

COVID-19 and Energy

Uncertainty in the Pandemic and the Energy Stock Market: Evidence From China

Mengxu Xiong^{1 a}

¹ School of Economics, Huazhong University of Science and Technology, China

Keywords: china, svar, energy stock market, uncertainty

<https://doi.org/10.46557/001c.27021>

Energy RESEARCH LETTERS

Vol. 2, Issue 3, 2021

This study probes the relation between uncertainty, the Chinese stock market, and the Chinese energy stock market during the COVID-19 pandemic period, using a structural vector autoregressive model. This paper shows that uncertainty negatively shocks both the energy and A-share markets. The impulse response results suggest that the adverse influence of uncertainty on the energy stock market lasts longer.

I. Introduction

This paper investigates the effects of the COVID-19 pandemic on the Chinese energy stock market. The unexpected COVID-19 pandemic not only has been disrupting the world and threatening human lives, but also has significant social and economic consequences (Narayan, 2021). The pandemic has led to financial market overreaction (Narayan et al., 2020) and reduced oil demand and oil prices (Narayan, 2020). However, a reduction in confirmed coronavirus cases can improve liquidity in financial markets (Haroon & Rizvi, 2020). Although previous studies have explored the consequences of the pandemic, research from the uncertainty viewpoint is limited.

Indeed, the COVID-19 health emergency has led to widespread uncertainty in health and economic recovery (Szczygielski et al., 2021). To study how uncertainty affects economic activities, studies have proposed numerous indicators, such as policy uncertainty, monetary policy uncertainty, and trade policy uncertainty (Gu et al., 2021). Despite this, macroeconomic uncertainty is believed to be an essential source of business cycle fluctuations (Shi & Shen, 2021), and the literature that studies the uncertainty resulting from public health concerns is scarce. The sense of uncertainty can even be an underlying mechanism through which the pandemic undermines economic activities. We thus use the uncertainty index constructed by Narayan et al. (2021) to analyze how sentiment about COVID-19 uncertainty impacts the economy.

In studying the influence of uncertainty on economic activities, we focus on the energy industry, due to its crucial role in the global economy. More precisely, we explore the reaction of the Chinese energy market to pandemic-related uncertainty. The rationale is that stock prices should reflect all information at a given time, consistent with Fama's

(1970) efficient market hypothesis. In addition, the volatility in the stock market should reflect investors' expectations in terms of future profitability (Breinlich et al., 2018). In this regard, the financial market would have responded promptly to the outbreak of the pandemic as it incorporated new information emanating from the shock. Therefore, we hypothesize that the sentiment captured by COVID-19 uncertainty reduces Chinese energy stock prices.

To verify our hypothesis, we examine the relation between the uncertainty index (*Uncertainty*), the Chinese stock market index (*CSI 300*), and the Chinese energy stock market index (*SZESI*). Specifically, we use a structural vector autoregressive (SVAR) model to analyze the dynamic interactions between these variables. Our results show that uncertainty during the pandemic has negatively impacted energy stock prices, and the impulse response suggests that the Chinese energy market is more vulnerable than the Chinese stock market. To establish the robustness of our findings, we use the CSI 1000 as an alternative proxy for the Chinese stock market and find consistent results.

The contributions of our findings are twofold. First, we add to the literature that studies the influences of the COVID-19 pandemic on the financial market from an energy market perspective (for a survey of this literature, see Narayan (2020)). Second, we use a novel index and study the influence of the pandemic from the perspective of uncertainty. Because no other studies have utilized this COVID-19 uncertainty index recently developed by Narayan et al. (2021), it allows us to draw fresh insights into the role of uncertainty in influencing energy prices.

The remainder of the paper proceeds as follows. Section II presents the data and methodology. Section III discusses the results. The concluding remarks are provided in the final section.

^a **Corresponding author:** Mengxu Xiong, School of Economics, Huazhong University of Science and Technology, Wuhan 430074, China. Email: xiongmx@hust.edu.cn.

Table 1. Descriptive statistics and main results

Panel A: Selected descriptive statistics								
Variables		SD		Min		Mean		Max
uncertainty		12.456		0		56.316		100
Δuncertainty		10.149		-37.86		0.0408		40.1
CSI 300		563.718		3530.31		4598.087		5807.72
SZESI		205.184		2157.29		2578.002		3001.4
Panel B: SVAR results								
Part I								
lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-898.969				2.00E+10	3.22E+01	32.2553	32.3217
1	-799.113	199.71	9	0	7.70E+08*	28.9683*	29.1366*	29.4023*
2	-795.594	7.0393	9	0.633	9.30E+08	29.1641	29.4585	29.9236
3	-791.651	7.8859	9	0.546	1.10E+09	29.3447	29.7653	30.4297
4	-778.32	26.662*	9	0.002	9.80E+08	29.19	29.7369	30.6005
Part II								
		Coef.	Std.	Err.	z	P>z	[95% Conf. Interval]	
Matrix A								
		a_{21}	2.11	.694	3.04	0.002	.75	3.471
		a_{31}	1.074	.429	2.50	0.012	.233	1.916
		a_{31}	-.3706	.077	-4.84	0	-.521	-.221
Matrix B								
		b_{11}	9.986	.944	10.58	0	8.137	11.836
		b_{22}	56.078	5.299	10.58	0	45.693	66.464
		b_{33}	51.867	4.9	10.58	0	42.261	61.472

This table (Panel A) presents the descriptive statistics (standard deviation (SD), mean, minimum (Min.), maximum (Max.), of all the variables, and we conduct first-difference on the nonstationary variable. The variables are the China Shanghai-Shenzhen 300 index (*CSI 300*); the energy index (*SZESI*) reported by Shenzhen stock exchange; and the COVID-19 related uncertainty index of Narayan et al. (2021), denoted *uncertainty*, with delta denoting its first difference. Panel B presents the estimation results from the SVAR model. Part I shows the information criteria test results, where FPE is financial prediction error, AIC is Akaike Information Criteria, HQIC is the Hannan-Quinn Information Criteria, and SBIC is the Schwarz Information Criterion. The statistics relating to log likelihood (LL) and likelihood ratio (LR), degrees of freedom (df) and probability value (p) are also provided. Part II exhibits the estimated coefficients of A and B matrices.

II. Data and Methodology

A. Data

This study uses the China Shanghai–Shenzhen 300 index (*CSI300*), which consists of the 300 largest and most liquid A-share stocks, to proxy for the Chinese stock market. To depict the fluctuations in the energy market, we retrieve the energy index reported by Shenzhen Stock Exchange (*SZESI*), an index that represents the Chinese energy market. For the COVID-19 uncertainty measure, we use the uncertainty index compiled by Narayan et al. (2021). Specifically, their indicator is constructed based on counts of words related to uncertainty and risk as reported in 45 global newspapers. Our final sample comprises of time-series data from December 31, 2019, to April 28, 2021, as shown in Panel A of [Table 1](#).

B. SVAR

To examine the relation between COVID-19 uncertainty and the energy stock market, we adopt the SVAR model, which has been widely used in energy research (Chen et

al., 2016). Specifically, we define a vector of three variables, denoted as Y_t ($Y_t = Uncertainty_t, CSI300_t, SZESI_t$). Then the SVAR model is established as follows:

$$Y_t = \sum_{i=1}^p A_i Y_{t-i} + A_t \quad (1)$$

$$A_t = B \varepsilon_t \quad (2)$$

where Y_t denotes the percentage change in the uncertainty index, the Chinese A-share stock index, and the energy stock index, respectively; A_i is the unknown coefficient matrix to be estimated; and U_t and ε_t are forecast errors and structural shocks for Y_t , respectively. Therefore, the structural model with imposed restrictions in the A and B matrices are written as

$$\begin{bmatrix} 1 & 0 & 0 \\ a_{21} & 1 & 0 \\ a_{31} & a_{32} & 1 \end{bmatrix} \begin{bmatrix} Uncertainty \\ CSI300 \\ SZESI \end{bmatrix} \quad (3)$$

$$= \begin{bmatrix} b_{11} & 0 & 0 \\ 0 & b_{22} & 0 \\ 0 & 0 & b_{33} \end{bmatrix} \begin{bmatrix} \varepsilon_{Uncertainty} \\ \varepsilon_{CSI300} \\ \varepsilon_{SZESI} \end{bmatrix} \quad (4)$$

$$Uncertainty = b_{11} \varepsilon_{Uncertainty} \quad (4)$$

$$CSI300 = -a_{21} Uncertainty + b_{22} \varepsilon_{CSI300} \quad (5)$$

Table 2. Robustness checks

	Coef.	Std.	Err.	z	P>z	[95% Conf.Interval]	
Matrix A							
	a_{21}	2.948	1.057	2.79	0.005	0.875	5.02
	a_{31}	0.819	0.406	2.02	0.044	0.023	1.616
	a_{32}	-0.292	0.0481	6.07	0	-0.387	-0.198
Matrix B							
	b_{11}	9.773	0.923	10.58	0	7.963	11.583
	b_{22}	77.333	7.307	10.58	0	63.011	91.655
	b_{33}	27.853	2.632	10.58	0	22.695	33.012

This table presents the estimated coefficients of A and B matrices when we replace *CSI 300* in Table 1 (Panel B) with *CSI 1000* as a proxy for the stock market.

$$SZESI = -a_{31}Uncertainty - a_{32}CSI300 + b_{33} \varepsilon_{SZESI} \quad (6)$$

In this case, $-a_{31}$ and $-a_{32}$ reflect the influence of uncertainty and *CSI 300* on *SZESI*, respectively, whereas $-a_{21}$ reveals the effect of uncertainty on *CSI 300*. Considering that the variable *Uncertainty* is not stationary and does not meet the requirements for using the SVAR model, we conduct first differences on it. The descriptive statistics of all the variables are reported in Panel A of Table 1.

III. Results and Discussion

A. Coefficients of the A and B matrices

Panel B of Table 1 presents the results of our estimation. It is worth mentioning that we use information criteria to determine the optimal lag order, which is presented in Part I of Table 1, Panel B. The coefficients indicate that uncertainty in the COVID-19 pandemic exerts a negative shock on both the A-share market and the energy stock market, and the fluctuations in energy market are positively related to those of the A-share market. Specifically, a one standard deviation in the uncertainty shock induces a 1.07% reduction in the energy stock price.

B. Impulse Response Function

Furthermore, we analyze the impulse responses of COVID-19 uncertainty on the energy stock market and the Chinese A-share market. Figure 1 presents the impulse response results from standard deviation shocks to uncertainty. The stock prices of both markets react negatively to the unexpected shock, and we note that the A-share stock market seems to be more resilient to the uncertainty than its energy counterpart, which takes longer to recover from the adverse impacts.

C. Robustness Checks

In this section, we conduct a robustness test to ensure that our results are credible. Specifically, we replace the

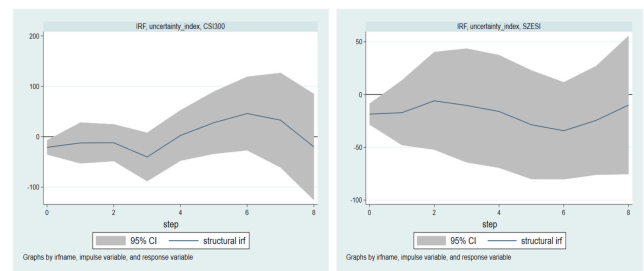


Figure 1. Impulse Response

The figure plots the response of stock prices of A share market and energy market to a one standard deviation shock to uncertainty due to COVID-19.

CSI 300 index with the *CSI 1000*, an alternative proxy for Chinese stock prices. This analysis yields results similar to those presented in Table 2. In other words, the negative effects of COVID-19 uncertainty on the energy market and the A-share market continue to hold, strengthening our confidence that our baseline results are robust.

IV. Conclusion

This study investigates the relation between the uncertainty due to COVID-19 and the Chinese stock and energy markets during the COVID-19 pandemic. The empirical analysis is based on an SVAR framework. Our findings suggest that uncertainty leads to a significant drop in the prices of both the energy and stock markets. The impulse response analysis reveals that the adverse effect of uncertainty is more persistent in the energy market. The implication is that the massive spike in uncertainty during the pandemic has potentially triggered volatility in the financial market, and the energy stock market seem to be more vulnerable. This claim should be further verified using different approaches. We leave this for future studies.



REFERENCES

- Breinlich, H., Leromain, E., Novy, D., Sampson, T., & Usman, A. (2018). The Economic Effects of Brexit: Evidence from the Stock Market. *Fiscal Studies*, 39(4), 581–623. <https://doi.org/10.1111/1475-5890.12175>
- Chen, H., Liao, H., Tang, B.-J., & Wei, Y.-M. (2016). Impacts of OPEC's political risk on the international crude oil prices: An empirical analysis based on the SVAR models. *Energy Economics*, 57, 42–49. <https://doi.org/10.1016/j.eneco.2016.04.018>
- Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *Journal of Finance*, 25(2), 383–417. <https://doi.org/10.2307/2325486>
- Gu, X., Zhu, Z., & Yu, M. (2021). The macro effects of GPR and EPU indexes over the global oil market—Are the two types of uncertainty shock alike? *Energy Economics*, 100, 105394. <https://doi.org/10.1016/j.eneco.2021.105394>
- Haroon, O., & Rizvi, S. A. R. (2020). Flatten the curve and stock market liquidity—An Inquiry into emerging economies. *Emerging Markets Finance and Trade*, 56(10), 2151–2161.
- Narayan, P. K. (2020). Oil price news and COVID-19—Is there any connection? *Energy Research Letters*, 1(1), 13176. <https://doi.org/10.46557/001c.13176>
- Narayan, P. K. (2021). COVID-19 research outcomes: An agenda for future research. *Economic Analysis and Policy*, 71, 439–445. <https://doi.org/10.1016/j.eap.2021.06.006>
- Narayan, P. K., Devpura, N., & Wang, H. (2020). Japanese currency and stock market—What happened during the COVID-19 pandemic? *Economic Analysis and Policy*, 68, 191–198. <https://doi.org/10.1016/j.eap.2020.09.014>
- Narayan, P. K., Iyke, B. N., & Sharma, S. S. (2021). New Measures of the COVID-19 Pandemic: A New Time-Series Dataset. *Asian Economics Letters*, 2(2), 23491.
- Shi, X., & Shen, Y. (2021). Macroeconomic uncertainty and natural gas prices: Revisiting the Asian Premium. *Energy Economics*, 94, 105081. <https://doi.org/10.1016/j.eneco.2020.105081>
- Szczygielski, J. J., Brzeszczyński, J., Charteris, A., & Bwanya, P. R. (2021). The COVID-19 storm and the energy sector: The impact and role of uncertainty. *Energy Economics*, 105258. <https://doi.org/10.1016/j.eneco.2021.105258>