

Consumer Industry in this Turn's Monetary Policy: Evidence from Necessity and Non-Necessity Goods in US

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Abstract. The US Federal Reserve's interest rates have been acting as main factors that influence the economy, especially the consumers' consumption aspect of the market, since its very beginning. This paper researches the impact of Federal Reserve's interest rates hike on the consumption goods market. While the scale of the consumption goods market as a whole has too many niche industries that does not necessarily affect the common consumers, and there are too many factors to control for. Necessity goods market and non-necessity goods market data from the S&P 500 Index are chosen to be the dependent variables to represent the research purpose. On the other hand, Federal Reserve's interest rates consists multiple variables and they all have different effects on the economy, the exchange rate between US dollars and Chinese RMB is chosen to be the independent variable in this research for its stability and strong link to the interest rates change. This paper uses VAR model and ARMA-GARCH Model to estimate such impact. The result shows that the effects of Federal Reserve's interest rates hike on necessity goods and non-necessity goods are overall negative effects. In particular, the interest rates hike affects non-necessity goods market way more than it affects the necessity goods market.

Keywords: Consumer Industry; Monetary Policy; VAR model; ARMA-GARCH Model.

1. Introduction

The Federal Reserve System is, the main financial arrangement of America [1]. Its responsibility is to maintain the financial system and ensure financial security to operate stabliy. It was set for performing the duties of United Sates central bank. Besides, it includes CreditUnion, Savings and Loans Association and branch banks. Also, it affects the federal funds rate by operating the public market.

In America, the government subsidizes rate is the loan cost that store foundations loan hold adjusts to other safe organizations short-period on a not guaranteed premise [2]. Save adjusts are sums held at the Federal Reserve to keep up with storehouse organizations' hold necessities. Organizations with excess adjusts in their records loan those adjusts to foundations needing bigger equilibriums [3]. The government subsidizes rate is a significant benchmark in monetary business sectors [4].

Financial arrangement of The United States concerns those approaches connected with the stamping and printing of cash, strategies overseeing the legitimate trade of cash, request stores, the cash supply, and so forth. In America, The Federal Reserve System, casually known as "The Fed" is the financial power [5].

The Federal Reserve's leading body of lead representatives, alongside the Open Market Committee are the guideline authorities of money-related strategy in the United States, however the U.S. is special in that the money-related strategy job is at last shared alongside the United States Treasury [6, 7]. The Treasury is the penultimate organization on financial arrangement; however, it is straightforwardly associated with money related approach through printing and stamping central bank notes and fortunes [8].

Rate Hikes are a kind of close financial strategy, and the Fed answers the ongoing economy by raising loan fees. A general financing cost climb can raise bank loan fees, subsequently diminishing

the cash supply, and the dollar will appreciate. Likewise, the financing cost climb will build the dollar swapping scale will affect the economy, for instance, after the dollar appreciates, the cost of gold will fall, and everybody is more ready to hold the dollar; The monetary standards of different nations will deteriorate, and so on.

Powered by monstrous financial and money related upgrade, the U.S. economy has recuperated quickly from the downturn brought about by the pandemic. The U.S. economy shrank by 3.4 percent in 2020 and kept 5.6 percent development in 2021. As indicated by the International Monetary Fund's January 2022 gauge, the U.S. economy is as yet expected to develop by 4.0% in 2022. From one perspective, on the grounds that the monetary development rate is essentially higher than the potential development rate. Then again, in light of the fact that homegrown utilization recuperates quicker than the creation recuperation, the US expansion rate keeps on increasing. In February 2022, the U.S. CPI developed at a year-on-year pace of 7.9 percent, a 40-year high, and the center CPI, barring food and energy costs, developed at 6.4 percent year-on-year, a record high beginning around 1982. In February 2022, the U.S. joblessness rate tumbled to 3.8 percent [9]. Under the reason areas of strength for of, high expansion, serious work market, Fed needs to increment loan fees.

The rest of this paper will be organized as follows: Part 2 is the Literature Review, Part 3&4 is Researches, Part 5 is Discussion and part 6 is the conclusion.

2. Literature Review

2.1 Federal Reserve

The Federal Reserve, as the central bank of the United States, controls the whole country's money supply and supervises all the depository institutions. All the commercial banks will report their incoming and outgoing, loans and saving, etc. to the Fed. It is important to note that the Federal Reserve cannot be regarded as one of the government's branches, it is a quasi-governmental Institution [10].

2.2 History of the Federal Reserve and its Model

The Fed has gone through many leaders since its inception. Their performance has been mixed, with some contributing to good economic growth and others making policies that may have indirectly contributed to the recession. The goal of monetary policymakers is stable and non-inflationary growth all the time. Looking back on positive leadership, Chairman William McChesney Martin in the 1950s and early 1960s and Chairman Alan Greenspan in the late 1980s and later led to decades of low inflation and moderate real volatility. Instead, in the late 1930s, under the leadership of Marriner Eccles, the Fed triggered a major recession that led to severe deflation [11].

Since its establishment, the Federal Reserve has created many models to analyze micro - and macro-economic conditions and applied the knowledge of econometrics to help formulate good policy. The first Fed model was the MPS, and the theory of this model was the IS/LM and the Phillips curve. In terms of monetary policy, the model contains three main channels of transmission: The cost and investment of capital, non-human wealth and consumption, and housing construction and credit rationing. These channels all work through interest rates. After the exchange rate crisis, the leaders realized that the model was limited to a single country and that there was less of an economic development equation that represented foreign countries. Because of the aforementioned singularities, the second Fed model, MCM, is widely used in international capital flows and bilateral trade flows in combination with the long-run neoclassical growth model based on MPS theory. The model that is emerging in this ongoing refinement is the model FRB/WORLD, which provides the explicit specification of expectation formation and intertemporal decision making, and which is subsequently being compared to the VARs model. The measurement and results of these two models are similar and have their own characteristics [12]. The specialties of VAR and ARMA-GARCH models are the expected duration of the period, usage distribution, and standard deviation [13].

The research conducted in this paper will also measure the impact of benchmark interest rates on necessities and non-necessities based on the VAR model combined with the ARMA-GARCH model.

2.3 Monetary Policy and its Influence to the Market

In order to promote price level stability and sustainable employment, the Fed's good monetary policy is essential.

As the currency of global banks, the dollar influences the cost of financing and the financial cycle around the world. Thus, the Fed influences the pricing of dollar assets by setting monetary policy to change the exchange rate or change the type of investors in international asset markets. Domestically, contractionary monetary policy controls the money supply, raising interest rates and reducing economic activity. As unemployment rose sharply, production and capacity utilization fell, and the stock market fell, household economies deteriorated. At the same time, monetary tightening in the United States will also affect international markets, and global risk asset prices will contract [14].

By affecting interest rates, all kinds of spending are affected, such as business spending, household spending on consumer goods, and residential investment. Increasing the nominal federal funds rate would raise the funds rate and push up bond rates. This means that monetary policy stimulates or slows aggregate spending and demand in the short run. And inflation is the embodiment of the impact in the long run [15]. At the same time, interest rate changes have a more elastic impact on young people's consumption, which means that they have a greater impact on non-daily necessities because price changes immediately reflect consumer demand for non-daily necessities [16].

2.4 Existing research on different types of consumption

Monetary policy influences the consumption of durable and nondurable things. One study used the VAR model to analyze the response of durable goods and non-durable goods to shocks under the condition of optimal policies. The analysis concludes that factors specific to durable goods explain the corresponding magnitude of the industry output gap. The demand for durable goods is the demand for inventory, and changes in inventory demand make the demand for new products more volatile. Durable goods are sensitive to real interest rates and are prone to large output gaps. A rise in real interest rates is associated with an elastic price equilibrium. From the perspective of wages and prices, the real interest rate required to stabilize price inflation is sharply reduced, which makes households expect capital gains on durable goods, and the inventory demand for durable goods is greatly increased, leading to a production boom. High output gap fluctuations in durable goods and associated wage differentials account for the large losses in durable goods [17].

Monetary policy influences the consumption of renewable and nonrenewable energy. One study used the ARDL model to analyze the asymmetric impact of monetary policy on energy consumption under uncertainty. This uncertainty has a negative impact on renewable energy consumption both in the short and long run but has no significant negative impact on non-renewable energy consumption. Furthermore, decreasing the degree of uncertainty can give a positive influence on nonrenewable energy consumption. However, research indicated that the direction and magnitude induced by the monetary policy are not stable [18].

Monetary policy has different effects on a family's consumption in different situations, such as in families with different amounts of debt and different incomes. As interest rates adjust, monthly payments fall, freeing up money for indebted households and increasing balances, according to the study on household loans and balances and spending. The consumer response of households is tempered by their desire to voluntarily deleverage. Low-income households also exhibit a higher marginal propensity to consume and less deleveraging. Those who can't get credit because of poor credit histories tend to spend less on durable goods and are slower to pay down debt. The importance of credit constraints in shaping household consumption and saving decisions and revealing a negative correlation between the two. The model concludes that if all mortgage rates in the US were adjustable, a change in the federal funds rate would have a significantly larger impact on consumer spending. Lowering interest rates or monthly payments can help ease cash flow and liquidity constraints [19].

In the previous research, there are few research on household consumption, some of which are in the following directions: the influence of household consumption level, the influence of durable goods and non-durable goods, etc., while there is almost no research on necessities and non-necessities. At the same time, we will focus on whether the total impact of non-essential plus necessities is positive or negative, which will also help us to more carefully target and solve the problem when formulating future policies.

This paper will include the following sections: Section 3 will use the model to measure the positive and negative effects of the exchange rate increase on consumption necessities and non-necessities. Section 4 will describe and analyze the experiment. Section 5 discusses the research. Section 6 summarizes the whole article and research.

3. Research Design

3.1 Data sources

Considering the long-term stability of the RMB exchange rate, this paper chose the USD/RMB exchange rate to reflect the Federal Reserve's interest rate hike. In this paper, the S&P 500 Index Essentials Consumption [20] and Non-essentials Consumption [21] are selected to reflect the impact of interest rate hikes on consumer goods. The above variables are selected from the *investing.com*, the daily data from 2021.9.1 to 2022.8.4, and processed with formula $\ln(1 + index)$ for logarithmic processing. Table 1 shows variables' definition and their sources.

Table 1. Variables' definition and data sources

Variables	Definitions	Data sources
Necessity goods	logarithm of S&P 500 Consumer Discretionary index	investing.com
Non-necessity goods	logarithm of S&P 500 Consumer Staples index	investing.com
Exchange rate	logarithm of USD to CNY Exchange rate index	investing.com

In this study, yield is calculated as follows:

$$\ln Yield = \ln\left(1 + \frac{index_t - index_{t-1}}{index_t}\right) \quad (1)$$

Figure 1 depicts the logarithmic yield of the Consumer Indexes Series after processing the original data.

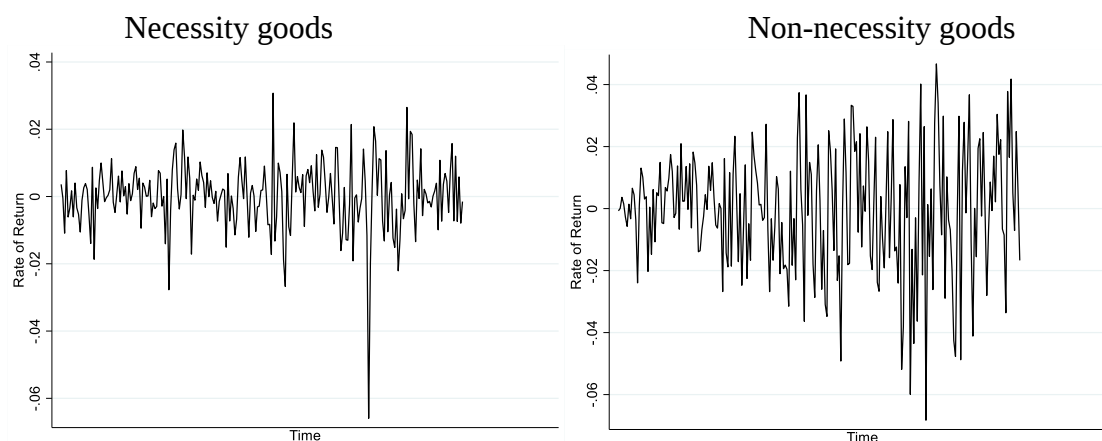


Fig. 1 Yield trend

3.2 Unit-root test

To avoid spurious regression, it is essential to ensure that the time series stays stationary. Therefore, the unit-root test is carried out in this paper by using the Augmented Dickey Fuller Test (ADF-test) to prove the series is stationary [22].

When processing ADF-test, time series x_t usually can be written as:

$$x_t = c_t + \beta x_{t-1} + \sum_i^{p-1} \phi_i \Delta x_{t-i} + \varepsilon_t \quad (2)$$

The null hypothesis for the test is $\beta = 1$, which denotes that the series is non-stationary and has a unit root. The alternative hypothesis is $\beta < 1$, which denotes that the series is stationary.

Table 2 shows the test result:

Table 2. ADF test

Variables	t-statistic	p-value
Index		
Necessity goods	-2.462	0.3471
Non-necessity goods	-2.170	0.5068
Exchange rate	-1.537	0.8162
Yield		
Necessity goods	-10.472	0.0000***
Non-necessity goods	-9.945	0.0000***
Exchange rate	-11.050	0.0000***

Table 2 shows that all yields series with p-values less than 0.05, which pass the ADF-test and are stationary. However, all index series with p-values larger than 0.05, which does not pass the ADF-test, are non-stationary. As a result, this paper used yield series to build econometric models.

3.3 Vector-autoregression

Sims first introduced the Vector Autoregression Model (VAR), which is an essential tool for impact response analysis and widely used in macro econometric analysis [23].

In this case, this paper assumes that the retail prices of domestic consumer goods in the United States remain unchanged in the short term. Based on this hypothesis, the impact of the Fed's interest rate hikes on the consumer goods sector from different perspectives of supply and demand and monetary policy will have different results. Therefore, variables need to be introduced into the VAR model to analyze specifically how the impact of the Fed's interest rate hike will affect the consumer goods sector in the United States. The model is as follows:

$$x_t = \Gamma_0 + \Gamma_1 x_{t-1} + \Gamma_2 \text{Exchange rate} + \Gamma_p x_{t-p} + \varepsilon_t \quad (3)$$

$$\text{Where } x_t = \begin{bmatrix} x_{1t} \\ x_{2t} \\ x_{3t} \end{bmatrix}, \Gamma_0 = \begin{bmatrix} \beta_{10} \\ \beta_{20} \\ \beta_{30} \end{bmatrix}, \varepsilon_t = \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix}, \Gamma_1 = \begin{bmatrix} \beta_{11} & \gamma_{11} & \lambda_{11} \\ \beta_{21} & \gamma_{21} & \lambda_{21} \\ \beta_{31} & \gamma_{31} & \lambda_{31} \end{bmatrix}, \dots, \Gamma_p = \begin{bmatrix} \beta_{1p} & \gamma_{1p} & \lambda_{1p} \\ \beta_{2p} & \gamma_{2p} & \lambda_{2p} \\ \beta_{3p} & \gamma_{3p} & \lambda_{3p} \end{bmatrix}.$$

In (3), x_t represents to the three response variables in this model. $\Gamma_1, \Gamma_2, \dots, \Gamma_p$ are the coefficient matrix for the corresponding terms. ε_t is the error term matrix in period t .

To further validate the relationship and intrinsic mechanism between Necessity goods, non-necessity goods and Fed rate hikes, this paper also used the impulse response function, which was worked by Sims [24] and are regularly applied to capture the propagation mechanism of a shock across time [25].

The function is as follows:

$$\frac{\partial x_{t+s}}{\partial \varepsilon_t} = \varphi s \quad (4)$$

This equation illustrates how the error term ε_t at the t -th period affects the value of the variable $(t + s)$ - th at the x_{t+s} period when other variables and error terms at other time periods remain constant.

Subsequently, all impulse responses in the VAR system can be visualized graphically, and these impulse response diagrams are very important for analyzing the VAR model.

3.4 ARMA-GARCH Specification

Considering the fluctuation of the rate of return, we constructed a ARMA-GARCH model.

ARAM Model. Normal ARAM (p, q) model is formed as:

$$r_t = \phi_0 + \sum_{i=1}^p \phi_i r_{t-i} + a_t - \sum_{i=1}^q \theta_i a_{t-i} \quad (5)$$

$\{a_t\}$ is a series of white noise, p and q being all non-negative integers.

$$a_t = \sigma_t \varepsilon_t, \sigma_t^2 = \alpha_0 + \sum_{i=1}^m \alpha_i a_{t-i}^2 + \sum_{j=1}^s \beta_j \sigma_{t-j}^2 + \Gamma \times \text{Exchange rate} \quad (6)$$

GARCH model was introduced by Bollerslev (1986) as the generalized GARCH model. For a series of logarithmic rate of return r_t , making $a_t = r_t - u_t$ as the moment's interest, a_t follows GARCH (m, s) model (6). GARCH model is fact, based on the ARCH model, adding the consideration of heteroscedastic function's p -th autoregressive nature, it can effectively fit heteroscedastic functions with long-term memories. ARCH model is a special case within the GARCH model.

Any time series consists of an equation of mean and an equation of variance, and the general ARMA model ignores the equation of variance because the residuals are a white noise; The GARCH model has the mean equation being a constant and the residuals of the model are under the ARCH effect as defaults. The analysis using ARMA-GARCH model has to satisfy the condition of the general ARMA model in regard to the mean while the residuals have to follow the GARCH process so that the modeling of the mean and variance can be done respectively [26].

4. Empirical Result

4.1 Var order selection

Properly determining the optimal lag order is important for building VAR models. The error term's autocorrelation may be substantial and result in inconsistent parameter estimates if there are too few lag variables. The error term's autocorrelation problem can be solved with replacing the original k -value with properly chosen higher number to add appropriate amount of lag variables in the VAR model. However, if the k -value was excessively high, thus too many lag variables were added into the model, it would end up decreasing the degrees of freedom, which can negatively affects the effectiveness of model parameter estimation works. The ideal number of lag variables is chosen in this study by using the LR test.

Table 3 shows that when $lag = 10$, LR-test is established. Therefore, the order of the VAR model is determined as 11.

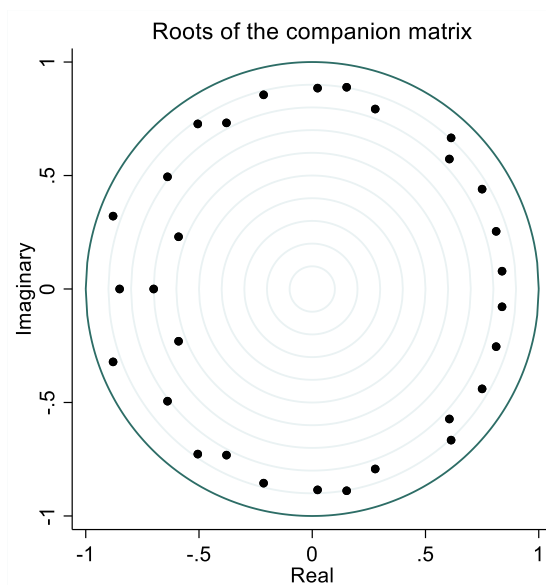
Table 3. VAR model identification

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	2260.1		9		2.5e-13	-20.519	-20.5004*	-20.4728*
1	2269.3	18.416	9	0.031	2.5e-13*	-20.5209*	-20.4462	-20.3358
2	2273.49	8.3769	9	0.497	2.6e-13	-20.4772	-20.3464	-20.1533
3	2281.7	16.41	9	0.059	2.6e-13	-20.47	-20.2831	-20.0072
4	2287.91	12.42	9	0.191	2.7e-13	-20.4446	-20.2017	-19.843
5	2292.98	10.156	9	0.338	2.8e-13	-20.4089	-20.1099	-19.6685
6	2297.5	9.0286	9	0.435	2.9e-13	-20.3682	-20.0131	-19.4889
7	2305.83	16.666	9	0.054	2.9e-13	-20.3621	-19.951	-19.344
8	2311.16	10.661	9	0.300	3.0e-13	-20.3287	-19.8615	-19.1718
9	2316.76	11.198	9	0.262	3.1e-13	-20.2978	-19.7746	-19.0021
10	2335.12	36.721*	9	0.000	2.8e-13	-20.3829	-19.8036	-18.9483
11	2340.11	9.9714	9	0.353	2.9e-13	-20.3464	-19.711	-18.773
12	2347.79	15.356	9	0.082	3.0e-13	-20.3344	-19.643	-18.6222

4.2 Stability Condition of VAR Estimates

Before performing parameter estimation, a stationarity test for the VAR system is needed.

The test results are depicted in Figure 2's unit circle; since all of the points representing eigenvalues are contained within the unit circle, the VAR estimate can be said to be stationary.


Fig. 2 VAR stability

4.3 Impulse Response Graph of the VAR model

Figure 3 shows the impulse response results of re response variable necessity goods and non-necessity goods. From the results shown in the figure, the net effect of a unit exchange rate shock on both the essential and non-essential consumer industries in the $t = 0$ period is negative, and the impact on the non-essential industries is greater.

Specifically, the largest negative effect on the consumer sector for essentials emerged in $lag = 10$, which was greater than 0.1% in value. The largest negative effect on the non-essential consumer sector occurred in $lag = 6$, at a size of about 0.2%. Exchange rate shocks have a greater impact on the non-essential consumer sector, and this paper argues that the possible reason is that the prices of non-essential goods are more elastic.

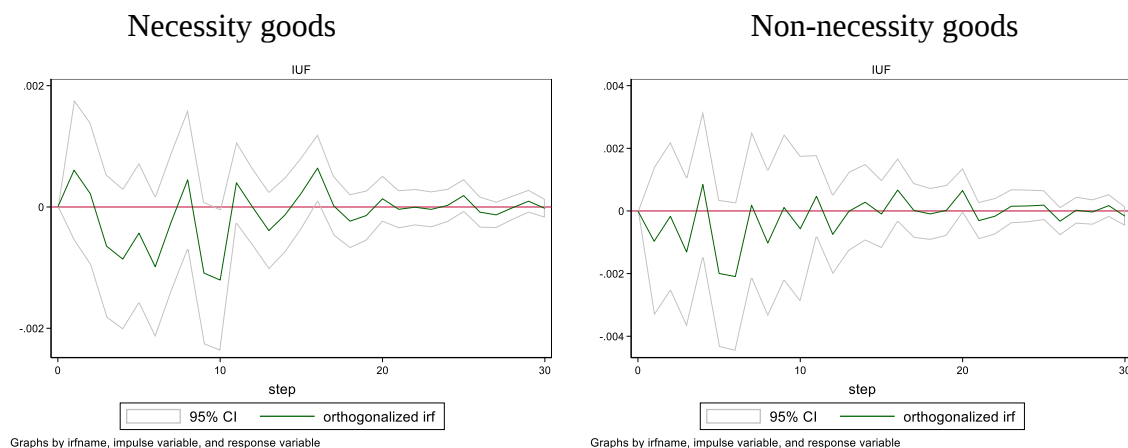


Fig. 3 Impulse and response

4.4 ARMA order selection

Through the partial autocorrelation plot (PACF plot) of the series, the AR part of the series can be determined. And through the autocorrelation Plot (ACF Plot), this paper can find out the MA part of the series. The result is shown in Figure 4. For necessity goods, PACF falls into the 95% confidence interval when $lag = 10$ or more, ACF falls into the 95% confidence interval when $lag = 9$ or more; for non-necessity goods, PACF falls into the 95% confidence interval when $lag = 10$ or more, ACF falls into the 95% confidence interval when $lag = 7$ or more.

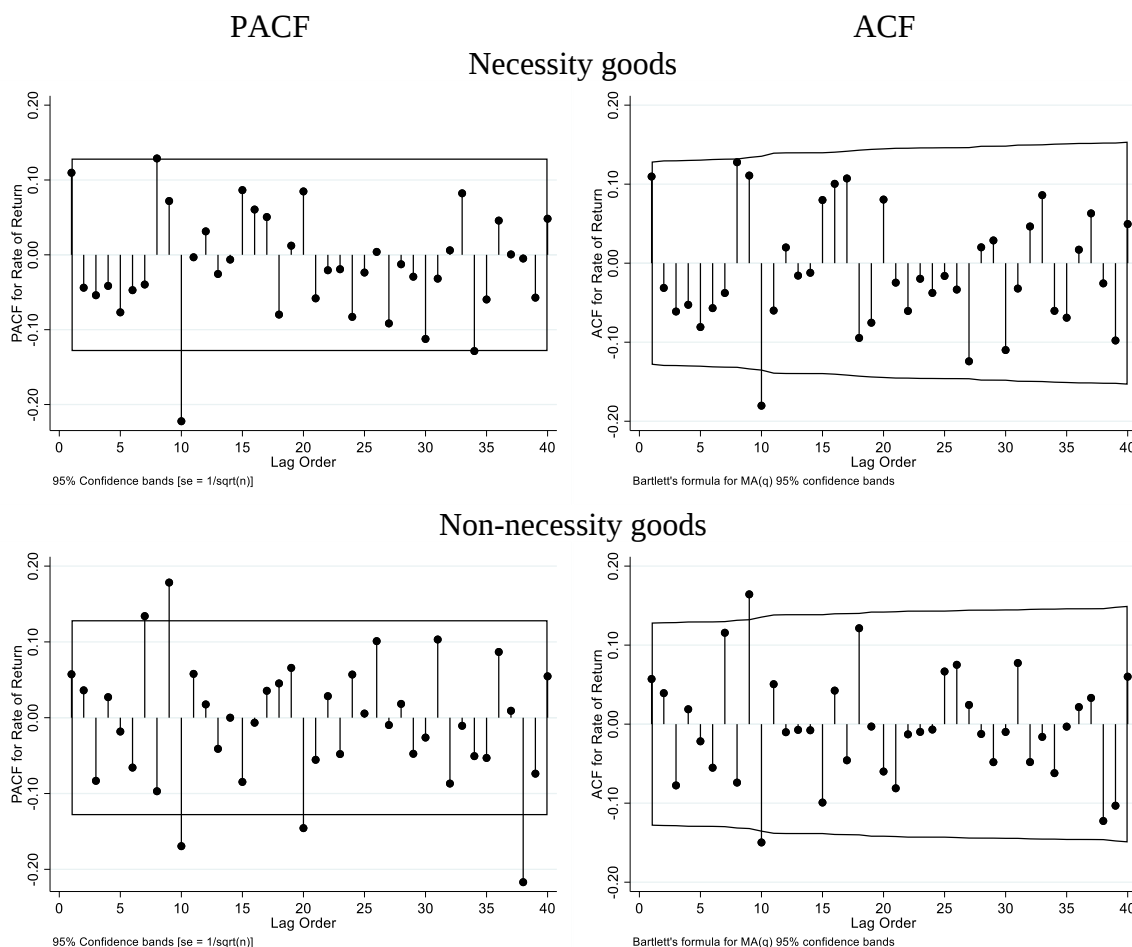


Fig. 4 PACF and ACF

4.5 ARMA-GARCH Model Results

From the estimated results of ARMA-GARCH (Please see Table 4), the ARCH items and GARCH items in column (1) are significant, and the GARCH items in column (2) are significant. This indicates that there is significant conditional heteroscedasticity in both the essential and non-essential consumer industries, and that GARCH model can be performed.

From the perspective of the coefficient of the exchange rate, the exchange rate change has a large impact on the volatility of the earnings of these two industries. Specifically, the logarithmic yield of the exchange rate changed by one unit, and the daily volatility of the income of the essential and non-essential consumer industries increased by 513.4403 and 386.5799, respectively, and the coefficients were significant at the level of 1%.

Specifically, the logarithmic yield of the exchange rate changed by one unit, and the daily volatility of the income of the essential and non-essential consumer industries increased by 513.4403 and 386.5799, respectively, and the coefficients were significant at the level of 1%.

Table 4. ARMA-GARCH estimation results

Variables	(1)		(2)	
	Necessity goods		Non-necessity goods	
	Coefficient	Std.err	Coefficient	Std.err
Exchange rate	513.4403***	71.7123	386.5799***	102.4156
ARCH (-1)	0.2177***	0.0679	0.0806	0.0549
GARCH (-1)	0.6964***	0.0642	0.8762***	0.0742
Constant	-12.0413***	0.4664	-11.6330***	0.9622

5. Discussion

Our thesis aims to show that the impact of currency shocks on discretionary consumer sectors is greater. The Federal Reserve has limitless ability to impact this rate, and albeit the government supports rate is set by banks getting and loaning assets to one another, the bureaucratic assets rate by and large stays inside a restricted reach above and beneath the objective (as members know about the Fed's ability to impact this rate). Expecting a shut economy, where unfamiliar capital or exchange doesn't influence the cash supply, when cash supply increments, financing costs go down. Organizations and purchasers have a lower cost of capital and can expand spending and capital improvement projects. This energizes momentary development. Alternately, when the cash supply falls, loan fees go up, expanding the expense of capital and prompting more moderate spending and venture. The Federal hold increments loan fees to battle Inflation. After all, for import companies, they can purchase the product in a lower price from the international market and then sell them at a higher price. Based on the afore-mentioned data, for investors, the essential goods are a better area to be invested in since its price fluctuation is more flexible and the demand steadily increases. For future researches, people can focus on specific products and analyze the sale's data of each product based on general marketing.

6. Conclusion

As the central bank of the United States, the Federal Reserve controls the money supply and continuously makes various policies for the currency exchange rate. Higher interest rates have increased unemployment and reduced productivity, worsened household economic conditions and thus affecting household consumption. This paper studies the positive and negative effects of interest rate increases on non-essential and essential items through VAR and ARMA. In the experiment, RMB is used to reflect the phenomenon of US dollar interest rate increase, and S&P 500 Index Essentials Consumption and Essentials Consumption are selected to show the impact of interest rate, and variables are introduced into the VAR model to detect the results. Considering the yield volatility,

ARMA-GARCH is used to further test the possibility. Finally come to the conclusion: Exchange rate shocks have a greater impact on the non-essential consumer sector, and this article argues that the possible reason is that the prices of non-essential goods are more elastic.

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