

# The Impact of US Economy Policy Uncertainty on the Chinese Monetary Policy Effectiveness: Evidence from Quantile Regression Analysis

Yueli Tang\*/ 1<sup>st</sup>, Jing Yang/ 2<sup>nd</sup>

\* Corresponding author: 15273121007@163.com, yj13876195734@163.com

<sup>1</sup> \* Hainan Vocational University of Science and Technology Haikou, China

<sup>2</sup> Hainan Vocational University of Science and Technology Haikou, China

**Abstract**—In order to cope with the impact of US economic policy uncertainty (EPU) on the Chinese macroeconomy, the paper studies the impact from the US EPU on the Chinese monetary policy efficiency. By constructing the quantile regression model, the paper analyzes that the impact of US EPU on the efficiency of the Chinese monetary policy based on interest rate and money supply operation across quantiles. It is found that when consumer price index (CPI), industrial production index (IP) and international trade surplus (ITD) are booming or depressed, the effect of Chinese monetary policy is asymmetrically affected by US EPU, and the degree of impact is not consistent across quantile levels.

**Keywords**-component; Chinese monetary policy efficiency; US EPU; Asymmetric effect; Quantile Regression

## 1 INTRODUCTION

The impact of EPU on macroeconomic variables has been one of the hot topics in the field of international macroeconomic research in recent years. The occurrence of events such as the 2008 global financial crisis and the European debt crisis increased the anxiety of the global financial and economic markets. The chain reaction of the macroeconomic environment also made the trend of economic policies pursued by governments very uncertain, which would have a certain positive or negative impact on the economy of other countries. As the world's largest economy, the US's presidential elections, shrinking balance sheets, reduction of interest and foreign trade policies that have had a greater impact on the economic life of China and other developing countries. The article systematically analyzes whether the US EPU has a significant impact on China's CPI, IP and ITD or not, and provides a theoretical basis for governments to deal with the uncertainty of global economic policies.

## 2 LITERATURE REVIEW

With the penetration of economic globalization, the EPU has gradually attracted attention from domestic and foreign scholars. Scholars have conducted theoretical discussions and empirical analyses in the direction and intensity of the impact of EPU on the macroeconomic effects, and generally believe that EPU weakens the effectiveness of monetary policy. Balcilar et al. (2017) investigated the effect of the US EPU on the effectiveness of monetary policy in the euro area by constructing a vector autoregressive model (VAR), and found that the increasing the US EPU restrained the price and output level of the euro area<sup>[1]</sup>. Pellegrino (2018) built a nonlinear Interacted-VAR model to study whether the effectiveness of monetary policy in the euro area is affected by the level of European EPU. The results show that the uncertainty weakens the maximum and total effects of monetary policy shocks<sup>[2]</sup>.

The EPU has a negative effect on output, price and investment etc. L. Tian et al. (2017) found that although EPU did not bring significant shocks to Chinese macro economy, it showed obvious negative shock characteristics<sup>[3]</sup>. Z.G. Ouyang et al. (2019) used the time-varying VAR model to study the impacts of EPU on Chinese economic growth, and found that EPU had a restraining effect on Chinese economic growth, and the inhibitory effect had been alleviated after the new normal<sup>[4]</sup>. Z.W. Xu and W.P. Wang (2019) found that EPU would cause a significant decline in the Chinese output<sup>[5]</sup>.

Most of the above studies have analyzed the macroeconomic effects of EPU based on traditional regression estimation methods, they study the spillover effects of the EPU on the macro economy at the average level while ignoring the changes of the spillover effects under extreme macroeconomic conditions. Quantile regression analysis method is widely used in the financial field because of its robustness and comprehensiveness. H.M. Zhu et al. (2019) used a panel quantile regression model to consider the asymmetric impact of crude oil prices and EPU on the Chinese bulk commodity market in different market conditions<sup>[6]</sup>. Based on quantile regression theory, Bekiros et al. (2016) and Guo et al. (2018) found that in different stock market conditions, EPU had asymmetric spillover effects on the stock markets of various countries<sup>[7-8]</sup>. Combining previous studies, this article establishes a quantile regression model to study the impact of the US EPU on Chinese CPI, IP, ITD across different quantiles.

## 3 QUANTILE REGRESSION MODEL

Quantile regression was first proposed by Koenker and Bassett in 1978. It provides a method for estimating the linear relationship between the independent variable and the conditional quantile of the dependent variable<sup>[9]</sup>. Traditional regression models focus on the conditional mean of the dependent variable while ignoring the specificity of the tail. Quantile regression overcomes some of the limitations of mean regression, including sensitivity to outliers, the necessity of assuming normal distribution and heteroscedasticity. Compared with mean regression, quantile regression allows data to have outliers, non-normal distribution, and heteroscedasticity. It does not require strong distribution assumptions. It allows us to focus on the quantiles of the conditional distribution of random variables rather than being limited to focusing on the conditional mean. By collecting the regression results on different quantiles,

we can get a more complete description of the statistical characteristics of the conditional distribution, and the analysis results are more comprehensive.

Let  $Y$  have the distribution function  $F_Y(y) = P(Y \leq y)$ , then for any  $0 < \tau < 1$ , the  $\tau$  the quantile of  $Y$  satisfies  $F_Y^{-1}(\tau) = \inf\{y : F_Y(y) \geq \tau\}$ . The quantile regression model is given by the following formula:

$$Q_i(\tau | x) = \alpha(\tau) + x'(t)\beta(\tau) \quad (1)$$

where  $\alpha(\tau)$  is the constant term, expresses unobserved effect, and  $\beta(\tau)$  refers to the effect from independent variable to the  $\tau$  the quantile of dependent variable  $Y$  in the equation, the estimated value is as follows:

$$\hat{\beta}(\tau) = \arg \min_{\beta \in R^p} \sum_{i=1}^n \rho_{\tau}(Q_i(\tau | x) - x'(t)\beta(\tau) - \alpha(\tau)) \quad (2)$$

where  $\rho_{\tau}(u) = u(\tau - I(u < 0))$  is the check function, and  $I(\cdot)$  is the indicator function.

The article establishes a quantile regression model to compare and analyze the impacts of the US EPU on the transmission mechanism of Chinese monetary policy objectives under different quantiles. The quantile regression model constructed in the article is as follows:

$$Q_i(\tau | \cdot) = C + \beta_{IBOR} IBOR_i + \beta_{BM} BM_i + \beta_{EPU} EPU_i + \beta_{EI} EPU \cdot IBOR_i + \beta_{EM} EPU \cdot BM_i \quad (3)$$

In the model,  $Q_i$  express the consumer price index (CPI<sub>*t*</sub>), industrial production index (IP<sub>*t*</sub>), the international trade surplus (ITD<sub>*t*</sub>), which represent the three major goals of Chinese monetary policy, and  $Q_i(\tau | \cdot)$  represents the corresponding conditions Quantile.  $\beta_{IBOR}$  and  $\beta_{BM}$  are the coordination effects from two the common intermediary variables such as the Chinese IBOR and BM, indicating the coordination effect of the Chinese monetary policy implementation in achieving monetary policy goals;  $\beta_{EPU}$  represents the exogenous effects from the US EPU,  $\beta_{IBOR}$  and  $\beta_{BM}$  represent the interaction effects from the interaction of the US EPU with Chinese IBOR and BM, quantifying the impaction from the US EPU to the effects of two intermediary target in the transmission process.

## 4 EMPIRICAL ANALYSIS

Through establishing quantile regression model, the article systematically analyzes the impact of the US EPU on the transmission of Chinese monetary policy under different conditional quantiles. We analyze the research results combining with economic theory and draw conclusions.

### 4.1 Variables and data

The article uses the EPU compiled by Baker et al. (2016), and its compilation is based on the frequency of news media reporting on economic and policy uncertainty <sup>[10]</sup>. The index is

relatively comprehensive and accurate, and is widely used to study the impact of economic policy uncertainty on the macro economy. The article selects the CPI, IP, and ITD as the quantitative index of Chinese monetary policy goals for price stability, economic growth and international balance of payments. China mainly affects prices, production, and balance of payments by adjusting interest rates and money supply. This article introduces the IBOR and BM. Considering that China joined the World Trade Organization in November 2001 and began large-scale economic and trade exchanges with countries around the world, the article selects monthly data from January 2002 to June 2020 to study whether the US EPU has an impact on the transmission of Chinese monetary policy. The EPU comes from [www.policyuncertainty.com](http://www.policyuncertainty.com), and the data on Chinese monetary policy targets comes from the economic statistics database of China Economic Network.

## 4.2 Descriptive statistics

Table 1 shows the results of preprocessing and descriptive statistics on each data.

**Table 1** Descriptive statistics

	Min	Max	Mean	standard deviation	Skewness	Kurtosis	JB test
CPI	-2.574	1.963	0.014	0.588	-0.398	2.013	40.605***
IP	-13.406	14.925	0.019	2.670	0.415	13.876	1701.8***
ITD	-2126.711	32700.000	191.774	2271.585	13.573	192.664	334789.7***
EPU	-60.104	193.449	4.467	32.164	1.883	7.113	573.311***
IBOR	0.810	6.430	2.219	0.716	1.126	5.096	273.407***
BM	-1.268	4.720	1.200	1.011	0.568	0.580	14.473***

Note: "\*\*\*\*", "\*\*\*", and "\*" indicate rejection of the null hypothesis with confidence intervals of 1%, 5%, and 10%, respectively.

It can be seen from the skewness, kurtosis and JB test that most of the sequences reject the null hypothesis of normal distribution, and are represented as asymmetrical distributions such as left-biased, right-skewed, peaked or flattened; By constructing quantile regression model, it is possible to obtain the impact of the US EPU on Chinese macroeconomic variables at different quantiles. The article selects 5 quantiles to perform quantile regression analysis on each variable. Table 2 lists the parameter estimates and significance test results of each variable at different quantiles.

**Table 2** Parameter Estimation

	Parameter	5th	10th	50th	90th	95th
CPI	IBOR	-0.028	0.208**	-0.07	-0.072	-0.124
	BM	-0.057	-0.107*	-0.011	0.095	-0.062
	EPU	-0.004	-0.001	-0.001	-0.011	-0.014*
	EPU.IBOR	0.002	-0.001	0.001	0.003	0.002
	EPU.BM	0.001	0.001	-0.001	0	0.003

IP	IBOR	0.503*	0.285*	-0.058	-0.448***	-0.41
	BM	0.143	0.055	0.119	0.364***	1.192***
	EPU	0.01**	0.026**	0.006	0.018	0.027
	EPU.IBOR	0	-0.008*	-0.003	-0.006	-0.004
	EPU.BM	-0.005	0	0	0.019**	0.03**
ITD	IBOR	-11.035	-9.651	6.413	-10.588	-66.172**
	BM	25.707	-4.595	-4.923	-16.934*	-48.4*
	EPU	-4.015**	-1.856	-0.019	-2.228**	-3.024
	EPU.IBOR	1.912***	0.935	0.052	0.877**	1.438**
	EPU.BM	-0.268	-0.2	-0.107	-0.089	-0.66

Note: "\*\*\*\*", "\*\*\*", and "\*\*" indicate rejection of the null hypothesis with confidence intervals of 1%, 5%, and 10%, respectively.

### 4.3 The impact of US EPU on Chinese CPI

#### 4.3.1 The coordination effect of IBOR and BM on CPI

IBOR has a significant positive effect on CPI only at the low quintile (10th), that is, the higher Chinese IBOR will increase low price, stimulate production to a certain extent, and promote economic development. In most cases, IBOR does not have a significant impact on price, related to the residents' enthusiasm for saving and the country's strong price control. Increasing BM will have a significant negative effect on CPI at the low quintile (10th), that is, significantly inhibit the price increase during the low price period. During the economic downturn, the relaxation of the money supply not only failed to stimulate consumption, but aggravated the downturn in prices. This may be related to the pessimistic attitude of the residents towards the current economic production.

#### 4.3.2 The exogenous effect of EPU on CPI

EPU has a significant negative inhibitory effect on CPI at the very high quintile (95th), that is, during the period of high prices in China, the US EPU increases, and CPI tend to stabilize. In most cases, the US EPU has no significant impact on CPI, which may be related to Chinese strong domestic demand and a large number of international trading partners.

#### 4.3.3 The interaction effect of EPU.IBOR and EPU.BM on CPI

EPU.IBOR and EPU.BM have no significant correlation with CPI at any quintile. The interaction between the US EPU and the IBOR and BM do not have a significant impact on price, which reflects Chinese CPI are operating steadily, and they are overall not easily affected by international factors.

#### **4.4 The impact of US EPU on Chinese IP**

##### **4.4.1 The coordination effect of IBOR and BM on IP**

$\beta_{IBOR}$  are significantly negative at the high quantile (90th), and significantly positive below the low quantiles ( $\leq 10$ th). It can be seen that the raising IBOR has the effect of cooling down during the production boom period, and has the effect of promoting production and improving the downturn during the production downturn.  $\beta_{BM}$  are significantly positive above the high quantiles ( $\geq 90$ th), that is, the increase BM will promote economic development, and this promotion will be more significant during economic prosperity.

##### **4.4.2 The exogenous effect of EPU on IP**

EPU below the low quintiles ( $\leq 10$ th) has a significant positive effect on IP, that is, during the domestic production downturn, the increase Us EPU will promote IP. In the stable or prosperous stage, the IP is not affected by the US EPU, which has a certain relationship with the huge domestic demand and the degree of openness to the outside world.

##### **4.4.3 Interactive effect of EPU.IBOR and EPU.BM on IP**

In the low quantile (10th), EPU.IBOR is significantly negatively correlated with IP, indicating that under the impact of the US EPU, the interaction of the US EPU and the IBOR on the IP produce a significant inhibitory effect. EPU.BM is significantly positively correlated with IP above the high quintiles ( $\geq 90$ th), indicating that the interaction between the US EPU and the BM supply exacerbates the prosperity of industrial production.

#### **4.5 The impact of US EPU on Chinese ITD**

##### **4.5.1 The coordination effect of IBOR and BM on ITD**

$\beta_{IBOR}$  are significantly positive at the very high quintile (95th). It can be seen that adjusting IBOR upward will significantly inhibit ITD further growth during the booming period, which plays a role in stabilizing the international balance of payments.  $\beta_{BM}$  are significantly negative above the high quantiles ( $\geq 95$ th). In the boom, increasing BM can significantly improve the trade gap and achieve a relatively stable renminbi value.

##### **4.5.2 The exogenous effect of EPU on ITD**

EPU has a significant negative inhibitory effect on ITD at the very low quintile (5th) and high quintile (90th), that is, the increase US EPU, is not conducive to economic and trade exchanges between countries. The sluggish of the import and export trade are exacerbated during the downturn, and its further growth has been suppressed during the booming.

### 4.5.3 The interaction effect of EPU.IBOR and EPU.BM on ITD

EPU.IBOR is significantly positively correlated with ITD at the very low quintile (5th) and above the high quintiles ( $\geq 90$ th), indicating that the interaction between US EPU and IBOR improved the sluggish state of ITD but exacerbated its trade surplus gap during the booming period.  $\beta_{BM}$  accepts the null hypothesis, that is, the interaction between the US EPU and the BM does not have a significant impact on the ITD.

## 5 CONCLUSION

The article systematically studies the impact of the US EPU on the transmission effect of Chinese monetary policy, and finds that when the price, industrial growth, and international trade surpluses are prosperous or sluggish, the effect of Chinese monetary policy is asymmetrically affected by US EPU.

The rise in the interbank lending rate overnight promotes the price recovery during the downturn in prices, promotes production during the downturn in production, and curbs overproduction during the boom in production. The increase in the supply of broad money intensifies price increases during periods of low prices and promotes economic development, and this promotion is more significant during periods of economic prosperity; In addition, the increase in the supply of broad money will significantly improve its trade surplus gap in periods of trade prosperity.

The increase in the US EPU promotes prices to stabilize during the high price period, promotes production during the production downturn, and exacerbates the trade deficit during the downturn in import and export trade. In general, the US EPU has different effects on Chinese economy in different periods of development.

Under the influence of the US EPU, the interaction between the US EPU and the interbank overnight lending rate has a significant inhibitory effect on the industrial production during the economic downturn, and has a significant positive effect on the sluggish and prosperity import and export trade. The interaction between the US EPU and the broad money supply has exacerbated the prosperity of industrial production.

In general, the US EPU will affect the transmission of Chinese monetary policy based on interest rate and money supply operations, and its degree of impact is inconsistent in different periods.

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