Research Article

Analysis of the Impact of U.S. Trade Policy Uncertainty on China Based on Bayesian VAR Model

Huan Yan, Weiguo Xiao, Qi Deng, and Sisi Xiong

Economics and Management School, Wuhan University, Wuhan 430000, China

Correspondence should be addressed to Weiguo Xiao; 2011201050029@whu.edu.cn

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Using a set of Chinese economic data and a Bayesian vector autoregression (BVAR) model, this study empirically analyzes the spillover effects of U.S. trade policy uncertainty on the output, consumption, investment, and net export in China. The results find that U.S. trade policy uncertainty is an important factor influencing China’s real economy. Specifically, an increase in U.S. trade policy uncertainty has a significant negative effect on China’s output, consumption, and net export in the short and long run, but it will have a negative impact on investment in the short run and a positive impact in the medium and long run.

1. Introduction

With the deepening of global economic integration, the trade volume and cross-border capital flow among countries are increasing and the spillover effects of macroeconomic policies of the world’s major economies are becoming more obvious. Considering the powerful economic status of the United States in the world, its economic policies not only affect its own economy but also have a great impact on the development of other economies.

Since March 2018, the Trump administration has initiated a trade war on the grounds that the U.S. was running a large trade deficit with China. Since then, the United States has repeatedly issued a list of tariffs on Chinese exports to the United States, and China has also raised tariffs on U.S. exports to China in response. With the escalation of the trade war, the trade policy uncertainty between China and the United States has gradually increased, not only adversely affecting bilateral trade between China and the United States but also causing significant losses to global trade, and the IMF estimates that the U.S.-China tariffs reduced global economic output by 0.8% in 2020, meaning a loss of 700 billion or the equivalent of Switzerland’s GDP. So far, U.S. President Joe Biden has amplified his predecessor’s policies by strengthening antiChina alliances and implementing additional sanctions, the future of bilateral trade and economic relations remains highly uncertain.

Therefore, under the realistic background of trade war, this study focuses on the spillover effect of U.S. trade policy uncertainty on China’s macroeconomy. The marginal contributions of this study are twofold. Firstly, different from the existing studies that only focus on the impact of trade policy uncertainty on its domestic economy, we expand the research scope of trade policy uncertainty to study the impact of one country’s trade policy uncertainty on other countries’ economies. Secondly, unlike the existing literature that mostly investigates the impact of trade policy uncertainty based on a specific trade policy, such as China’s accession to the WTO or permanent normal trade relations, this study uses the news-based index of trade policy uncertainty constructed by Baker et al. [1] to capture the degree of uncertainty of U.S. trade policy over the period from 1997 to 2017. The trade policy uncertainty index can not only more comprehensively reflect the changes of U.S. trade policy but is also exogenous to China’s macroeconomic variables.

The remainder of this study is organized as follows: in Section 2, we briefly review the relevant literature on the trade policy uncertainty. Section 2 introduces the BVAR model, identification strategy, and data that we employed.
Results and analysis are presented in Section 4. Finally, Section 4 offers a concluding summary.

2. Literature Review

Since the pioneering work of Bloom [2], many scholars have empirically analyzed the macroeconomic effect of uncertainty and achieved fruitful research results. With the deepening of research, scholars extend the uncertainty to the field of trade policy. The existing research on trade policy uncertainty is mainly divided into three categories as follows:

The first stream of literature focuses on the measurement of trade policy uncertainty. Baker et al. [1] constructed the economic policy uncertainty index based on the frequency of news reports and found that the policy uncertainty index was highly consistent with macro fluctuations, which, to some extent, explained the rationality of the policy uncertainty index. Inspired by this method, Handley and Limão [3] constructed the trade policy uncertainty index based on news information data and found that the index rose sharply after Trump was nominated and elected president. Caldara et al. [4] constructed firm-level trade policy uncertainty based on text analysis of transcripts of quarterly earnings calls of publicly listed companies. Another common measurement method of trade policy uncertainty in literature is tariff measurement, which assumes that tariff is the only source of trade policy uncertainty and analyzes the impact on trade before and after trade policy changes. Handley and Limão [5] constructed tariff uncertainty based on the gravity model. Pierce and Schott [6] used the difference between nonpermanent normal trade relations tariffs and permanent normal trade relations tariffs to measure trade policy uncertainty.

The second stream of literature focuses on the macroeconomic impact of trade policy uncertainty: (1) The Effect on Imports and Exports. Handley [7] empirically tested the impact of trade policy uncertainty on export enterprises by using Australian data, and the results showed that without the binding commitments implemented after the establishment of WTO in 1996, the growth of export product varieties would have declined by 7% from 1993 to 2001. That is, the reduction of the trade policy uncertainty increased the variety of Australian export products by 7%; if Australia reduces all its tariffs and restrictions to zero, more than half of predicted new product growth is accounted for by reducing uncertainty. Mao [8] took the implementation of PNTR policy as a quasi-natural experiment and studied the impact of trade policy uncertainty on Chinese enterprises’ imports by using DID method; they found that the decrease of trade policy uncertainty significantly expands the scale of import, increases the probability of import, prolongs the duration of import, and improves the quality of import products. (2) The Effect on Employment. Chen and Xu [9] investigated the impact of the decline in trade policy uncertainty caused by China’s accession to the WTO in 2001 on China employment and found that the decline in trade policy uncertainty significantly increased the number of Chinese enterprises’ employment, because the decline in trade policy uncertainty led to the expansion of the range of trade products. This, in turn, contributed to the increase in employment of Chinese companies. Pierce and Schott [6] studied the impact of PNTR granted to China in 2001 on manufacturing employment in the United States and found that permanent normal trade relations status meant that the external trade policy uncertainty faced by China was reduced, and this change had a negative impact on manufacturing employment in the United States. (3) The Effect on Foreign Investment. Shepotylo and Jan [10] used foreign direct investment data from 2003 to 2013 to study the impact of trade policy uncertainty on foreign investment, that is, a reduction in trade policy uncertainty facing Ukraine would lead to an increase in EU investment in Ukraine. Caldara et al. [4] discussed the effect of trade policy uncertainty shock from macro and micro perspectives respectively, their firm-level estimates show that trade policy uncertainty in 2018 may have lowered aggregate U.S. investment by 1%, and their aggregate evidence based on VAR analysis suggests that a negative impact of about 1.5% to 2% on private investment.

The third stream of literature focuses on the microeconomic impact of trade policy uncertainty: (1) The Effect on Procurement Patterns. Schott et al. [11] studied the impact of trade policy uncertainty on procurement patterns of enterprises and found that when trade policy uncertainty is high, enterprises will choose American-style procurement considering the risk of trade war. When trade policy uncertainty is low, the possibility of a trade war is also low, and enterprises will choose Japanese-style procurement because it has lower costs and can improve social welfare. (2) The Effect on Corporate Profits and Savings. Wang [12] empirically studied the impact of trade policy uncertainty on export enterprises’ profits by using Chinese micro-enterprise data from 2000 to 2006 and found that in both the short and long term, the decline of trade policy uncertainty significantly promoted the increase of export enterprises’ profits. Mao and Xu [13] found that a decline in trade policy uncertainty has a significant negative impact on the corporate savings rate. The mechanism analysis shows that the decrease of trade policy uncertainty promotes the enterprises to increase the R&D of new products, increase the import of intermediate goods, and ease the financing constraints of enterprises, thus reducing the corporate savings rate. (3) The Effect on Product Innovation. Tong and Li [14] empirically found that the trade policy uncertainty was reduced after China’s accession to WTO, which could significantly improve the product innovation capacity of Chinese export enterprises, and this effect was more significant for foreign enterprises, processing trade enterprises, and entry enterprises. (4) The Effect on Stock Returns. Bianconi et al. [15] used the difference-in-difference method to test the impact of trade policy uncertainty on U.S. corporate stock returns. The empirical results show that U.S. tradeable industries more exposed to trade policy uncertainty had significantly higher stock returns than less exposed industries. He et al. [16] studied the monthly stock market volatility of China and the United States and found that trade policy uncertainty had a heterogeneous impact on the Chinese stock
market and U.S. stock market. Specifically, China-U.S. trade conflict has a positive impact on U.S. stock market but has a negative impact on Chinese stock market.

3. Model Setting, Variable Selection, and Data Description

3.1. BVAR Model Introduction. In general, the reduced VAR model can be written as follows:

$$y_t = \sum_{k=1}^{p} A_k y_{t-k} + \epsilon_t + \epsilon_t,$$  \hspace{1cm} (1)

where $y_t$ is the $n \times 1$ dimension endogenous variable, including U.S. trade policy uncertainty, GDP, consumption, investment, and net exports. $A_k$ represents the $n \times n$ dimension parameter matrix, $\epsilon$ and $c$ represent the $n \times 1$ dimension errors term and intercept term, respectively, and $P$ represents the lag intervals for an endogenous variable. The Bayesian approach treats the parameters in a model equation as a random variable with a possible prior distribution. The Minnesota prior distribution simplifies the complex distribution of parameter is multivariate normal random variable $\pi(A, \Sigma)$, and the prior distribution is thought to contain some relevant information obtained by the predictor prior to the prediction. Due to the lack of prior information, this study estimates the prior distribution of the coefficient matrix by using the Minnesota priors.

The Minnesota prior distribution assumes that the prior distribution of parameter is multivariate normal random distribution, that is, $A \sim N(A_0, V_0)$, where $A_0 = \mu_1 1, \ldots, 1$ is the $n^p \times 1$ dimension column vector, in which $\mu_i$ is the hyperparameter. To avoid the overfitting of BVAR model, the initial value of $\mu_i$ is 0. $V_0 = I_\ell \otimes U_0$ represents $n^p \times n^p$ dimension covariance matrix, where $I_\ell$ is the $n$-dimensional identity matrix, $U_0$ represents $np \times np$ dimension block diagonal matrix, and the diagonal elements are composed of $P \times n \times n$ dimensional sub-block matrices, and the elements of each sub-block matrix are set as follows:

$$u_{ij}^p = \begin{cases} \left( \frac{\lambda_i}{\lambda_j} \right)^2, & i = j, \\ \frac{\lambda_i \lambda_j \sigma_j}{p^3 \sigma_i}, & i \neq j. \end{cases}$$ \hspace{1cm} (2)

where $p$ is the lag order of model and here represents the $p$-th block matrix on the diagonal of matrix $U_0$, $i, j = 1, \ldots, n$, and $\sigma_i$ is the $i$-th diagonal element of the covariance matrix. The other non-diagonal elements of the matrix $U_0$ are set to 0. The Minnesota prior distribution simplifies the complex selection of all elements of the covariance matrix $V_0$ to specify three scalars $\lambda_1, \lambda_2$, and $\lambda_3$, with $\lambda_1$ representing the overall compactness, $\lambda_2$ representing the correlation of cross variables, and $\lambda_3$ representing the attenuation degree of the variance of lag variables, respectively.

3.2. Identification of Uncertain Shocks. To identify the U.S. trade policy uncertainty shock, the standard Cholesky decomposition method is used to impose short-term constraints on the BVAR model. Following the general approach of the existing literature, the specific approach of this study is as follows: first, this study puts the U.S. trade policy uncertainty before the real economic variables in China. This means that the impact of U.S. trade policy uncertainty will immediately have a contemporaneous effect on the real economic variables of China, but the real economic variables of China will not have a contemporaneous effect on U.S. trade policy, that is, the U.S. uncertainty shock is exogenous to China (Colombo [17], Huang et al. [18]). Secondly, following the approach of Zhu and Cai [19], this study puts the real economic variables of China into the model in order of GDP, consumption, investment, and net export; this means that China’s GDP is only affected by the impact of U.S. trade policy uncertainty over the same period, consumption is affected by the U.S. trade policy uncertainty and China output at the same period, and investment is simultaneously affected by U.S. trade policy uncertainty, output, and consumption, while net exports are simultaneously affected by all other variables.

3.3. Variable Selection. The sample period of this study is from 1997Q1 to 2017Q4. In 1996, the Eighth National People’s Congress issued National Economic and Social Development and Ninth Five-Year Program: Vision and Goals for 2010, which is the first medium and long-term plan after China’s transition to a market economy, marking the beginning of China’s strategic focus on the development of heavy industry. As a result, China’s economic structure has undergone significant transformation (Chang et al. [20]), so this study chose the first quarter of 1997 as the starting time. As part of the data set used in this study was only updated to the fourth quarter of 2017, this study chooses the fourth quarter of 2017 as the sample ending time. Specific variables are selected and processed as follows:

1. **Output Variable.** In this study, the gross domestic product calculated by the expenditure approach is used as the proxy variable of China’s output, which is denoted by GDP. First, since the National Bureau of Statistics of the People’s Republic of China only publishes annual data, the Fernandez [21] method is used to interpolate the original annual data into quarterly data. Second, the nominal GDP is divided by the GDP deflator to adjust for real GDP. Finally, this study uses X13-ARIMA-SEATS method for seasonal adjustment and then takes the logarithm.

2. **Consumption Variable.** Existing literature generally adopt total retail sales of consumer goods as a proxy variable of household consumption (for example, Zhang et al. [22]); however, there are some differences between the total retail sales of social consumer goods and the final consumption expenditure in GDP accounting. First, the total retail sales of social consumer goods not only include the catering income and the retail sales of commodities, and they do not include other service expenditure such as education and medical care, but the final consumption...
expenditure in GDP accounting includes all categories. Second, part of consumption expenditure in total retail sales of consumer goods is actually counted as an investment in GDP accounting. Third, the final consumption expenditure in GDP accounting also includes “shadow consumption expenditure” (Li [23]), such as the value of own housing. Therefore, in this study, household consumption calculated by the expenditure approach is used as the proxy variable of consumption, which is denoted by investment. First, since the National Bureau of Statistics of the People’s Republic of China only publishes the annual consumption data measured by the expenditure approach, this study uses the method of Fernandez [21] to interpolate the original annual data into quarterly data. Second, the nominal household consumption is divided by the GDP deflator to adjust for real household consumption. Finally, this study uses X13-ARIMA-SEATS method for seasonal adjustment and then takes the logarithm.

(3) Investment Variable. In this study, fixed asset investment is used as the proxy variable of investment, which is denoted by Investment. First, since the fixed asset investment is a monthly cumulative value, it needs to be converted into quarterly data by difference. Second, the nominal fixed asset investment is divided by the fixed asset investment price index to adjust for the actual fixed asset investment. Finally, this study uses X13-ARIMA-SEATS method for seasonal adjustment, and then takes the logarithm.

(4) Net Export Variable. The common practice in literature is to use the difference between goods trade export and goods trade import to measure net export, but the net export measured by this method contains negative numbers, which is difficult to do logarithmic processing and interpolation. Therefore, this study uses the ratio of trade balance to GDP as the proxy variable of net export, which is denoted by NetExports.

(5) U.S. Trade Policy Uncertainty. This study selects the U.S. trade policy uncertainty index constructed by Baker et al. [1] as the proxy variable, which is denoted by TPU.

The data on China’s gross domestic product, consumption, investment, and net exports in this study are from Chang et al. [20], who constructed a set of time series database suitable for the study of China’s macroeconomy. The original data of this database are all from the National Bureau of Statistics of China. In addition, U.S. trade policy uncertainty data are from https://www.policyuncertainty.com. The software used in this study is Eviews 10 and Matlab, and Table 1 describes the data used in our study.

4. Empirical Results and Analysis

Before estimating the BVAR model, it is necessary to test the stability of the variables and select the optimal lag order of the model.

4.1. Stationary Test. In general, macroeconomic time series data are nonstationary. To avoid the pseudo-regression problem, the ADF stationarity test is conducted for all processed data, and the test results are listed in Table 2.

The results of the unit root test show that the U.S. trade policy uncertainty index, GDP, consumption, investment, and net export all accept the null hypothesis at a significance level of 10%, that is, the original time series of each variable is nonstationary. However, the first-order difference of GDP and investment rejects the null hypothesis at the significance level of 5%, and the first-order difference of US trade policy uncertainty, consumption, and net export rejects the null hypothesis at the significance level of 1%. The results of ADF stationarity test indicate that all variables are stationary after the first-order difference.

4.2. Selection of Optimal Lag Order. Before estimating the BVAR model, another key step is to select the optimal order for the econometric model. The optimal lag order is selected according to LR, FPE, AIC, SC, and HQ information criteria. The test results are listed in Table 3. It can be found that the optimal lag order is 4 according to LR information criterion, 8 according to AIC information criterion, and 1 according to FPE, SC, and HQ criterion. Therefore, based on various information criteria, the optimal lag order is selected as 1.

4.3. Cointegration Test. According to the results of stationarity test, all variables are first-order integration, so the VAR model can be selected for Johansen cointegration test. Based on the optimal lag order, the Johansen cointegration test results are listed in Table 4.

The test results in Table 4 show that, at the significance level of 5%, there is a stable long-term co-integration relationship among US trade policy uncertainty, output, investment, consumption, and net export.

4.4. Impulse Response Analysis. The impulse response function can analyze the current and future effects of one standard deviation shock of the disturbance term on each variable in the model and can reflect the interaction among the variables. Based on the impulse response function, we investigate the impact of U.S. trade policy uncertainty on China’s macroeconomy and set the policy shock as one standard deviation of U.S. trade policy uncertainty rising, the shock period is 20.

The impulse response of China’s macroeconomic variables to the U.S. trade policy uncertainty is shown in Figure 1. Specifically, Figure 1(c) shows the effect of U.S. trade policy uncertainty on China’s GDP. In terms of the direction of impulse response, given one positive standard deviation shock of the US trade policy uncertainty, China’s GDP has a negative response and reaches its maximum value in the first period and then slowly picks up. From the fourth period, that is, one year later, the impact on GDP gradually disappeared. In terms of the degree of impulse response, one positive standard deviation of U.S. trade policy uncertainty
reduces China’s GDP by a maximum of about 0.04% in the current period. This indicates that an increase in the U.S. trade policy uncertainty will lead to a decline in China’s gross domestic product. The possible reason is that trade policy uncertainty directly reduces China’s net exports, leading to a decline in domestic household income. A fall in household disposable income would further depress consumption, causing the economy’s aggregate demand to fall. Insufficient demand in the labor and commodity markets led to a reduction in employment and a contraction in business investment, which ultimately led to a decline in the level of total output.

Figure 1(d) shows the effect of one positive standard deviation shock of U.S. trade policy uncertainty on China’s investment. In terms of the direction of impulse response, when one positive standard deviation of U.S. trade policy uncertainty is given, the investment shows a negative response in the current period, but it turns to a positive response from the second period and reaches the highest point in the third period. Then the impact on the investment gradually weakens from the third period and returns to preshock levels after about 20 periods. In terms of the degree of impulse response, one positive standard deviation of U.S. trade policy uncertainty causes the investment to decline by...
about 0.18% in the current period and rise to the maximum value of about 0.7% in the third period. This indicates that a rise in U.S. trade policy uncertainty will lead to a decline in Chinese investment in the short term and an increase in the medium to long term. The possible reason is that, due to the irreversibility of investment, there is a threshold for the optimal investment of the enterprise. When the external demand reaches a certain upper limit, the enterprise will increase the investment, and when the demand drops to a certain lower limit, the enterprise will reduce the investment. An increase in trade policy uncertainty will raise the upper limit of the threshold, cause enterprises to wait and see, and ultimately lead to lower investment levels (Bernanke [24], Bloom [2]). For the long-term effect, according to the structure of China’s fixed assets investment, the real estate investment accounts for a large proportion. Because China’s real estate has a strong collateral nature, when policy uncertainty rises, the real estate industry has more collateral and higher expected returns than other industries and there is less information asymmetry with financial institutions such as banks, so more development credit is available. Therefore, in the medium and long term, trade policy uncertainty increases the scale of real estate investment and hence, fixed asset investment. The empirical evidence in this study is in line with Jing et al. [25], who found that an increase in economic policy uncertainty significantly increases the size of investment and financing in the real estate sector.

Figure 1(e) shows the effect of U.S. trade policy uncertainty on China’s consumption. In terms of the direction of impulse response, given one positive standard deviation shock of the US trade policy uncertainty, consumption has a
negative response in the first period, reaches the minimum in the fourth period, and then gradually weakens, back to pre-shock levels after about 20 periods. In terms of the degree of impulse response, one positive standard deviation of U.S. trade policy uncertainty will lead to a drop in consumption of about 0.01% in the current period and a peak of about 0.035% in the fourth period. This indicates that increased uncertainty about trade policy will lead to lower consumption in China, possibly because higher uncertainty about U.S. trade policy will force domestic residents to be more concerned about their future income. Thus, domestic residents will increase their precautionary savings by consuming less (Barrero and Bloom [26]).

Figure 1(f) shows the effect of U.S. trade policy uncertainty on China’s net export. In terms of the direction of impulse response, given one positive standard deviation shock of the U.S. trade policy uncertainty, net exports have a negative response and reach its minimum value in the first period, subsequently, the impact of trade policy uncertainty begins to weaken gradually from the second period and returns to the pre-shock level after about 20 periods. In terms of the degree of impulse response, one positive standard deviation of U.S. trade policy uncertainty will result in a fall in net exports of about 0.2% in the current period. This indicates that higher U.S. trade policy uncertainty will lead to a decrease in China’s net exports. The possible reason is that an increase in trade policy uncertainty will hinder potential enterprises from entering the export market and inhibit the development of international trade, thus reducing the volume of export trade. A typical fact is that China’s accession to the World Trade Organization in 2001 significantly reduced the possibility of tariff escalation, thus greatly reducing trade policy uncertainty, which in turn led to a surge in China’s exports to the United States. An empirical study by Handley and Limão [5] finds that China’s accession to WTO reduced the U.S. threat of a trade war, which can account for over one-third of China’s export growth in the period 2000–2005. In addition, empirical studies on Portugal (Handley and Limão [27]), Cuba (Limão and Maggi [28]), and 149 different countries (Osnago et al. [29]) all have found that reduced trade policy uncertainty would increase trade volume. Our empirical evidence based on China is consistent with the existing conclusions.

5. Conclusions

In this study, we document the spillover effect of U.S. trade policy uncertainty on real economic activity in China. In doing so, we estimate a Bayesian VAR model on a data set over the period from the first quarter of 1997 to the fourth quarter of 2017. The main results can be summarized as follows:

An increase in U.S. trade policy uncertainty has a significant negative effect on China’s output, consumption, and net export in the short and long run, but it will have a negative impact on investment in the short run and a positive impact in the medium and long run. Regarding the specific degree of impulse response, one positive standard deviation of US trade policy uncertainty can reduce China’s output, investment, consumption, and net exports by about 0.04%, 0.18%, 0.01%, and 0.2%, respectively, over the same period. From the perspective of influencing peaks, the maximum deviation of China’s output, investment, consumption, and net export is about 0.04%, 0.7%, 0.035%, and 0.2%, respectively. Our empirical results suggest that U.S. trade policy uncertainty is an important factor influencing China’s real economy.

Based on the research conclusion, China can take different measures to mitigate the adverse effects of U.S. trade policy uncertainty: first, China should sign free trade agreements, promote the implementation of the “Belt and Road” initiative and actively participate in international rule-making to reduce the negative impact of single country trade policy on China’s economy. Second, China can implement a prudent monetary policy and an active fiscal policy to provide liquidity support for the real economy and reduce the tax burden on enterprises, so as to cope with the increase of trade policy uncertainty. Our framework in this study can be extended to study the effects of U.S. various policy uncertainty on a wider range of economies in a straightforward manner. As this study only focuses on the macroeconomic response, a natural extension is to study the spillover effects on the microeconomic aspects, for instance, stock return and corporate behavior.

Data Availability

All the data are included within the article. Further data can be requested from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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