash.

#### **4.4 Re-Estimate Based on Comprehensive PMI/CPI**

PMI is an index summarized through the monthly survey of purchasing managers, which more closely reflects the changing trend of capacity utilization and confidence in economic development. At the same time, PMI is a comprehensive economic monitoring index system released monthly, which is divided into manufacturing PMI and service PMI, and its calculation formula is:  $PMI = \text{order} \times 30\% + \text{production} \times 25\% + \text{employees} \times 20\% + \text{delivery} \times 15\% + \text{inventory} \times 10\%$ . Therefore, it conforms to the regime-based asset allocation model in terms of its comprehensiveness, predictability and timeliness. In terms of data analysis, the manufacturing PMI and service PMI are combined to form a comprehensive PMI. The combination method is: comprehensive PMI = 50% manufacturing PMI index + 50% service PMI index. HP Filtering Method (setting) is also adopted  $\lambda=12$ ) filtering out its seasonal characteristics and the impact of economic fluctuations, we get the data of the comprehensive PMI index excluding economic fluctuations.

In terms of threshold setting, if the PMI is greater than 50, it is considered that the economy is in a growth regime, while if the CPI is higher than 3%, it is considered that there is inflation.

Similarly, the return rates of four representative indexes at different regimes of the new economic cycle described by PMI are calculated by calculating the return rates of four major categories of assets in this chapter. The results are shown in Table 9:

**Table 9: Asset Allocation Based on Comprehensive PMI/CPI (Monthly)**

	Frequency	Stock	Bond	Cash	Commodity
Overheating	25.95%	0.16%	0.14%	0.18%	<b>0.23%</b>
Stagflation	4.32%	<b>0.50%</b>	0.25%	0.14%	0.43%
Recovery	52.97%	<b>0.54%</b>	0.31%	0.11%	0.36%
Recession	16.76%	-0.28%	<b>0.26%</b>	0.10%	-0.72%

The recovery regime accounts for almost 53% of all economic regimes, and the average yield of stock ranks first in this regime, with average monthly return of 0.54%, followed by a commodity, with an average monthly yield of 0.36%. In contrast, the yield of bonds and cash is lower than commodities and stock. Therefore, at this regime, we should hold stock to obtain high returns.

In the overheated regime of the economic cycle, which accounts for about 26% of all economic regimes, commodity leads the rest of 3 categories of assets with 0.23% monthly return. The second place is stock, with an average yield of 0.16%. In contrast, the yields of bonds and cash are relatively close. Therefore, at this regime, we should switch to hold commodities to obtain higher returns.

In the recession regime of the economic cycle, the average yield of stock and commodity decreased significantly compared with the previous overheating and recovery regime, which are -0.28% and -0.72% respectively. The average yield of bonds is the highest, with average monthly yield of 0.26%. thus, in this economic regime, we should switch to hold bonds to obtain stable returns.

In the stagflation regime of the economic cycle, which accounts for only 4.32% of all economic regimes, the average yield of stock and commodity are 0.50% and 0.43% respectively. In contrast, the average yield of bonds is 0.25%. Therefore, at this regime, we should still hold stock to gain more yield. This result is different from traditional asset allocation theory, however, similar to the results of IAV-CPI asset allocation model of 4.3,

stagflation regime only accounts for 4% of the whole economic cycle in the past 20 years in China. Thus, we consider that there may have some representativeness bias in this regime.

In terms of the effectiveness test of the matching degree between the regime-based asset allocation model and China's capital market, this paper first tests the matching degree and difference of the asset allocation model under the Chinese economic cycle divided by the traditional two-dimensional indicators of the year-on-year growth rate of industrial added value in the current month and the year-on-year growth rate of CPI in the current month under the usual research method. The test results show that under this economic cycle, the return rate of major categories of assets in China's capital market conforms to the conclusion that the optimal investment strategy at different economic regimes elaborated by the regime-based asset allocation model in the recession (Bond), recovery (Stock) and overheating (Commodity) regime of the economic cycle. In addition, in terms of differences, the test results show that different regimes of the economic cycle have a significant impact on the yields of bonds and commodity. Therefore, we argue that the main asset chosen by the model of this paper is similar to the results of Merrill Lynch model in the US.

Then, this paper tests that whether there are significant differences between models of PMI-CPI and IAV-CPI. The new economic regime is divided by the comprehensive PMI index and the comprehensive CPI index as two-dimensional indicators after optimizing the usual research methods, applied to China's capital market. The test results show that under this economic cycle, the return rate of major assets in China's capital market conforms to the conclusion of optimal investment strategies in different economic regimes elaborated by the regime-based asset allocation model in the recession regime, recovery regime and overheating regime of the economic cycle. In addition, in terms of differences, the results show that different regimes of the new economic cycle have a significant impact on the return rates of stock and commodity. At the same time, there are significant differences in the return rates of four categories of assets in the recession and recovery regimes of the new economic cycle.

## **5. Prediction of Economic Regime and Construction of Asset Portfolio Based on the Predicted Economic State**

In the part of the results of China and the United States, this paper has pointed out that the research method based on economic status uses the growth rate of China's

industrial added value (IAV) or the PMI and CPI as dimensional indicators to divide the economic cycle. This group of indicators are common indicators of China's economy and have been commonly used by other scholars.

However, those economic indicators still have deficiency. Through analysis, it can be found that indicators of commonly used Merrill Lynch models such as OECD output gap index, which measures the economic output of the United States, is a reflection of economic expectation and economic confidence. Which means, those indicators used to measure economic output in the US need to be timely and predictable and indicators that describe the level of inflation need to be balanced and deterministic, which is usually a presentation of general economic results. However, In China, the growth rate of industrial added value or growth of GDP are the results of economic growth in a specific period of time than the growth expectations. Therefore, compared with Merrill Lynch's research methods, these two groups of indicators are slightly insufficient in describing economic growth expectations, so they are not quite suitable for predicting the turning point of the economic cycle.

To sum up, the asset allocation model based on economic regime has two significant defects: first, due to the inability to obtain economic data for the current period, we can only use data that lags for one or more periods to characterize the indicators for the current period. For example, when we need to study asset allocation in January 2022, we are unable to obtain economic data for January in advance (the Bureau of Statistics release the data for January in Feb). Therefore, we have to use lagged data of December and even November 2021 to represent economic regime of Jan 2022 (this is because the December data release date is also after January 15th), resulting in too much data lag. Therefore, the model assumes that the economic state has continuity and does not change between the two periods. However, with the macroeconomy adjust to the potential hub, the cyclical economic fluctuations have accelerated significantly, and the recent COVID-19 has exacerbated the fluctuations. In this case, using the comprehensive PMI/CPI data of the previous period to represent the current economic state may ignore the transformation of economic state, especially in the period of rapid transformation of economic state. For example, the PMI rose to 51 and CPI also rose to 3.2 in Jan 2020, indicating that the economy is entering an overheating state. If the asset allocation model lags behind, the commodities should be allocated according to overheating in February 2020, but in fact, the impact of COVID-19 in February makes the PMI quickly move down, and the economy switches from overheating to stagflation. At this time, the allocation of

commodities according to models with lagged data will cause huge losses, If the model can predict that the economic state will be switched in February and allocate cash according to the stagflation state after switching, this loss can be avoided.

Second, due to the imperfect statistical system in China, the statistical data are actually lagged behind. For example, China's CPI data is generally released on the 10th of next month, while the industrial added value data is released before the 15th of next month. As a result, the asset allocation decision in February can only be made after the 15th, when the market transaction in February has been more than half. Therefore, strictly speaking, the asset allocation model used above actually has statistical fallacies.

### 5.1 Setting of M-Logit Model

Therefore, a possible improvement is to predict the current economic state according to the existing historical data, and then select the asset category according to the predicted economic state. This paper uses a simple regression model to predict the economic state of the next period.

The explanatory variable "economic regime" in this paper is classified variable. In statistical measurement methods, logistic regression model is a typical classified variable model. "Economic regime" has four states: overheating, recession, recovery and stagflation, and each state is mutually exclusive. Therefore, this paper adopts a disordered multiple logistic model, that is, M-logit model. M-logit model is another natural continuation of Logit model, which takes one of the results of multi category variables as the reference result, and compares it with other results in pairs, which is equivalent to transforming multi category regression into logit regression of n-1 binary variables for regression. In order to calculate the regression model, it is assumed that:

$$Regime_i = \alpha + \sum_{i=1}^n \beta_i x_i + e_i \quad (\text{Formula 5.1.1})$$

In the above formula 5.1.1, regime is the basis for decision-making, regime is 0, which means the economic state is overheating, regime is 1, which means the economic state is recession, regime is 2, which means the economic state is recovery, regime is 3, which means the economic state is stagflation. X is the variable of each sample, where  $i=1,2,3 \dots n$ . Beta is the parameter corresponding to each variable, e is the random error term that obeys the standard normal distribution, and the influence of X on the economic state is

determined by the following formula:

$$\begin{aligned} P(\text{regime}_i = j | x_i) &= P(\text{regime}_i = \alpha_j + \beta_{ji}x_i + e_{ji} > 0) = P(e_{ji} \leq \alpha_j + \beta_{ji}x_i) \\ &= F(e_{ji} = \alpha_j + \beta_{ji}x_i) \end{aligned} \quad (\text{Formula 5.1.2})$$

Logistic distribution function is:

$$P(\text{Regime}_i = j | x_i) = \frac{e^{\sum_{i=1}^n \beta_{ji}x_i + e_i}}{1 + \sum_{j=1}^{J-1} e^{\sum_{i=1}^n \beta_{ji}x_i}} \quad (\text{Formula 5.1.3})$$

The above equation 5.1.3 shows  $P(\text{Regime}_i = j)$ , where  $j=0,1,2,3$ . There are two footnotes of parameter beta in the model: J and I, where j is to distinguish the category of the explained variable and I is to distinguish the independent variable x. Footnote J shows that now there is another J-1 group of beta estimates, that is, the number of parameter estimates is (J-1) M. When  $\alpha_j + \beta_{ji}x_i$  tends to infinity,  $P(\text{Regime}_i = j | x_i)$  infinity is close to 1, on the contrary, when  $\alpha_j + \beta_{ji}x_i$  is infinitesimal,  $P(\text{Regime}_i = j | x_i)$  is close to 0.

When regime=0 is taken as the reference group, the logistic regression model is:

$$\ln\left(\frac{P(\text{regime}_i > j)}{P(\text{regime}_i \leq j)}\right) = \ln(\text{odds}_{\text{regime}_i}) = \alpha_j + \sum_{i=1}^n \beta_{ji}x_i \quad (\text{Formula 5.1.4})$$

$P(\text{Regime}_i = j)$  is the probability of occurrence of various economic state. Odds is the ratio of the probability of occurrence of events to the probability of events which do not occur, which can be called occurrence ratio or probability ratio, and log (odds) is called occurrence ratio.

## 5.2 Variables to Predict Economic Regimes.

(1) Dependent variable (Regime): the explained variable in this paper is the economic regime of period T (Regime). Regime has four values: Regime is 0, which means the economic state is overheating, regime is 1, which means the economic state is recession, regime is 2, which means the economic state is recovery, regime is 3, which means the economic state is stagflation.

(2) Main independent variable Regime\_1: The one-period lagged economic regime (Regime\_1) is the core independent variable, which means that, the transformation process between economic regimes can be predicted. The research conducted by Shi et al. (2007)

found that China's economic status is relatively stable, and that the economic regime of the next period has a strong correlation with the current period. This conclusion is also consistent with the preliminary results of this paper. That is to say, we can predict the regime of current period (Regime) using the regime of lagged period (Regime\_1)

(3) Control variables: As for the control variables, we do not know in advance which indicator will be contained in the optimal combination of leading indicators. Therefore, we choose as many potential leading indicators as possible when conducting modeling experiments. In order to balance the high-intensity calculation and global optimization, this paper adapts some methods to reduce the number of modeling experiments. The continuous elimination method used by Birchenhall et al. (1999) is a good method.

Finally, this paper utilizes 7 control variables with a lag of one period to predict the economic regime, which are respectively one-period lagged CPI (CPI\_1), one period lagged PMI (PMI\_1), one period lagged (M2\_1), one-period lagged growth rate of fixed-asset investment (INV\_1), one-period lagged growth rate of social retail consumption growth (CONSUM\_1), one-period lagged growth rate of export growth (EXP\_1) and one period lagged SHIBOR (SHIBOR\_1) representing the financing tension. That is to say, these indicators are X in formula 5.1.1.

Thus, the function of this paper is:

$$Regime_t = \alpha + \beta_1 Regime_{t-1} + \beta_2 CPI_{t-1} + \beta_3 PMI_{t-1} + \beta_4 M2_{t-1} + \beta_5 INV_{t-1} + \beta_6 CONSUM_{t-1} + \beta_7 EXP_{t-1} + \beta_8 SHIBOR_{t-1} + \varepsilon_t \quad (\text{Formula 5.2.1})$$

### 5.3 Regression Model and Results

As illustrated in table 10, R2 of M-logit model is 0.755, which means this model can predict the future economic state. Among them, the significant variables are one-period lagged Regime (REGIME\_1), cpi, PMI, INV. For example, the coefficient of the Regime\_1 is 0.912, which is significant at the 5% level, indicating that the economic status of period t-1 is highly correlated with that of period t. On the whole, it can be seen from the overall trend of the model that the model can predict the change of economic state to a certain extent.

**Table 10: Regression Results of Logit Model (Formula 5.2.1)**

Tips: (1) Dependent variable is regime of time t.

(2) Regime\_1 is lagged one period regime.

(3) The regression model of (1) is logit model with control variables.

(4) \*\*\*, \*\*, \* represents significant level of 1%, 5%, 10%.

VARIABLES	(1) regime
Regime_1	0.912** (2.02)
CPI_1	-1.726*** (-3.59)
PMI_1	-0.855*** (-2.79)
M2_1	0.254 (1.30)
INV_1	-0.235* (-1.69)
CONSUM_1	0.269* (1.76)
EXP_1	-0.016 (-0.46)
SHIBOR_1	-0.315 (-0.61)
Constant	47.385*** (3.04)
R2	0.755
N	185

Figure 3 shows the actual economic state and the economic state predicted based on the M-logit model of formula 5.2.1. From figure 3, we can find that the only deficiency of this model is that there is a certain error in the prediction at the break point. In addition, due to the uncertainty of the impact of COVID-19 after 2020, the prediction after 2020 has a certain error.

**Figure 3: Actual Economic Regime and Forecast Economic Regime of M-Logit Model**

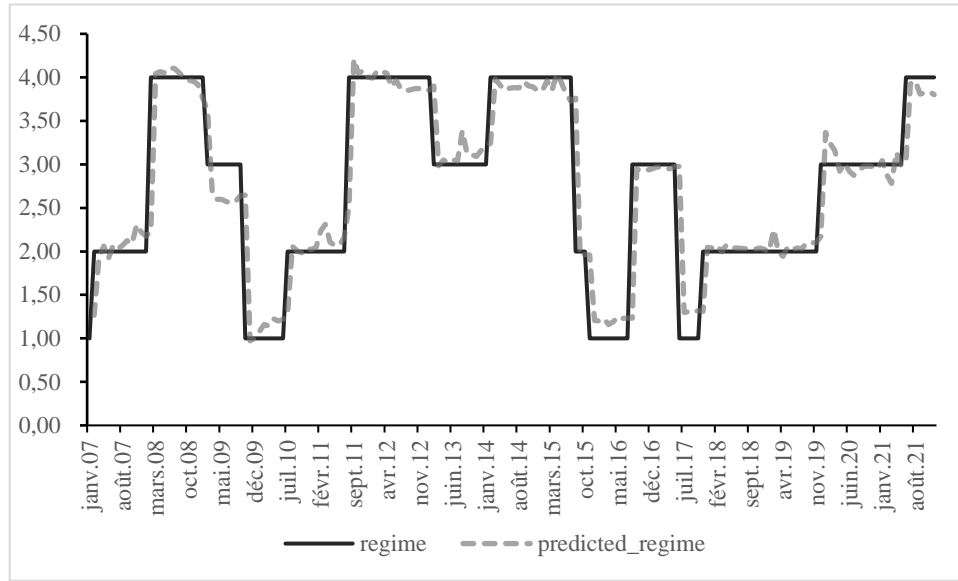


Table 11 and table 12 represent the results of the asset allocation model that defines the state according to the prediction model and the asset allocation model that defines the economic state according to the original standard respectively. It should be noted that this table reports the holding period return rate of various assets in each economic state from 2007 to 2022, that is, the product of the asset return rate in each month in this state. For example, in the 24 months of overheating, the stock yield is 0.87, which means that the holding period yield of holding the CSI 300 stock index in these 24 months is -13%, and so on. According to the results of the table, we should hold commodities in the overheated state, stocks in the stagflation regime, stocks in the recovery regime and bonds in the recession regime. According to this result, the holding period yield from 2007 to 2022 is 525%. According to the original strategy of PMI and CPI, the return on holding period is 438%. Therefore, it can be considered that after HP Filtering, regime-based allocation based on the predicted M-logit model is relatively better than original regime-based asset allocation model.

**Table 11 Asset Allocation Model Based on Predicted Regime.**

Predicted_regime	Stock	Bond	Commodity	Shibor
Overheating	0.87	1.07	1.54	1.05
Stagflation	2.14	1.17	1.44	1.13
Recovery	1.61	1.15	1.51	1.11
recession	0.70	1.18	0.48	1.15

*Table 12 Asset Allocation Model Based on Original (Unpredicted) Economic State*

Regime	Stock	Bond	Commodity	Shibor
Overheating	2.01	1.16	2.03	1.11
Stagflation	0.71	1.14	1.06	1.12
Recovery	2.05	1.13	0.96	1.11
recession	0.91	1.13	0.76	1.11

## 6. Conclusion

Through the test of China's economic data, this paper confirms that China's economy does have a very obvious cyclical phenomenon, and there are representative categories of assets with outstanding yield in different regimes of the economic cycle. However, some results of this paper is different from the traditional research based on the markets of developed countries, so the traditional model may not be completely applicable to China's capital market. Compared with the United States, China is still in the developing regime, that is, there is still a gap between China and the United States in terms of capital market maturity, comprehensive national strength and capital internationalization. Therefore, applying an investment strategy summarized in the mature capital market to the developing capital market is bound to be too harsh and pursue its perfect match. The practical significance of the optimal investment strategy of the regime-based asset allocation model in this paper is far greater than the framework conclusion of its original theory.

In addition to using the traditional GDP/CPI model and the industrial added value /CPI model to define the economic state, the Chinese economic cycle divided by the comprehensive PMI index and CPI index is more suitable to be used as the "localization" economic cycle to apply the economic state theory to the Chinese capital market. This conclusion can be applied to the Chinese capital market. The timeliness of the comprehensive PMI index and the comprehensive CPI index has a certain reference value for investors in determining the regime of the current economic cycle. At the same time, after determining the regime of the economic cycle, this paper combines the idea of optimal investment strategy in traditional research, allocate bonds in the regime of economic recession in China, allocate stock or appropriately allocate commodities in the regime of China's economic recovery and overheating and allocate cash in the stagflation regime of China's economy to improve the overall return on investment.

Whether in terms of the degree of matching with the research results based on the United States and the support of statistical significance, or in terms of the growth of the

total net value of the optimal investment strategy, the test results of taking the comprehensive PMI index and the comprehensive CPI index as the two-dimensional data of the economic cycle are better than the test results of taking the growth rate of industrial growth value or the growth rate of GDP and CPI as the two-dimensional data of the economic cycle.

However, due to the time lag and inaccuracy of the traditional model, this paper also uses M-logit model to predict the economic state and its transformation. The asset allocation model based on M-logit model not only has high prediction accuracy, but also can obtain excess returns compared with the traditional model.

To sum up, this paper has the following conclusions: Firstly, at this regime, there is still room for improvement in the effectiveness of the two-dimensional indicators used to divide the economic cycle based on the year-on-year growth rate of industrial growth value in the current month and the year-on-year growth rate of CPI in the current month (especially in the effectiveness of matching the original theory of the regime-based asset allocation model) in China's capital market. The asset allocation model based on M-logit prediction can effectively improve this problem. Secondly, at this regime, whether compared with the traditional division of economic cycles based on the year-on-year growth rate of industrial added value and the year-on-year growth rate of China's CPI, or the division of economic cycles based on the leading indicators and lagging indicators of macroeconomic prosperity index, The economic cycle divided by the comprehensive PMI index and the comprehensive CPI index is more suitable as a "localized" economic cycle to apply the regime-based asset allocation model to the actual investment in China's capital market, that is, this paper is effective to optimize the effectiveness of asset allocation model based on economic regime in China's capital market through the above methods.

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