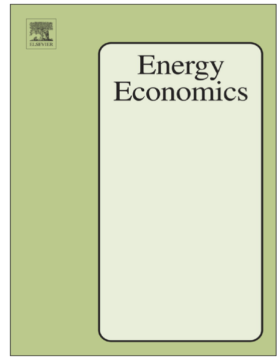
Journal Pre-proof



Global oil price uncertainty and excessive corporate debt in China

Xiaohang Ren, Jianing Qin, Chenglu Jin, Cheng Yan

PII: S0140-9883(22)00507-2

DOI: https://doi.org/10.1016/j.eneco.2022.106378

Reference: ENEECO 106378

To appear in: *Energy Economics*

Received date: 4 April 2022

Revised date: 10 September 2022

Accepted date: 16 October 2022

Please cite this article as: X. Ren, J. Qin, C. Jin, et al., Global oil price uncertainty and excessive corporate debt in China, *Energy Economics* (2022), https://doi.org/10.1016/j.eneco.2022.106378

Global oil price uncertainty and excessive corporate debt in China

Xiaohang Ren[a], Jianing Qin[a], Chenglu Jin[b,*] Cheng Yan[c]

[a] *School of Business, Central South University, Changsha 410083, China*

[b] *School of Finance, Zhejiang University of Finance & Economics, Hangzhou 310018, China*

[c] *University of Essex, Colchester, CO4 3SQ, UK*

E-mail addresses: domrxh@outlook.com (X.H. Ren), 1437131778@qq.com (J.N. Qin) chenglu.jin@zufe.edu.cn (C.L. Jin), cheng.yan@essex.ac.uk (C. Yan)

**Corresponding author:*

Abstract: Oil price uncertainty has widely influenced the economic development of the world. This study explores the influence of oil price uncertainty on the excessive debt behavior of Chinese listed companies during 2010－2019. Our results show that a global oil price uncertainty can significantly reduce excessive corporate debt, and the impact is predominant among small, non-state-owned, non-high-tech, or non-energy firms. Results also show that oil price uncertainty acts from both demand and supply channels. In particular, at the demand level higher product-market demand can weaken the impact of oil price uncertainty, while at the supply level higher financing constraints can enhance the impact of oil price uncertainty. Our findings are robust to a range of tests. Under the construction of the market-oriented system, enterprises should establish differentiated financing decisions for different businesses to deal with oil price fluctuations, and financial institutions also need to pay more attention to the excessive debt phenomenon of different types of corporate under the uncertain oil price.

Keywords: Oil price uncertainty; Excessive debt; Product-market Demand; Financing Constraints; Moderating Effect

1. Introduction

Risks are accumulating in the worldwide political, economic, health, scientific, cultural, and security fields, which significantly impacts both global oil supply and demand sides and leads to dramatic global oil price uncertainty. There is a long line of literature that focuses on the impact of oil market shock on economic growth, stock returns, and other economic indicators (Elder & Serletis, 2010; Maghyereh & Abdoh, 2020; Maheu et al., 2020; Soyemi et al., 2019). Several studies have investigated the relationship between oil price uncertainty and microstructures, firm-level characteristics, or decision-making processes (Alhassan, 2019; Hasan et al., 2022; Wong & Hasan, 2021). However, most prior research has studied the impact of oil price uncertainty on corporate investment (Chen et al., 2020; Wang et al., 2017; Wu & Wang, 2021) rather than on corporate debt.

Given the current global inflation and economic downturn, the overall debt of enterprises has increased, and the problem of excessive debt has become prominent (Alessi & Detken, 2018; Soe, 2018). This is especially serious in emerging countries such as China. Crude oil imports to China and import dependence have increased dramatically, producing extensive data. Figure 1 shows that dependency reached 73% in 2020 (refer to National Bureau of Statistics), and Figure 2 shows that China's crude oil import value will rank first in the world in 2019. Thus, the impact of the global oil market will inevitably affect the financing of Chinese enterprises.

Insert Fig. 1

Insert Fig. 2

Previous studies have confirmed that macro-uncertainty has a stronger impact on corporate debt than trait uncertainty (Baum et al., 2009). Oil price uncertainty, as a type of macro-uncertainty, affects the volatility of production costs and future profits (Henriques & Sadorsky, 2011) and is essential for decision-making (Gupta & Krishnamurti, 2018; Wang et al., 2022). Oil price changes may have an effect on corporate debt status, but this question is rarely addressed in the existing literature. We aim to fill this gap by quantitatively gauging the impact of the global oil price uncertainty on excessive corporate debt.

We develop our tests in two steps. First, we use the fixed-effect model to explore the role of the oil price uncertainty on excessive corporate debt and the Logit model to explore the role of the oil price uncertainty on the dummy variable of excessive corporate debt in China. Empirically, using CSI A-share data in China from 2010–2019. Results show that oil price uncertainty weakens the excessive debt levels of companies. It will work in both demand and supply. From the perspective of demand, enterprises facing fluctuations tend to take preventive incentives to reduce their own financing needs. In terms of supply, the oil price uncertainty could lead to insufficient bank credit. The risk of corporate default will also be greater, and financing costs will increase, so the company will reduce its debt. Although China's economy is shifting from government-led to market-led, it still retains Chinese characteristics, such as state-owned enterprises. When considering these firm-level heterogeneities, oil has no significant impact on the excessive debt of either large enterprises or state-owned enterprises; however, the excessive debt weakening capacity of small enterprises and non-state-owned holding enterprises is very significant. Whatever the technical level of enterprises, the impact of the oil price uncertainty on excessive corporate debt is significantly negative. Oil price uncertainty also significantly weakens the excessive debt levels of non-energy enterprises and non-high-tech enterprises. We also run some robustness tests on our findings. For example, we re-examine the problem by using alternative measures of the oil price uncertainty and by controlling some special policies during our sample period, but oil price uncertainty still significantly reduces the level of excessive corporate debt. To examine the endogenous problem, we use the lag phase of the oil price uncertainty as an instrumental variable and run an instrumental variable-generalized method of moments (IV-GMM) model, which also gives consistent results.

In the second step, we further explore the channels at the demand and supply levels. We discuss the impact of enterprises' product-market demand and financial constraints on the relationship between oil price uncertainty and enterprise excessive debt. First, oil price uncertainty is very likely to affect enterprises' product-market demand, since oil is the raw and processed material of most industrial products. At the same time, the establishment of the Chinese market-oriented system enables the demand of the product market to have an important impact on the corporate debt

(Jong, 2007). When suffering a big negative shock, less demand creates a higher risk of default. Final default risk can offset tax incentives and return on investment, which enhances the financial difficulties and insolvency of enterprises (Altman et al., 2019; Falato et al., 2021). Consequently, total debt rises even further. Second, financing constraints also significantly affect corporate strategies on debt structure. Because debt financing is an inevitable financing channel for enterprises. When the macro impact is large, companies are more constrained by financing costs (Coldbeck & Ozkan, 2018; Martínez-Sola et al., 2018). The literature separates the impacts of macro shock and financial market friction on the characteristics of a company. With the deepening of marketization, Chinese enterprises are affected by international uncertainties. Therefore, it is worthwhile to study the internal relationship between international oil price uncertainty, financing constraints, and the excessive debt of enterprises.

Our results show that product-market demand can significantly reduce the oil price uncertainty on excessive debt and can significantly reduce the impact of the oil price uncertainty on small enterprises, state-owned enterprises, non-state-owned enterprises, high-tech enterprises, non-high-tech enterprises, energy enterprises, and non-energy enterprises. For small enterprises, non-state-owned enterprises, non-high-tech enterprises, or non-energy enterprises, product-market demand can more significantly reduce the oil price uncertainty on excessive debt. Moreover, financing constraints can enhance the weakening effect of the oil price uncertainty on the excessive debt of enterprises and can significantly enhance the weakening effect of the oil price uncertainty for small enterprises, non-state-owned enterprises, high-tech enterprises, non-high-tech enterprises, and non-energy enterprises.

To briefly sum up, this paper contributes to the existing literature in four main ways. First, we fill a gap in the literature by showing robust evidence that a global oil price uncertainty will significantly reduce excessive corporate debt and that some firm-level characteristics may influence the strength of the impacts. Second, this paper provides further empirical evidence of incorporating product-market demand and financing constraints into our tests and provide evidence for the role of oil price uncertainty. Third, we provide new evidence for the excessive debt behavior of different types of enterprises in the face of oil price uncertainty, especially as small businesses and non-state-owned enterprises need to pay more attention to oil price changes. High-tech companies and energy companies need to adjust their product-market demand. Finally, we suggest that policymakers and enterprise senior management personnel should improve their understanding of oil price uncertainty and that the transmission of the oil price uncertainty should be taken into account when formulating relevant decisions, especially regarding banks and other financial institutions. This means they should pay attention to the international impact on enterprises and reasonably evaluate the debt risks of those enterprises.

The structure of the rest of this paper is as follows. The literature is reviewed in Section 2. Methods are presented in Section 3. The baseline results as well as subsample analysis is discussed in Section 4. Moderating effect analysis of product-market demand and financing constraints is performed in Section 5. Section 6 analyzes the robustness and endogenous, and Section 7 concludes.

2. Literature review

2.1. The impact of the oil price uncertainty

Oil price uncertainty has become an increasingly popular research topic in recent decades. Elder and Serletis (2010) studied the impact of the oil price uncertainty on economic activity. Since then, research on the impact of the oil price uncertainty on other economic levels has been extensively studied (Alhassan, 2019; Hasan et al., 2022; Smyth & Narayan, 2018; Wong & Hasan, 2021). In addition, other papers have analyzed the impact of the oil price uncertainty on corporate financial structure and investment decisions (Alaali, 2020; Maghyereh & Abdoh, 2020; Zhang et al., 2020).

Overall, the link between oil price uncertainty and corporate decisions has been extensively studied. However, there are relatively few studies on the impact of the oil price uncertainty on corporate financing strategies. But some studies also suggest a potential relationship between them. First, crude oil as a commodity is one of the important inputs in the production of many goods and services. While some companies may not consume crude oil directly during the production process, crude oil may be an indirect cost for the company (Hasan et al., 2022; Ren et al., 2022a). As a result, the more uncertain the oil price is, the more likely the level of excessive corporate debt will be affected. Second, fluctuations in oil prices are usually linked to inflation or deflation. At this point, the central bank will adjust interest rates to respond (Sadorsky, 2012), and the company's financing decisions are likely to be affected by uncertainty in crude oil prices. Thus, this paper provides an analysis of the effect of the oil price uncertainty on excessive corporate debt.

2.2. Excessive debt

Initially, studies on excessive debt focused on the level of joint debt. Companies should have reasonable debt levels (Faulkender et al., 2012; Flannery & Rangan, 2006; Pattillo, 2002). Thereafter, Caskey et al. (2012) decompose the debt ratio into the target debt ratio and the excessive debt ratio. Some studies have suggested that too high corporate debt drives a weak investment recovery in many countries (Aivazian et al., 2005; Gebauer et al., 2018). Therefore, scholars have paid more attention to the enterprise's excessive debt ratio than to the actual debt ratio, and they have explored methods to reduce the excessive debt of enterprises. Prior studies have tested how to adjust the deviation between actual and reasonable debt levels by focusing on bank competition and cash flow (Faulkender et al., 2012; Jiang et al., 2017). Boubakri et al. (2012) suggested that ties between corporate executives and political actors will make companies less dependent on debt financing, and Wang et al. (2014) showed that economic policy uncertainty will lead companies to use their internal funds to reduce the negative impact of policy uncertainty and reduce excessive debt. In addition, overconfident managers tend to overestimate the value of their company, indicating that their external financing is too high in comparison to internal financing costs, and they will prioritize endogenous financing instead of excessive debt.

However, these theories focus primarily on the enterprise-level impacts, and there is a lack of studies on the influence of macro factors. To fill this gap, we introduce the macro factor of the oil price uncertainty to study its impact on excessive debt.

2.3. The determinants of corporate financing decisions

The cause of excessive enterprise debt involves the financing decisions of enterprises. Many studies select common proxy variables, including the proportion of fixed assets, the non-debt tax shield, growth opportunities, profitability, and other company financial data.

First, some studies have found that companies with a low proportion of fixed assets are more inclined to debt. Companies with fewer physical assets have high liquidation costs, thus, they will pay more attention to bank loan terms and benefit from the reduction in information asymmetry related to banking regulations. Therefore, they should prefer to have more debt (Denis & Mihov, 2003; Rauh & Sufi, 2010). Second, Lei (2020) showed that replacing the debt tax shield with a non-debt tax shield can reduce the corporate debt level. Most existing studies support this reverse relationship (Lanis et al., 2021). Furthermore, according to the agency cost doctrine (Jensen & Meckling, 1976), the degree of equity concentration should be negatively related to the debt level. If the major shareholders control of a Chinese company is strong, they can appoint the management of the company, which leads to fewer agency problems. Therefore, companies have a tendency to reduce debt to reduce repayment pressure. However, when the equity is too concentrated, it becomes easy for major shareholders to collude with managers and worsen the degree of excessive debt.

In addition, pecking order theory suggests that managers are reluctant to issue shares, while high-growth companies face greater financing need. As a result, companies will choose higher debt (Frank and Goyal, 2003; Serrasqueiro, 2015). The agency theory states that there is a negative correlation between growth opportunities and corporate debt (Shapior, 2005; Eisenhardt, 1989). Finally, there are also differing opinions about how profitability affects corporate debt. Companies with strong profitability have less debt (Schwartz & Dalmacio, 2020). Pecking order theory assumes that profitable companies will choose internal financing rather than debt. However, the trade-off theory argues that enterprises with higher profitability, due to the tax shield, will increase their debt to obtain more deductions (Xu, 2012).

Hence, many studies have investigated the influence of several corporate-specific characteristics on corporate debt. However, the relationship between macroeconomic impacts and financial decisions is not clear, especially since the oil price uncertainty has not been sufficiently studied. Thus, this paper first determines the directional impact of the oil price uncertainty on the excessive debt of enterprises and then explores the moderating roles of product-market demand and financing constraints.

3. Methods

3.1. Definitions of variables

(1) Excessive debt

We first estimate the target debt ratio of the enterprise, which is determined by enterprise characteristics, industry, and macro factors. As suggested in the existing literature (Denis & Mekeon, 2012; Uysal, 2011), the enterprise target debt ratio *DA* is expressed as:

$$DA_t = \alpha_0 + \alpha_1 SOE_{t-1} + \alpha_2 ROA_{t-1} + \alpha_3 IND\_LEVB_{t-1} + \alpha_4 GROWTH_{t-1} + \alpha_5 FATA_{t-1} + \alpha_6 SIZE_{t-1} + \alpha_7 TOP1_{t-1} \quad (1)$$

Next, the excessive debt ratio *EXDA* is measured by the differences between the actual debt ratio of the enterprise and the target debt ratio. The larger the *EXDA*, the higher the degree of excessive debt of the enterprise. In addition, the dummy variable *EXDA_dum* is set. If *EXDA* > 0, the *EXDA_dum* value is 1; otherwise, it is 0. The debt ratio (*DA*) in model (1) is calculated by the asset-debt ratio of the enterprise. Meanwhile, according to Chang et al. (2014), model (1) also controls the profit margin of total assets (*ROA*), state-owned property rights (*SOE*), median industry asset-debt ratio (*IND_LEVB*), total assets growth rate (*GROWTH*), fixed assets to total assets (*FATA*), enterprise scale (*SIZE*), the largest shareholder shareholding ratio (*TOP1*).

(2) Oil price uncertainty

Existing literature commonly measures oil price uncertainty using standard deviations of oil price changes or conditional variance calculated by the GARCH model (Alaali, 2020; Henriques & Sadorsky, 2011; Sadorsky, 2008; Wang et al., 2017). We also apply standard deviations of oil price changes to measure the oil price uncertainty. We use the daily oil price obtained from the IEA website[1] and select the daily closing price from the West Texas Intermediate (WTI) crude oil contract. In the robustness test, the Brent Crude and Chicago Board Options Exchange (CBOE) Crude Oil Volatility Index are chosen for recalculation. The annual oil price volatility is calculated following Sadorsky (2008):

$$\sigma_t = \sqrt{\frac{1}{N-1}\sum_{t=1}^{N}(r_t^0 - E(r_t^0)^2} \cdot \sqrt{N} \tag{2}$$

Crude oil price fluctuations and annual average prices are shown in Figure 3. According to the figure, oil prices were the most volatile in 2015 and 2016. The main factor in the two-year decline was the competition between Organization of Petroleum Exporting Countries (OPEC) crude oil supply and production growth in U.S. shale oil, which boosted North American crude oil production. The battle between OPEC members and U.S. shale oil producers has led to increasing supply and a severe oversupply in the crude oil market.

[1] Source: https://www.iea.org/

Insert Fig. 3

(3) Product-market demand

In the literature, sales growth is commonly used as a proxy for product-market demand (Aghion et al., 2012; Ding et al., 2018), as it reflects significant changes in business due to demand. Following Sun et al. (2021), we further divide demand into high and low demand states. The dummy variable *D_dum*, which we use to alleviate the measurement problem, is 1 when sales growth is greater than 0; otherwise, it is 0.

(4) Financing constraints

The financing constraint index Kaplan & Zingales (*KZ*) is constructed according to the company's operating net cash flow, dividends, cash holding, asset-debt ratio, and Tobin's Q (Kaplan & Zingales, 1997). The larger the *KZ* index, the higher the financing constraints that listed companies face.

(5) Control variables

Based on the excessive debt literature (Chang et al., 2014; Buccola, 2014; Sun et al., 2021), we control for the proportion of fixed assets (*FATA*), profitability (*ROA*), non-debt tax shield (*NDTS*), management expense rate (*EXP*), growth opportunities (*GROWTH*), income tax rate (*ETR*), book-value to market-value rate (*MB*), stock proportion of the largest shareholder (*TOP1*), profit volatility (*VEBITTA*), and cash flow volatility (*VCF*). Table A1 summaries all variables.

3.2. Model constructions

To investigate the impact of the oil price uncertainty on excessive corporate debt, this paper develops the following model:

$$EXDA_{i,t} = \beta_0 + \beta_1 OPU_t + \beta_2 SIZE_{i,t} + \beta_3 GROWTH_{i,t} + \beta_4 FATA_{i,t} + \beta_5 ETR_{i,t} + \beta_6 ROA_{i,t} + \beta_7 EXP_{i,t} + \beta_8 MB_{i,t} + \beta_9 TOP1_{i,t} + \beta_{10} NDTS_{i,t} + \beta_{11} VEBITTA_{i,t} + \beta_{12} VCF_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$Logit(EXDA\_dum_{i,t}) = \beta_0 + \beta_1 OPU_t + \beta_2 SIZE_{i,t} + \beta_3 GROWTH_{i,t} + \beta_4 FATA_{i,t} + \beta_5 ETR_{i,t} + \beta_6 ROA_{i,t} + \beta_7 EXP_{i,t} + \beta_8 MB_{i,t} + \beta_9 TOP1_{i,t} + \beta_{10} NDTS_{i,t} + \beta_{11} VEBITTA_{i,t} + \beta_{12} VCF_{i,t} + \varepsilon_{i,t} \quad (4)$$

EXDA represents excessive debt ratio of company *i* in year *t*. *EXDA_dum* is a dummy variable. The OPU_t denotes the oil price uncertainty in year *t*. It is worth noting that *OPU*'s slope coefficient β measures the function of the oil price uncertainty on excessive corporate debt.

To test whether the impact of oil price uncertainty is affected by the product-market demand and financing constraints, we introduce the interaction item revision, as follows:

$$EXDA_{i,t} = \beta_0 + \beta_1 OPU_t + \beta_2 OPU_t \times M_{i,t} + \beta_3 M_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 GROWTH_{i,t} + \beta_6 FATA_{i,t} + \beta_7 ETR_{i,t} + \beta_8 ROA_{i,t} + \beta_9 EXP_{i,t} + \beta_{10} MB_{i,t} + \beta_{11} TOP1_{i,t} + \beta_{12} NDTS_{i,t} + \beta_{13} VEBITTA_{i,t} + \beta_{14} VCF_{i,t} + \varepsilon_{i,t} \quad (5)$$

$$Logit(EXDA\_dum_{i,t}) = \beta_0 + \beta_1 OPU_t + \beta_2 OPU_t \times M_{i,t}$$
$$+\beta_3 M_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 GROWTH_{i,t}$$
$$+\beta_6 FATA_{i,t} + \beta_7 ETR_{i,t} + \beta_8 ROA_{i,t} + \beta_9 EXP_{i,t}$$
$$+\beta_{10} MB_{i,t} + \beta_{11} TOP1_{i,t} + \beta_{12} NDTS_{i,t}$$
$$+\beta_{13} VEBITTA_{i,t} + \beta_{14} VCF_{i,t} + \varepsilon_{i,t} \quad (6)$$

In equation (6), *M* is moderating variables, including *D_dum* and *KZ*. *OPU*×*M* represents the interaction term. In this equation, we focus on the coefficients of the oil price uncertainty and interaction terms. When $\beta_1 > 0$ and $\beta_2 < 0$, the moderating variable alleviates the negative impact of the oil price uncertainty on excessive debt; when $\beta_1 > 0$ and $\beta_2 > 0$, the moderating variable aggravates the adverse impact on excessive debt; when $\beta_1 < 0$ and $\beta_2 > 0$, the moderating variable weakens the favorable impact of excessive debt; and when $\beta_1 < 0$ and $\beta_2 < 0$, the moderating variable enhances the positive impact of the oil price uncertainty on excessive debt.

3.2. Data sample and summary

In this paper, the CSI A-share listed companies from 2010 to 2019 are collected from the China Stock Market & Accounting Research Database (CSMAR) listed company database and the CBOE website. We screen the sample according to the following principles, which are widely used in the literature: 1) eliminating companies that have undergone special treatment; 2) deleting financial companies due to their differing financial structures; 3) deleting any companies that are not listed before 2010. The final sample includes 3,214 enterprises. To eliminate the influence of outliers, we winsorize the top and bottom 0.5% of all corporate continuous data.

Table 1 presents the descriptive statistics of the main variables. The average oil price fluctuation over the sample period was 14%, with a maximum value of 21.1% and a minimum value of 7.9%. When excessive debt is measured by dummy variable. Excessive debt equaling 1 indicates the existence of excessive debt in the current period with risks and weak risk resistance ability. When excessive debt is 0, there is no excessive debt phenomenon. The average value of the excessive debt of the sample enterprises is 49.4%, indicating that 49.4% of the enterprises had excessive debt. The fact that almost half of the enterprises have excessive debt phenomenon poses great challenges to the operation of the enterprises and the overall market environment. The average oil price impact suffered by the sample enterprises is 14.04%.

Insert Table 1

4. Empirical results and discussion

4.1. Baseline results

Results suggest that increasing shock in oil prices will undermine excessive corporate debt. The key explanatory variable *OPU* weakens excessive corporate debt at the 1% significance level (Table 2). The results using the OLS regression show that the coefficient of the *OPU* is -0.0779. After controlling for firm fixed effects, the coefficient of the *OPU* is -0.0901. In other words, an increased standard deviation from the impact of oil prices will lead to a reduction in excessive debt levels by 9.01%. The Logit-FE model *OPU* estimated coefficient is -2.1428, suggesting that an increased standard deviation of the oil price impact differs from the fixed-effect model by 0.12%.

Insert Table 2

There are two possible fundamental mechanisms through which oil price uncertainty affects corporate debt. First of all, oil price uncertainty has a marked impact on the economy and may lead to insufficient bank credit. Additionally, corporate default risk increases due to information asymmetry (Maghyereh & Abdoh, 2020). To reduce this risk, banks will tighten their credit supply. When financing costs increase, companies will decrease their debt (Gungoraydinoglu et al., 2017). Secondly, due to preventive incentives and opportunity costs, companies will also reduce their own financing needs. Studies have shown that oil price uncertainty increase corporate cash flow and even investment spending to withstand risks (Chen et al., 2020; Zhang et al., 2020). This suggests that companies will reduce their financing needs to cope with the international oil price uncertainty. Regarding the regression results of the other control variables, the non-debt tax shield and profitability, which have significant negative effects on corporate debt, is consistent with the conclusions of the trade-off theory. However, consistent with the pecking order theory, greater growth opportunities will increase corporate debt. This is also consistent with the characteristics of Chinese financial markets (Nguyen et al., 2020).

4.2. Subsample analyses

(1) Subsample analysis according to enterprise size

In this paper, the total asset scale is selected to measure the enterprise scale. Enterprises with total assets greater than the average total assets are large enterprises, and the rest are small enterprises. Columns (1) and (3) in Table 3 lists the regression results of large-scale enterprises; the *OPU* estimated coefficient are positive and significant in the fixed-effect model. Columns (2) and (4) list the regression results of small-scale enterprises, and the *OPU* coefficient is still significantly negative. The regression results show that small enterprises are affected by the oil price uncertainty with the main regression, but large enterprises are affected by the uncertainty with the main regression and are not always significant.

Compared with small business, large enterprises are more likely to obtain bank loans due to good credit (Li et al., 2019; Saona et al., 2020). Their default risk or bankruptcy risk is lower, and they have a debt financing advantage. Under the same conditions, the target debt ratio may be higher. In addition, large enterprises can cultivate innovative talents, promote technological innovation, improve energy utilization efficiency, and weaken the impact of an oil price uncertainty. Due to these characteristic advantages, large enterprises are less affected by the oil price uncertainty. Small business, in contrast, is significantly affected by oil price uncertainty. Rising international the oil prices will lead to increasing production and logistical costs for these enterprises, as their ability to fight against rising costs is weak. In addition, these business encounter difficulty obtaining external funds, and increased operating costs can have serious effects. Eventually, small companies are forced to cut back on their debt.

Insert Table 3

(2) Subsample analysis according to SOE

According to the SOE classification, enterprises are divided into state-owned enterprises and non-state-owned enterprises. In Table 4, columns (1) and (3) list the regression results of state-owned holding enterprises. The *OPU* estimated coefficient is negative but not significant. The *OPU* coefficient of non-state-owned holding enterprises is still significantly negative. This shows that SOEs in China are less affected by the oil price fluctuations, but the excessive debt of the non-state-owned enterprises is significantly affected by the oil price fluctuations.

The possible reason why SOEs resist the uncertainty in oil prices is that they have the convenience of equity financing, which affects their debt levels. Wu et al. (2019) claimed that China's state-owned enterprises have the advantage of equity financing, making them face fewer obstacles to obtaining equity financing. Loof (2004) shows that companies that can access convenient equity financing will reduce their reliance on debt. In addition, when conducting financing requirement, financial institutions may discriminate against companies according to the type of ownership (Lv et al., 2021), and Chinese SOEs are often considered less risky and therefore insensitive in the face of uncertain oil prices. Besides, considering the national economy and social order, the government may also help these SOEs. Finally, SOEs also tend to have high target debt ratios when developing financing strategies, so they are less likely to receive excess debt.

Insert Table 4

(3) Subsample analysis according to the technology level of the industry

We further investigate whether the technology content of industry might influence the relationship between oil price uncertainty and excessive corporate debt. According to the strategic emerging industry classification directory and related policies in China, the following 16 groups are classified as high-tech industries: pharmaceutical manufacturing; chemical fiber manufacturing; rubber and plastic product manufacturing; ferrous metal smelting and extension processing; general equipment manufacturing; automotive manufacturing; automobile, railway, shipping, aerospace, and other transportation equipment manufacturing; computer, communications, and other electronic equipment manufacturing; instrument manufacturing; other manufacturing; telecommunications, television, and satellite transmission services; internet and related services; software and information technology services; and research and experimental development. Other industries are non-high-tech industries.

Table 5 shows the estimated coefficients of *OPU* are negative and significant at 10% and 5% in the fixed-effect and Logit-FE models. The *OPU* estimated coefficient of non-high-tech industrial enterprises is significantly negative. Moreover, the *OPU* estimated coefficient of the fixed-effect regression model of high-tech industrial enterprises is -0.0550, and the *OPU* estimated coefficient of non-high-tech industrial enterprises is -0.1198, indicating that the *OPU* weakening effect is stronger in non-high-tech industrial enterprises. The non-high-tech classification contains various aspects of production and life, which are affected by the price of crude oil. However, the entire high-tech field, and especially information technology, has been deeply integrated into various non-high-tech industries. Studies by Haugland et al. (2020) and Sadorsky (2012) have also confirmed the growing impact of the oil price uncertainty on the high-tech industry in recent years. In this context, we also prove that the high-tech industry can also be increasingly affected by the impact of oil prices.

Insert Table 5

(4) Subsample analysis according to affiliation with energy enterprises

Economic uncertainty is also linked to the carbon market (Dou et al., 2022), and research on traditional energy companies is increasing (Dong et al., 2021; Duan et al., 2021; Ren et al., 2021). As oil is closely linked to carbon emission reduction, this paper examines troditional energy enterprises as a subsample. For a working definition of the energy-intensive manufacturing industry, referring to the Energy Information Administration and the China Energy Report (2018), nine industries are represented by the selected traditional energy companies: bulk chemicals; paper; oil refining; glass; cement; steel and aluminum; transportation; oil and gas development; and power and heat production and supply. These companies all consume “a lot of energy, have high energy intensity, or both” (Unruh, 2002).

Table 6 shows that the *OPU* estimated coefficient for energy enterprises is only significant at 10% and 5% in the fixed-effect model and Logit-FE model, respectively. The *OPU* coefficient for non-energy enterprises is still significantly negative. Moreover, the *OPU* estimated coefficient of the fixed-effect model of energy enterprises is -0.0643, and the *OPU* estimated coefficient of non-energy enterprises is -0.0925, which indicates that the weakening effect of *OPU* on excessive debt is greater for non-energy enterprises. Studies generally agree that traditional energy companies are more hit directly by uncertainty in oil prices. But given the actual situation in China, most Chinese traditional energy companies are large state-owned enterprises, and they are less responsive to oil price uncertainty due to the advantages of debt financing and equity financing. Notably, this results in oil price uncertainty significantly affecting excessive debt levels in China's non-energy-related industries. The stock market research also shows that the oil market significantly affects Chinese non-energy industries (Xiao et al., 2018; Zhu et al., 2016). The possible reason is that macroeconomic factors are not only strictly exogenous variables, but also experience industry impacts. The energy industry, as an important pillar industry in China, may have an impact on the macro economy. When faced with an oil price uncertainty, the energy industry may shift the risk and affect non-energy industries. In addition, there are also studies showing that rising aggregate demand for industrial commodities has a positive impact on the price of clean energy, which can be replaced by fossil fuels (Kollias et al., 2013; Ren et al., 2022b). As a result, when uncertain oil prices increase, the replacement effect of clean energy increases, and non-traditional energy companies may also be hit. Finally, according to the study of Chen et al. (2020), oil price uncertainty may have an impact on interest rates and inflation, thus affecting non-energy-related industries.

Insert Table 6

5. Further analysis

According to the analysis of the previous section, the oil price uncertainty mainly affects excessive debt from demand and supply. Therefore, in this section, we continue to explore the indirect channel of oil price uncertainty in two ways. We consider product-market demand as the possible channel on the demand side and financing constraints as the possible channel on the supply side, and expand the analysis of different subsamples.

5.1. Moderating effect of product-market demand

(1) Baseline result of product-market demand

Table 7 reports relevant results based on *D_dum*, showing that the coefficient of oil price uncertainty is significantly negative. This result is consistent with our previous finding. The coefficients of the interaction terms are found to be significantly positive throughout the sample. This means that the product-market demand combined with the oil price uncertainty exacerbates excessive corporate debt. The results of the interaction term show that under the premise of macro impact, high demand in the product market will cause enterprises to acquire excessive debt, thus weakening the impact of macroeconomic factors on the excessive debt of enterprises. It also shows that the financing decisions of enterprises are more inclined to adjust according to their own needs. Sun et al. (2017) showed that large demand has a strong inducing effect on corporate investment behavior. Irrational investment behavior can stimulate excessive debt, leading to more aggressive debt financing demand (Sun et al., 2017; Sun et al., 2021). In recent years, China's economy has continued to grow rapidly, and residents' disposable income has also greatly increased. With a relatively stable macro market environment, the product-market demand has sharply increased and stimulated market enthusiasm for investment. Optimistic market expectations push companies to adopt more aggressive financing strategies, leading to excessive debt.

Insert Table 7

(2) Subsample analyses of SOE and differing scales

Table 8 shows that the coefficient of *OPU* for large enterprises is positive and significant. Coefficients of *OPU* for small enterprises, SOEs, and non-SOEs are negative and significant. This is in general agreement with the previous regression results. The coefficients of the interaction terms of $OPU \times D\_dum$ for large enterprises, unlike the regression of the total sample, are negative; however, the interaction term coefficients for small enterprises, state-owned enterprises, and non-state-owned enterprises are still positive. Small-scale enterprises are more clearly affected by interaction terms than are large-scale enterprises, and non-SOEs are more susceptible to interaction items than SOEs. Scherer and Ross (1990) argued that companies with large amounts of money can set predatory pricing for weak firms to drive them out of the market. As both large-scale and state-owned enterprises possess sufficient funds, they do not need to have enough money to occupy the market share of other enterprises. To deal with this situation, small-scale enterprises or non-state-owned enterprises may choose to acquire high debt. Nadauld (2012) and Ghosh (2010) also noted that increased corporate debt under higher market demand would confer a strategic advantage in the product-market competition. In other words, companies will be more stimulated by demand for debt, although an oil price uncertainty might have an impact.

Insert Table 8

(3) Subsample analyses of different technology levels and affiliations with energy enterprises

Table 9 shows that the regression coefficient of *OPU* for high-tech enterprises and non-high-tech enterprises is negative and significant. The regression coefficient of *OPU* for traditional energy companies and non-traditional energy companies are negative and significant, whether the enterprise is a high-tech enterprise, a non-high-tech enterprise, an energy enterprise, or a non-energy enterprise. The interaction term coefficient $OPU \times D\_dum$ is positive. Moreover, high-tech enterprises are more significantly affected by the interaction items than are non-high-tech enterprises. Non-traditional energy companies are more vulnerable to interaction terms than traditional energy companies.

Hackbarth et al. (2006) noted that the debt of each enterprise is always affected by both its internal characteristics and external environmental factors. Dockner et al. (2018) argued that business with limited debt would be more inclined to adopt aggressive strategies in the product market. According to De Fiore and Uhlig (2015), a rising proportion of corporate debt can make enterprises more competitive in the product market. Especially in recent years, China has presented an investment-driven and capital factor-driven enterprise development model. Once the market has optimistic expectations and a positive demand impact, enterprises display consistent investment behavior and begin to adopt a more proactive financing strategy. According to the trade-off theory, because the tax shield effect of the high expansion period debt far exceeds the constraint of the bankruptcy cost, to leverage the value promotion of the interest tax shield, policymakers will try to increase the proportion of debt financing by raising the funds needed for the investment. Therefore, in the face of positive demand impact, a positive market environment can encourage enterprises to actively expand the scale of debt financing. Furthermore, it can also weaken the impact of the international market. High-tech companies are generally the first to receive market signals and to adopt more proactive debt financing strategies. Traditional energy companies focusing more on the impact of oil respond less to the market than do non-traditional energy companies.

Insert Table 9

5.2. Moderating effect of financing constraints

(1) Baseline result of financing constraints

Table 10 reports relevant results based on *KZ*. The coefficient of the oil price uncertainty is still significantly negative, as is the interaction term $OPU \times KZ$. This shows that financing constraints can strengthen the effect of the oil price uncertainty on excessive debt. This also shows that the pressure on the supply side will make companies passively reduce their own excessive debt levels. Levy and Hennessy (2007) used the financing constraints as mediating variable to regress the sample, and believed that these constraints would strengthen the adjustment of financial leverage. Therefore, as a kind of macro impact, the oil impact is bound to be subject to the moderating effect of financing constraints. Dynamic trade-off theory assumes that capital restructuring is a dynamic process in which enterprises trade-off between adjustment costs and benefits. Meanwhile, the size of the adjustment cost mainly depends on the degree of financing constraints (Coldbeck & Ozkan, 2018; Martínez-Sola et al., 2018). When the economic impact is large, companies are more constrained by financing costs than by capital adjustment because they are unable to obtain external financing. Therefore, more reliance on internal funds has led to a downward adjustment of debt levels. For companies not subject to financing constraints, the cost of capital structure adjustment is small. To obtain more returns, companies usually raise the debt level to enjoy more tax shield returns.

Insert Table 10

(2) Subsample analyses of SOE and differing scales

Table 11 shows the regression coefficients of *OPU* in comparison to *OPU* before the addition of the interaction term. Although the regression coefficient is different, the sign of the coefficients remains consistent based on the results of the interaction term $OPU \times KZ$. For large-scale and state-owned enterprises, the coefficient of the interaction terms is positive. However, for small and non-state-owned enterprises, the interaction term coefficient is still significantly negative. Consistent with the sample analysis of the main regression, SOEs and large enterprises are significantly less affected by the financing constraints than the non-state-owned enterprises and small enterprises.

Due to the government's adoption of soft budget constraints for state-owned enterprises regarding bank borrowing, these businesses have unique competitive advantages related to financing ability and speed. Therefore, the effect of financing constraints on state-owned enterprises is relatively weak. However, non-state-owned enterprises have less financial support and fewer preferential policies, and it is difficult for these enterprises to raise funds. So, they are more obviously affected by the moderating effect of financing constraints. Focusing on company size, small companies are more dependent on bank credit for external financing than large companies that have easy access to public capital markets (Bremus and Neugebauer, 2018; Moscalu et al., 2020). At the same time, small companies also face greater information asymmetry, fewer opportunities to diversify their owners' wealth, and excessive monitoring costs (Rostamkalaei and Freel, 2016; Zubair et al., 2020). Under the uncertainty of oil, banks' constraints on small enterprise financing are further enhanced (Li, 2021), and excessive debt of small enterprises decreased passively.

Insert Table 11

(4) Subsample analyses of different technology levels and affiliations with energy enterprises

Table 12 shows that the *OPU* regression coefficient remained negative for each subsample. For high-tech, energy, and non-energy enterprises, the *OPU* coefficients were all significant at the 1% level. The reason for the non-significant coefficient for energy enterprises may be multiple collinearity problems, as the interaction term *OPU*×*KZ* also contains the information when the independent variable oil price uncertainty explains the excessive debt, and there is a problem of repeated information interpretation between the two. Regression coefficients of *OPU*×*KZ* is negative for all subsamples. Except for the non-significant moderating effect of energy enterprises, all other samples were significantly moderated by financing constraints. The possible explanation is that high-tech companies are technology-intensive and asset-light, and usually have high sinking costs because it is riskier to innovate within them. The innovation activities of high-tech enterprises have a high risk of failure and a long investment cycle, so external investors are often not willing to provide financing for enterprise innovation (Hou, 2018). This makes these business' financing constraint problems very seriously and may lead to failure to achieve the target capital structure. In addition, China's energy enterprises are mostly large enterprises or SOEs. The financing constraints are small, so the moderating effect is significantly lower than in non-energy enterprises.

Insert Table 12

6. Robustness analysis

6.1. Alternative sample period

The sample period of this article is 2010–2019. Initial public offerings (IPO) suspension policies in effect during this time may have affected the financing methods of enterprises and therefore their level of excessive debt. To remove this effect, before we test, we remove the sample interval in which the relevant policy occurred. Specifically, after excluding the sample data from 2013 and 2014, the regression results show that the coefficient of *OPU* is still significantly negative, indicating that the results are not affected by the IPO suspension policy. In addition, during the financial crisis that began in 2008, China launched a huge "four trillion" economic stimulus plan (in 2010), which mainly benefited large-scale credit companies and may have had an impact on the conclusions of this paper. Columns (1) and (2) of Table 13 display the results of the regression after excluding the impact of the IPO suspension policy, and Columns (3) and (4) show the same after exclusion of the "four trillion" plan period. The robustness results are largely consistent with the main test results.

Insert Table 13

6.2. Alternative explanatory variable

The standard deviation of the oil price change is first calculated by using the daily closing price of Brent crude oil (Table 14). *OPU* estimated coefficients for both fixed-effect and Logit-FE models are negative and significant.

Insert Table 14

Furthermore, the CBOE Crude Oil Volatility Index (*OVX*) is used as a proxy variable for an oil price uncertainty. This is because traditional calculations are based on historical oil prices, from which only flowed oil price uncertainty predictions can be made (Elder & Serletis, 2010, Shaw et al., 2018). Instead, the option price implies the future volatility of crude oil and can be used to make a better prediction of the future. The *OVX* is a forecast of the 30-day expected volatility for crude oil and can be used as a proxy variable for an oil price uncertainty. Unlike historical data, it can provide both historical and future oil fluctuations and can be used as a good measure of uncertainty in the crude oil market (Kocaarslan et al., 2020; Shaw et al., 2018).

Following Zhang et al. (2020), we used the daily CBOE crude index to calculate oil price uncertainty, defined as follows:

$$OVX_t = \frac{1}{n}\sum_k^n ovx_{t,k} \quad (7)$$

$ovx_{t,k}$ denotes the daily implied volatility index on day *k*, year *t*. n denotes the number of trading days in year *t*. This paper reduces the *OVX* data by 100 times, in order to transform the percentage data into numerals. The results in Table 15 show that, although the *OPU* estimated coefficients of the fixed-effect and the Logit-FE models are numerically different from the main model, the sign is still negative and significant.

Insert Table 15

6.3. Endogenous problem

The instrumental variable method is chosen to overcome the model's possible endogenous problems. The GMM estimation of the panel data model is more efficient when there are more tool variables than endogenous explanatory variables. In this paper, the error term is assumed to be a heterovariance distribution. Therefore, we utilize the tool variable-generalized moment estimation method (IV-GMM). This paper mainly selects the lag items of *OPU* and the lags of exogenous variables, such as management expense rate and depreciation expense rate, as tool variables. To eliminate the effect of heterovariance, the logarithm of the excessive debt data is taken. Other data are mostly percentages and no longer paired.

Table 16 shows that after using the instrumental variables, oil price uncertainty still has a significant inhibitory effect on excessive debt with a statistical significance level of 5%. Besides, the model rejected the null hypothesis of no endogenous, indicating the presence of endogenous variables in the model. The Hansen J statistic is used to test whether the model had over-identification problems;

it is considered valid if the null hypothesis is acceptable. The Hansen test is between 0.1 and 0.25, indicating that the model tool variables are valid. The value of AR (2) is greater than 0.1, indicating that there is no perturbation term autocorrelation.

Insert Table 16

7. Conclusion

In recent years, the drastic fluctuations in the international crude oil market have attracted increased attention. However, the impact of the oil price uncertainty on financing decisions has not been thoroughly examined in the prior literature. To bridge this gap, we use the 2010–2019 data of listed non-financial Chinese companies to investigate the impact of the oil price uncertainty on excessive corporate debt. We find that oil price uncertainty can significantly reduce excessive corporate debt.

Regarding the heterogeneity of the direct effects of the oil price uncertainty, we find that they have no significant impact on the excessive debt of large or state-owned enterprises; however, they can significantly weaken small business and non-state-owned enterprises. In addition, oil price uncertainty also significantly weakens the excessive debt levels of companies, regardless of their technology level or whether they are affiliated with energy firms.

When we further explore the channels of the oil price uncertainty, we find that the product-market demand can significantly reduce the oil price uncertainty 's weakening effect on excessive debt. This enhancement is even more pronounced in small business, non-state-owned companies, high-tech companies, and non-traditional energy companies. Financing constraints can further enhance the oil impact on excessive debt. This weakening effect is even more pronounced in small enterprises, non-state-owned enterprises, high-tech enterprises, non-high-tech enterprises, and non-energy enterprises.

Finally, our results prove the significant impact of the oil market on corporate decision-making since the oil market reform in China. Therefore, enterprises and policymakers should treat this relationship seriously. In general, managers should be prepared to adjust their business strategies promptly to cope with macroeconomic impacts such as oil price uncertainty and make sure they can have a smooth transition, and they can develop a differentiated risk assessment framework based on different businesses. In addition, banks and other financial institutions should fully consider international impacts on enterprises, strengthen the risk assessment of state-owned enterprises and large enterprises, especially on the sensitivity to international oil price uncertainty. Finally, policymakers and regulators can adopt strategies to improve the level of competition in energy-related industries to mitigate the macroeconomic impact of oil price uncertainty, and thus to reduce the impact of oil price uncertainty on other business.

Acknowledgments:

This work is partially supported by grants from the National Natural Science Foundation of China (NSFC No. 72101229), Natural Science Fund of Hunan Province (2022JJ40647) and Zhejiang Provincial Natural Science Foundation (No. LQ20G030019).

Appendix A

Table A1. Definition and description of the variables.

Variable	Definition	Calculation
EXEDA	Excessive debt ratio	Formula (1) provided the specific calculation
EXEDA_dum	Dummy variable of excessive debt	See formula (1) for the specific calculation
OPU	Oil shock	Formula (2) provided the specific calculation
EXEDA	Return on assets	Total assets divided operating profit
GROWTH	Total asset growth rate	Annual change value of total assets divided by total assets of the previous period
SIZEVB	Firm size	Take the logarithm of total assets
MB	Book to market ratio	Total assets divided by the sum of the equity market value and the debt book value
EXP	Management expense rate	Operating income divided by management expenses
NDTS	Non-debt tax shield	Operating income divided depreciation expense
ETR	Rate of income tax	Total profit divided the difference between the income tax expense and the deferred income tax
VEBITTA	Profit volatility	The standard deviation for profitability for the first 3 years. Profitability = EBITDA / TA
VCF	Cash flow volatility	The standard deviation for the cash flow ratio for the first 3 years, Cash flow ratio = Cash flow / Total assets from operating activities
TOP1	The largest shareholder holds the shareholding proportion	Number of the shares issued outside divided by the number of shares held by the largest shareholder
FATA	Fixed assets ratio	Total assets divided fixed assets
D	product-market demand	Annual change in sales volume except for the previous e total sales
D_dum	Dummy variables of the product-market demand	D> 0, with a value of 1, or 0 otherwise
OVX	CEOE crude oil volatility index	Formula (7) provided the specific calculation
KZ	Financing constraints	Using Ordered Logistic Regression

Table A2. List of abbreviations.

Abbreviations	
NBS	National Bureau of Statistics
OPEC	Organization of Petroleum Exporting Countries
WTI	West Texas Intermediate
CSMAR	China Stock Market & Accounting Research Database
SOE	State-Owned Enterprise
IPO	Initial public offerings
CBOE	Chicago Board Options Exchange
GMM	Generalized method of moments
IV	Instrumental variable
OPU	Oil Price Uncertainty

References

Alaali, F. (2020). The effect of oil and stock price volatility on firm level investment: The case of UK firms. *Energy Economics, 87*, 104731.

Alessi, L., & Detken, C. (2018). Identifying excessive credit growth and leverage. *Journal of Financial Stability, 35*, 215-225.

Alhassan, A. (2019). Oil price volatility and corporate decisions: evidence from the GCC region. *Emerging Markets Finance and Trade, 55(9)*, 2057-2071.

Almeida, H., Campello, M., & Weisbach, M. S. (2004). The cash flow sensitivity of cash. *Journal of Finance, 59*(4), 1777-1804.

Alter, A., & Elekdag, S. (2020). Emerging market corporate leverage and global financial conditions. *Journal of Corporate Finance, 62*, 101590.

Altman, E. I., Hotchkiss, E., & Wang, W. (2019). *Corporate financial distress, restructuring, and bankruptcy: Analyze leveraged finance, distressed debt, and bankruptcy*. John Wiley & Sons.

An, Z., Li, D., & Yu, J. (2015). Firm crash risk, information environment, and speed of leverage adjustment. *Journal of Corporate Finance, 31*, 132-151.

Aivazian, V. A., Ge, Y., & Qiu, J. (2005). The impact of leverage on firm investment: Canadian evidence. *Journal of corporate finance, 11*(1-2), 277-291.

Baum, C. F., Stephan, A., & Talavera, O. (2009). The effects of uncertainty on the leverage of nonfinancial firms. *Economic Inquiry, 47*(2), 216-225.

Boubakri, N., Guedhami, O., Mishra, D., & Saffar, W. (2012). Political connections and the cost of equity capital. *Journal of Corporate Finance, 18*(3), 541-559.

Bremus, F., & Neugebauer, K. (2018). Reduced cross-border lending and financing costs of SMEs. *Journal of International Money and Finance, 80*, 35-58.

Buccola, V. S. (2014). An Ex Ante Approach to Excessive State Debt. *Duke LJ*, *64*, 235.

Caporale, G. M., Ali, F. M., & Spagnolo, N. (2015). Oil price uncertainty and sectoral stock returns in China: A time-varying approach. *China Economic Review, 34,* 311-321.

Caskey, J., Hughes, J., & Liu, J. (2012). Leverage, excess leverage, and future returns. *Review of Accounting Studies, 17*(2), 443-471.

Chang, C., Chen, X., & Liao, G. (2014). What are the reliably important determinants of capital structure in China? *Pacific-Basin Finance Journal, 30,* 87-113.

Chen, X., Li, Y., Xiao, J., & Wen, F. (2020). Oil shocks, competition, and corporate investment: evidence from China. *Energy Economics*, *89,* 104819.

Coldbeck, B., & Ozkan, A. (2018). Comparison of adjustment speeds in target research and development and capital investment: What did the financial crisis of 2007 change?. *Journal of Business Research, 84,* 1-10.

De Fiore, F., & Uhlig, H. (2015). Corporate debt structure and the financial crisis. *Journal of Money, credit and Banking, 47*(8), 1571-1598.

De Jong, A., Nguyen, T. T., & Van Dijk, M. A. (2007). Strategic debt: Evidence from Bertrand and Cournot competition. ERIM *Report Series Reference No. ERS-2007-057-F&A.*

Denis, D. J., & McKeon, S. B. (2012). Debt financing and financial flexibility evidence from proactive leverage increases. *Review of Financial Studies, 25*(6), 1897-1929.

Denis, D. J., & Mihov, V. T. (2003). The choice among bank debt, non-bank private debt, and public debt: evidence from new corporate borrowings. *Journal of Financial Economics*, *70*(1), 3-28.

Dockner, E. J., Elsinger, H., & Gaunersdorfer, A. (2018). The strategic role of dividends and debt in markets with imperfect competition. *Dynamic Games and Applications, 8*(3), 601-619.

Dong, K., Ren, X., & Zhao, J. (2021). How does low-carbon energy transition alleviate energy poverty in China? A nonparametric panel causality analysis. *Energy Economics, 103,* 105620.

Dou, Y., Li, Y., Dong, K., & Ren, X. (2022). Dynamic linkages between economic policy uncertainty and the carbon futures market: Does Covid-19 pandemic matter?. *Resources Policy, 75,* 102455.

Duan, K., Ren, X., Shi, Y., Mishra, T., & Yan, C. (2021). The marginal impacts of energy prices on carbon price variations: evidence from a quantile-on-quantile approach. *Energy Economics, 95,* 105131.

Eisenhardt, K. M. (1989). Agency theory: An assessment and review. *Academy of management review, 14*(1), 57-74.

Elder, J., & Serletis, A. (2010). Oil price uncertainty. *Journal of Money, Credit and Banking, 42*(6), 1137-1159.

Falato, A., Goldstein, I., & Hortaçsu, A. (2021). Financial fragility in the COVID-19 crisis: The case of investment funds in corporate bond markets. *Journal of Monetary Economics, 123*, 35-52.

Faulkender, M., Flannery, M. J., Hankins, K. W., & Smith, J. M. (2012). Cash flows and leverage adjustments. *Journal of Financial economics, 103*(3), 632-646.

Flannery, M. J., & Rangan, K. P. (2006). Partial adjustment toward target capital structures. *Journal of Financial Economics, 79*(3), 469-506.

Frank, M. Z., & Goyal, V. K. (2003). Testing the pecking order theory of capital structure. *Journal of financial economics, 67*(2), 217-248.

Gebauer, S., Setzer, R., & Westphal, A. (2018). Corporate debt and investment: A firm-level analysis for stressed euro area countries. *Journal of International Money and Finance, 86*, 112-130.

Ghosh, A., & Moon, D. (2010). Corporate debt financing and earnings quality. *Journal of Business Finance & Accounting, 37*(5-6), 538-559.

Gungoraydinoglu, A., Çolak, G., & Öztekin, Ö. (2017). Political environment, financial intermediation costs, and financing patterns. *Journal of Corporate Finance, 44*, 167-192.

Gupta, K., & Krishnamurti, C. (2018). Do macroeconomic conditions and oil prices influence corporate risk-taking? *Journal of Corporate Finance, 53,* 65-86.

Hackbarth, D., Miao, J., & Morellec, E. (2006). Capital structure, credit risk, and macroeconomic conditions. *Journal of Financial Economics, 82*(3), 519-550.

Hasan, M. M., Wong, J. B., & Al Mamun, M. A. (2022). Oil shocks and corporate social responsibility. *Energy Economics, 107,* 105881.

Haugland, B. T. (2020). Changing oil: self-driving vehicles and the Norwegian state. *Humanities and Social Sciences Communications, 7*(1), 1-10.

Henriques, I., & Sadorsky, P. (2011). The effect of oil price volatility on strategic investment. *Energy Economics, 33*(1), 79-87.

Hou, J. (2018). Does the pay gap in the top management team incent enterprise innovation?—Based on property rights and financing constraints. American *Journal of Industrial and Business Management, 8*(05), 1290.

Jiang, F., Jiang, Z., Huang, J., Kim, K. A., & Nofsinger, J. R. (2017). Bank competition and leverage adjustments. *Financial Management, 46*(4), 995-1022.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics, 3*(4), 305-360.

Jiang, F., Jiang, Z., & Kim, K. A. (2020). Capital markets, financial institutions, and corporate finance in China. *Journal of Corporate Finance, 63,* 101309.

Kane, A., Marcus, A. J., & McDonald, R. L. (1984). How big is the tax advantage to debt? *Journal of Finance, 39*(3), 841-853.

Kaplan, S. N., & Zingales, L. (1997). Do investment-cash flow sensitivities provide useful measures of financing constraints? *Quarterly Journal of Economics, 112*(1), 169-215.

Kocaarslan, B., Soytas, M. A., & Soytas, U. (2020). The asymmetric impact of oil prices, interest rates and oil price uncertainty on unemployment in the US. *Energy Economics, 86,* 104625.

Koirala, N. P., & Ma, X. (2020). Oil price uncertainty and US employment growth. *Energy Economics, 91,* 104910.

Kollias, C., Kyrtsou, C., & Papadamou, S. (2013). The effects of terrorism and war on the oil price–stock index relationship. *Energy Economics, 40,* 743-752.

Lanis, R., Richardson, G., Govendir, B., & Pazmandy, G. (2021). The effect of board of directors' expertise and tax avoidance on corporate debt. *Accounting & Finance, 61*(3), 4475-4511.

Levy, A., & Hennessy, C. (2007). Why does capital structure choice vary with macroeconomic conditions? *Journal of Monetary Economics, 54*(6), 1545-1564.

Lei, L. (2020). Research on the impact of tax shield effect on corporate capital structure—empirical analysis based on a-share listed companies. *Modern Economy, 11*(1), 126-139.

Li, K., Xia, B., Chen, Y., Ding, N., & Wang, J. (2021). Environmental uncertainty, financing constraints and corporate investment: Evidence from China. *Pacific-Basin Finance Journal*, *70*, 101665.

Li, X., Lin, C., & Zhan, X. (2019). Does change in the information environment affect financing choices? *Management Science*, *65*(12), 5676-5696.

Lööf, H. (2004). Dynamic optimal capital structure and technical change. *Structural Change and Economic Dynamics*, *15*(4), 449-468.

Lv, C., Shao, C., & Lee, C. C. (2021). Green technology innovation and financial development: Do environmental regulation and innovation output matter?. *Energy Economics*, *98*, 105237.

Maghyereh, A., & Abdoh, H. (2020). Asymmetric effects of oil price uncertainty on corporate investment. *Energy Economics*, *86*, 104622.

Maheu, J. M., Song, Y., & Yang, Q. (2020). Oil price shocks and economic growth: The volatility link. *International Journal of Forecasting*, *36*(2), 570-587.

Martínez-Sola, C., García-Teruel, P. J., & Martínez-Solano, P. (2018). Cash holdings in SMEs: speed of adjustment, growth and financing. *Small Business Economics*, *51*(4), 823-842.

Moscalu, M., Girardone, C., & Calabrese, R. (2020). SMEs' growth under financing constraints and banking markets integration in the euro area. *Journal of Small Business Management*, *58*(4), 707-746.

Nadauld, T. D., & Weisbach, M. S. (2012). Did securitization affect the cost of corporate debt? *Journal of financial economics, 105*(2), 332-352.

Nguyen, H. M., Vuong, T. H. G., Nguyen, T. H., Wu, Y. C., & Wong, W. K. (2020). Sustainability of both pecking order and trade-off theories in Chinese manufacturing firms. *Sustainability, 12*(9), 3883.

Pattillo, C. A., Poirson, H., & Ricci, L. A. (2002). External debt and growth. *Available at SSRN 879569.*

Rauh, J. D., & Sufi, A. (2010). Capital structure and debt structure. *Review of Financial Studies, 23*(12), 4242-4280.

Ren, X., Cheng, C., Wang, Z., & Yan, C. (2021). Spillover and dynamic effects of energy transition and economic growth on carbon dioxide emissions for the European Union: A dynamic spatial panel model. *Sustainable Development, 29*(1), 228-242.

Ren, X., Li, Y., Qi, Y., & Duan, K. (2022a). Asymmetric effects of decomposed oil-price shocks on the EU carbon market dynamics. *Energy, 254*, 124172.

Ren, X., Tong, Z., Sun, X., & Yan, C. (2022b). Dynamic impacts of energy consumption on economic growth in China: Evidence from a non-parametric panel data model. Energy Economics, 107, 105855.

Rostamkalaei, A., & Freel, M. (2016). The cost of growth: small firms and the pricing of bank loans. *Small Business Economics, 46*(2), 255-272.

Sadorsky, P. (2008). Assessing the impact of oil prices on firms of different sizes: Its tough being in the middle. *Energy Policy, 36*(10), 3854-3861.

Sadorsky, P. (2012). Correlations and volatility spillovers between oil prices and the stock prices of clean energy and technology companies. *Energy Economics, 34*(1), 248-255.

Saona, P., Muro, L., & Alvarado, M. (2020). How do the ownership structure and board of directors' features impact earnings management? The Spanish case. *Journal of International Financial Management & Accounting, 31*(1), 98-133.

Scherer, F. M., & Ross, D. (1990). Industrial market structure and economic performance. *University of Illinois at Urbana-Champaign's Academy for entrepreneurial leadership historical research reference in entrepreneurship.*

Seo, K. (2018). Excessive leverage and firm performance in competitive casino markets. *Tourism and Hospitality Research, 18*(4), 498-504.

Serrasqueiro, Z., & Caetano, A. (2015). TOff Theory versus Pecking Order Theory: capital structure decrade-isions in a peripheral region of Portugal. *Journal of Business Economics and Management, 16*(2), 445-466.

Shapiro, S. P. (2005). Agency theory. *Annu. Rev. Sociol., 31*, 263-284.

Soyemi, K. A., Akingunola, R. O. O., & Ogebe, J. (2019). Effects of oil price shock on stock returns of energy firms in Nigeria. *Kasetsart Journal of Social Sciences, 40*(1), 24-31.

Smyth, R., & Narayan, P. K. (2018). What do we know about oil prices and stock returns?. *International Review of Financial Analysis, 57,* 148-156.

Sun, W., Dong, K., & Zhao, T. (2017). Market demand dynamic induced mechanism in China's steel industry. *Resources Policy, 51*, 13-21.

Sun, W., Geng, D., & Dong, K. (2021). State of demand and excessive indebtedness: Evidence from Chinese listed manufacturing firms. *Finance Research Letters, 42*, 101942.

Unruh, B. (2002). Delivered energy consumption projections by industry. *Annual Energy Outlook 2002, Energy Information Administration.*

Wang, Y., Chen, C. R., & Huang, Y. S. (2014). Economic policy uncertainty and corporate investment: Evidence from China. *Pacific-Basin Finance Journal, 26,* 227-243.

Wang, X., Li, J., & Ren, X. (2022). Asymmetric causality of economic policy uncertainty and oil volatility index on time-varying nexus of the clean energy, carbon and green bond. *International Review of Financial Analysis*, *83*, 102306.

Wang, Y., Xiang, E., Ruan, W., & Hu, W. (2017). International oil price uncertainty and corporate investment: Evidence from China's emerging and transition economy. *Energy Economics, 61,* 330-339.

Wang, Y. (2020). *Study on investment-cash flow sensitivities' impacts on financing constraints of Chinese A-Share listed firms* (Doctoral dissertation).

Wong, J. B., & Hasan, M. M. (2021). Oil shocks and corporate payouts. *Energy Economics, 99,* 105315.

Wu, Y., Wu, Y., & Wang. (2019). *Reforming WTO rules on state-owned enterprises.* Springer Singapore.

Xiao, J., Zhou, M., Wen, F., & Wen, F. (2018). Asymmetric impacts of oil price uncertainty on Chinese stock returns under different market conditions: Evidence from oil volatility index. *Energy Economics, 74,* 777-786.

Xu, J. (2012). Profitability and capital structure: Evidence from import penetration. *Journal of Financial Economics, 106*(2), 427-446.

Zhang, X., Zhang, Z., & Zhou, H. (2020). Oil price uncertainty and cash holdings: Evidence from China. *Energy Economics, 87,* 104732.

Zhu, H., Guo, Y., You, W., & Xu, Y. (2016). The heterogeneity dependence between crude oil price changes and industry stock market returns in China: Evidence from a quantile regression approach. *Energy Economics, 55,* 30-41.

Zubair, S., Kabir, R., & Huang, X. (2020). Does the financial crisis change the effect of financing on investment? Evidence from private SMEs. *Journal of Business Research*, *110*, 456-463.

Tables

Table 1. Descriptive statistics of the variables.

Table 2. Baseline result of the oil price uncertainty on the excessive corporate debt (2010-2019).

Table 3. Heterogeneous effects 1: Subsample analysis according to the enterprise size.

Table 4. Heterogeneous effects 2: Subsample analysis according to SOE or not.

Table 5. Heterogeneous effects 3: Subsample analysis according to the technology level of the industry.

Table 6. Heterogeneous effects 4: Subsample analysis according to whether the enterprise is affiliated with energy enterprises.

Table 7. The moderation effect of the product-market demand.

Table 8. Subsample analysis of product-market demand in different enterprise scales and the SOE or not of enterprises.

Table 9. Subsample analysis of product-market demand in different technology level enterprises and whether the enterprise is affiliated with energy enterprises.

Table 10. The moderation effect of financing constraints.

Table 11. Subsample analysis of financing constraints in different enterprise scales and the SOE or not of enterprises.

Table 12. Subsample analysis of financing constraints in different technology level enterprises and whether the enterprise is affiliated with energy enterprises.

Table 13. Robustness checks 1: Alternative sample period.

Table 14. Robustness checks 2: Alternative explanatory variable (Brent Crude Oil—Brentr).

Table 15. Robustness checks 2: Alternative explanatory variable as *OVX*.

Table 16. Endogenous problem: IV- GMM estimation results.

Table 1. Descriptive statistics of the variables.

Variable	Obs	Mean	Std. Dev.	Min	Max
EXDA	22,681	-0.0000855	0.1567234	-0.5947765	0.839325
EXDA_dum	22,681	0.4940258	0.4999753	0	1
OPU	22,681	0.1404012	0.0398697	0.0791615	0.2110771
GROWTH	22,681	0.1648274	0.5713679	-0.886576	4.025327
STATE	22,681	0.3892686	0.4875951	0	1
FATA	22,681	0.2207538	0.1653357	0.0017679	0.7083131
ETR	22,681	0.1664217	0.178924	-0.616688	0.845868
ROA	22,681	0.0380779	0.0615817	-0.2346	0.211903
EXP	22,679	0.1043497	0.0839728	0.009745	0.526757
MB	22,136	0.6163798	0.2498186	0.112246	1.146479
TOP1	22,681	0.3435847	0.1485885	0.085	0.743
NDTS	22,681	0.8952836	2.031548	-2.836751	13.60242
VEBITTA	22,681	0.0381842	0.0309015	0.0023668	0.1718003
VCF	22,681	0.0281814	0.0346711	0.0010273	0.2118918
D__dum	22,681	0.6378026	0.4806461	0	1
KZ	21,792	0.5382974	1.801747	-14.79934	11.53685

Notes: Std. Dev. = standard deviation; Obs = number of observations; Mean = average value; Min = minimum in the sample; Max = maximum in the sample.

Table 2. Baseline result of the oil price uncertainty on the excessive corporate debt (2010-2019).

Variable	**(1) OLS**	**(2) OLS-FE**	**(3) Logit**	**(4) Logit-FE**
	EXDA	*EXDA*	*EXDA_dum*	*EXDA_dum*
OPU	-0.0779***	-0.0901***	-0.8576**	-2.1428***
	(-3.3827)	(-5.1839)	(-2.3561)	(-4.1360)
GROWTH	0.0407***	0.0353***	0.4869***	0.6046***
	(17.8967)	(26.9225)	(13.9310)	(14.2792)
FATA	-0.0108	0.0072	-0.1519*	-0.0689
	(-0.7650)	(0.7370)	(-1.7010)	(-0.2423)
ETR	-0.0027	-0.0020	0.0413	-0.0807
	(-0.3434)	(-0.4685)	(0.5114)	(-0.6134)
ROA	-0.6369***	-0.4492***	-7.1751***	-7.3876***
	(-20.6776)	(-27.5444)	(-25.1940)	(-15.1952)
EXP	-0.3852***	-0.1746***	-4.3832***	-3.3153***
	(-11.5931)	(-10.5285)	(-19.6792)	(-6.9683)
MB	-0.0556***	-0.0597***	-0.2890***	-0.8842***
	(-6.0880)	(-13.1203)	(-4.4110)	(-6.6151)
TOP1	0.0012	0.1205***	-0.0360	2.3937***
	(0.0769)	(10.3345)	(-0.3717)	(7.1119)
NDTS	-0.0002	-0.0023***	0.0096	-0.0428***
	(-0.2975)	(-5.9989)	(1.3332)	(-3.6105)
VEBITTA	0.5896***	0.1160***	7.6207***	1.8929**
	(10.4886)	(3.9067)	(14.8259)	(2.2111)
VCF	-0.1290**	-0.0646**	-2.3993***	-1.7305**
	(-2.4090)	(-2.5659)	(-4.9726)	(-2.3678)
_cons	0.0864***	0.0353***	0.7327***	
	(7.0290)	(5.0498)	(7.6139)	
Firm FE	NO	YES	NO	YES
N	22,134	22,134	22,134	13,150
R^2	0.1018	0.0740	0.0542	

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% statistical significance levels, respectively. Parenthetical numbers in the OLS and OLS-FE model = *t* of the two-tailed test; parenthetical numbers in the Logit and Logit-FE columns = *z* statistics; R^2 = Pseudo R^2.

Table 3. Subsample analysis according to the enterprise size.

Variable	(1) Large size	(2) Small size	(3) Large size	(4) Small size
	EXDA	*EXDA*	*EXDA_dum*	*EXDA_dum*
OPU	0.0573**	-0.1180***	1.0711	-2.6943***
	(2.0020)	(-5.9042)	(0.7388)	(-4.7007)
GROWTH	0.0367***	0.0356***	1.1384***	0.6026***
	(17.5146)	(23.0801)	(5.4203)	(12.9816)
FATA	-0.0428**	0.0125	-1.2181	0.0854
	(-1.9946)	(1.1218)	(-1.1575)	(0.2735)
ETR	-0.0003	-0.0062	-0.4569	-0.0831
	(-0.0462)	(-1.2573)	(-1.2349)	(-0.5737)
ROA	-0.3848***	-0.4507***	-11.3938***	-7.1210***
	(-9.3017)	(-25.2733)	(-5.1761)	(-13.9878)
EXP	-0.1253*	-0.1573***	-6.2857**	-2.9171***
	(-1.8711)	(-8.8840)	(-2.0855)	(-5.9612)
MB	-0.0429***	-0.0599***	-0.8280*	-0.9004***
	(-4.1911)	(-11.5709)	(-1.6825)	(-6.0953)
TOP1	0.0793***	0.1292***	2.8549**	2.3808***
	(3.5695)	(9.0864)	(2.5[illegible]0)	(6.1198)
NDTS	-0.0021***	-0.0024***	-0.0506*	-0.0476***
	(-3.7175)	(-5.3469)	(-1.7510)	(-3.5118)
VEBITTA	-0.1205**	0.1512***	-4.2533	2.4912***
	(-2.0378)	(4.5275)	(-1.4935)	(2.6886)
VCF	0.1299*	-0.0830***	6.5824*	-1.9422**
	(1.6855)	(-3.9521)	(1.7454)	(-2.5539)
_cons	0.0214	0.0346***		
	(1.2875)	(4.3704)		
Firm FE	YES	YES	YES	YES
N	3,413	18,721	1,656	10,873
R^2	0.1359	0.0708		

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% statistical significance levels, respectively. Columns (1) and (2) show the results of the OLS-FE model; parenthetical numbers in these columns are *t* of the two-tailed test. Columns (3) and (4) show the results of the Logit-FE model; parenthetical numbers in these columns are *z* statistics; R^2 = Pseudo R^2.

Table 4. Subsample analysis according to SOE or not.

Variable	**(1)** **State-owned**	**(2)** **Non-state-owned**	**(3)** **State-owned**	**(4)** **Non-state-owned**
	EXDA	*EXDA*	*EXDA_dum*	*EXDA_dum*
OPU	-0.0267	-0.1341***	-0.7035	-2.9523***
	(-1.0905)	(-5.6243)	(-0.8060)	(-4.4954)
GROWTH	0.0362***	0.0352***	0.8532***	0.5367***
	(16.8458)	(21.1287)	(8.9564)	(10.8823)
FATA	0.0096	0.0097	-0.3237	0.0411
	(0.7105)	(0.6942)	(-0.6955)	(0.1083)
ETR	0.0005	-0.0067	-0.2263	-0.0246
	(0.0767)	(-1.1234)	(-1.0589)	(-0.1436)
ROA	-0.3621***	-0.4810***	-7.4751***	-7.2452***
	(-13.1915)	(-23.2159)	(-7.7089)	(-12.5049)
EXP	-0.1314***	-0.1770***	-4.[illegible]***	-2.6782***
	(-4.3276)	(-8.5775)	([illegible])	(-4.7639)
MB	-0.0461***	-0.0682***	-0.7327***	-0.9666***
	(-6.8869)	(-11.0695)	(-3.1215)	(-5.7430)
TOP1	0.0437**	0.1645***	1.6869***	2.5857***
	(2.4726)	(10.3916)	(2.7114)	(6.1160)
NDTS	-0.0024***	-0.0026***	-0.0526***	-0.0359**
	(-4.9060)	(-4.4073)	(-3.0409)	(-2.1332)
VEBITTA	0.0207	0.1577***	0.2864	2.6778**
	(0.4787)	(3.9584)	(0.1962)	(2.4849)
VCF	-0.0652	-0.0835***	-0.4682	-2.3103***
	(-1.4351)	(-2.6612)	(-0.2826)	(-2.7227)
_cons	0.0361***	0.0381***		
	(3.2776)	(4.1788)		
Firm FE	YES	YES	YES	YES
N	8,676	13,458	4,808	8,041
R^2	0.0571	0.0854		

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% statistical significance levels, respectively. Columns (1) and (2) show the results of the OLS-FE model; parenthetical numbers in these columns are *t* of the two-tailed test. Columns (3) and (4) show the results of the Logit-FE model; parenthetical numbers in these columns are *z* statistics; R^2 = Pseudo R^2.

Table 5. Subsample analysis according to the technology level of the industry.

Variable	(1) High-tech	(2) Non-high-tech	(3) High-tech	(4) Non-high-tech
	EXDA	*EXDA*	*EXDA_dum*	*EXDA_dum*
OPU	-0.0550**	-0.1198***	-1.3530*	-2.8080***
	(-2.1939)	(-4.9684)	(-1.7756)	(-3.9618)
GROWTH	0.0336***	0.0371***	0.5549***	0.6664***
	(17.9727)	(20.1727)	(9.2017)	(11.0606)
FATA	0.0099	0.0039	0.0562	-0.1582
	(0.6329)	(0.3115)	(0.1209)	(-0.4384)
ETR	-0.0088	0.0045	-0.4672**	0.2665
	(-1.3930)	(0.7537)	(-2.4058)	(1.4803)
ROA	-0.3701***	-0.5358***	-6.7837***	-3.1426***
	(-16.2132)	(-22.8526)	(-9.5984)	(-11.9104)
EXP	-0.1961***	-0.1529***	-4.2387***	-2.6646***
	(-7.9124)	(-6.8446)	(-5.5396)	(-4.3539)
MB	-0.0475***	-0.0701***	-0.6[illegible]***	-1.1061***
	(-7.2560)	(-11.0738)	(-3.1[illegible]04)	(-6.1104)
TOP1	0.1173***	0.1224***	2.4142***	2.4262***
	(6.7454)	(7.7546)	(4.7358)	(5.3695)
NDTS	-0.0026***	-0.0021***	-0.0457***	-0.0429**
	(-4.7568)	(-3.9887)	(-2.7364)	(-2.5229)
VEBITTA	0.2084***	0.0582	2.3073*	1.6313
	(4.4547)	(1.5115)	(1.6533)	(1.5004)
VCF	-0.0363	-0.0819***	-1.1432	-2.2246**
	(-1.0637)	(-2.[illegible]907)	(-1.1292)	(-2.0795)
_cons	0.0224**	0.0474***		
	(2.2358)	(4.[illegible]447)		
Firm FE	YES	YES	YES	YES
N	10,552	11,582	6,093	7,057
R^2	0.0663	0.0844		

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% statistical significance levels, respectively. Columns (1) and (2) show the results of the OLS-FE model; parenthetical numbers in these columns are *t* of the two-tailed test. Columns (3) and (4) show the results of the Logit-FE model; parenthetical numbers in these columns are *z* statistics. R^2 = Pseudo R^2.

Table 6. Subsample analysis according to whether the enterprise is affiliated with energy enterprises.

Variable	**(1) Energy**	**(2) Non-energy**	**(3) Energy**	**(4) Non-energy**
	EXDA	*EXDA*	*EXDA_dum*	*EXDA_dum*
OPU	-0.0643*	-0.0925***	-2.7876**	-1.8503***
	(-1.8068)	(-4.6496)	(-2.4599)	(-3.1621)
GROWTH	0.0385***	0.0350***	0.7837***	0.5823***
	(12.4855)	(24.0708)	(7.2408)	(12.5532)
FATA	-0.0549***	0.0315***	-1.5638***	0.5357
	(-3.2320)	(2.6593)	(-2.9353)	(1.5734)
ETR	0.0100	-0.0059	0.2141	-0.1719
	(1.1183)	(-1.1857)	(0.7229)	(-1.1665)
ROA	-0.5838***	-0.4190***	-10.2600***	-6.7167***
	(-16.3486)	(-22.7304)	(-8.8620)	(-12.4488)
EXP	-0.2184***	-0.1685***	-3.7023**	-3.2965***
	(-4.6219)	(-9.4456)	(-2.5166)	(-6.5458)
MB	-0.0594***	-0.0583***	-0.9080***	-0.8422***
	(-6.1975)	(-11.2674)	(-3.0515)	(-5.6038)
TOP1	0.0807***	0.1290***	1.8674**	2.5079***
	(3.2915)	(9.7371)	(2.4963)	(6.6195)
NDTS	-0.0023***	-0.0024***	-0.0429**	-0.0448***
	(-3.5522)	(-5.0677)	(-1.9660)	(-3.1507)
VEBITTA	0.0553	0.1275***	1.5108	1.9419**
	(0.8487)	(3.8228)	(0.7516)	(2.0452)
VCF	-0.0624	-0.0527*	-3.5027**	-1.0903
	(-1.1013)	(-1.9001)	(-2.0049)	(-1.3450)
_*cons*	0.0714***	0.0266***		
	(4.7385)	(3.3693)		
Firm FE	YES	YES	YES	YES
N	4,684	17,450	2,870	10,280
R^2	0.0909	0.0723		

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% statistical significance levels, respectively. Columns (1) and (2) show the results of the OLS-FE model; parenthetical numbers in these columns are *t* of the two-tailed test. Columns (3) and (4) show the results of the Logit-FE model; parenthetical numbers in these columns are *z* statistics. R^2 = Pseudo R^2.

Table 7. The moderation effect of the product-market demand.

Variable	**(1) OLS-FE**	**(2) Logit-FE**
	EXDA	*EXDA_dum*
OPU	-0.1753***	-4.0306***
	(-6.0037)	(-4.4934)
OPU×*D_dum*	0.1330***	2.8372***
	(3.6975)	(2.6062)
D_dum	-0.0137***	-0.2727*
	(-2.6093)	(-1.7266)
GROWTH	0.0346***	0.5859***
	(25.9759)	(13.6367)
FATA	0.0071	-0.0787
	(0.7255)	(-0.2770)
ETR	-0.0023	-0.0775
	(-0.5206)	(-0.5885)
ROA	-0.4539***	-7.5026***
	(-27.7961)	(-15.3931)
EXP	-0.1674***	-3.1552***
	(-10.0419)	(-6.5898)
MB	-0.0597***	-0.8828***
	(-13.0807)	(-6.5756)
TOP1	0.1216***	2.4219***
	(10.4050)	(7.1757)
NDTS	-0.0022***	-0.0422***
	(-5.9119)	(-3.5555)
VEBITTA	0.1207***	2.0052**
	(4.0609)	(2.3346)
VCF	-0.0582**	-1.5738**
	(-2.3067)	(-2.1486)
_cons	0.0430***	
	(5.3526)	
Firm FE	YES	YES
N	22,134	13,150
R^2	0.0752	

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% statistical significance levels, respectively. Parenthetical numbers in the first column = *t* of the two-tailed test; parenthetical numbers in the second column = *z* statistics; R^2 = Pseudo R^2.

Table 8. Subsample analysis of product-market demand in different enterprise scales and the SOE or not of enterprises.

Variable	**(1) Large size**	**(2) Small size**	**(3) State-owned**	**(4) Non-state-owned**
	EXDA	*EXDA*	*EXDA*	*EXDA*
OPU	0.1357***	-0.2344***	-0.0859**	-0.2357***
	(2.6808)	(-7.0892)	(-2.1798)	(-5.7250)
OPU×D_dum	-0.1114*	0.1812***	0.1009**	0.1504***
	(-1.7997)	(4.4657)	(1.9945)	(3.0556)
D_dum	0.0204**	-0.0205***	-0.0096	-0.0161**
	(2.1827)	(-3.4746)	(-1.2903)	(-2.2397)
GROWTH	0.0368***	0.0349***	0.0358***	0.0345***
	(17.5394)	(22.1089)	(16.5080)	(20.2479)
FATA	-0.0446**	0.0123	0.0095	0.0095
	(-2.0764)	(1.1010)	(0.6998)	(0.6765)
ETR	-0.0004	-0.0064	0.0002	-0.0069
	(-0.0617)	(-1.3023)	(0.0309)	(-1.1508)
ROA	-0.3935***	-0.4554***	-0.3767***	-0.4841***
	(-9.4147)	(-25.5223)	(-13.3949)	(-23.3575)
EXP	-0.1167*	-0.1497***	-0.1141***	-0.1694***
	(-1.7361)	(-8.4032)	(-4.0676)	(-8.1595)
MB	-0.0417***	-0.0604***	-0.0464***	-0.0684***
	(-4.0663)	(-11.6137)	(-6.9292)	(-11.0264)
TOP1	0.0802***	0.1295***	0.0444**	0.1650***
	(3.6127)	(9.0873)	(2.5118)	(10.3758)
NDTS	-0.0020***	-0.0024***	-0.0023***	-0.0025***
	(-3.6553)	(-5.2733)	(-4.8280)	(-4.3584)
VEBITTA	-0.1129*	0.1555***	0.0247	0.1633***
	(-1.9065)	(4.6498)	(0.5687)	(4.0936)
VCF	0.1219*	-0.0765***	-0.0589	-0.0771**
	(1.7130)	(-2.8084)	(-1.2934)	(-2.4462)
_cons	0.0053	0.0470***	0.0409***	0.0480***
	(0.2953)	(5.1884)	(3.3860)	(4.4625)
Firm FE	YES	YES	YES	YES
N	3,413	18,721	8,676	13,458
R^2	0.1376	0.0725	0.0582	0.0866

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% statistical significance levels, respectively. All columns show the results of the OLS-FE model. Parenthetical numbers = t of the two-tailed test; R^2 = Pseudo R^2.

Table 9. Subsample analysis of product-market demand in different technology level enterprises and whether the enterprise is affiliated with energy enterprises.

Variable	**(1) High-tech**	**(2) Non-high-tech**	**(3) Energy**	**(4) Non-energy**
	EXDA	*EXDA*	*EXDA*	*EXDA*
OPU	-0.1494***	-0.1979***	-0.1726***	-0.1759***
	(-3.4510)	(-5.0015)	(-2.9777)	(-5.2171)
OPU×*D_dum*	0.1409***	0.1274**	0.1712**	0.1276***
	(2.7116)	(2.5547)	(2.3409)	(3.0943)
D_dum	-0.0136*	-0.0132*	-0.0256**	-0.0108*
	(-1.7892)	(-1.8053)	(-2.3682)	(-1.7997)
GROWTH	0.0326***	0.0366***	0.0392***	0.0340***
	(17.1188)	(19.6036)	(12.5061)	(22.9781)
FATA	0.0098	0.0037	-0.0538***	0.0313***
	(0.6286)	(0.2963)	(-3.1653)	(2.6413)
ETR	-0.0093	0.0045	0.0092	-0.0061
	(-1.4743)	(0.7454)	(1.1028)	(-1.2285)
ROA	-0.3738***	-0.5418***	-0.5859***	-0.4240***
	(-16.3699)	(-23.0416)	(-16.3546)	(-22.9864)
EXP	-0.1875***	-0.1458***	-0.2176***	-0.1593***
	(-7.5277)	(-6.4871)	(-4.5807)	(-8.8851)
MB	-0.0473***	-0.0702***	-0.0615***	-0.0578***
	(-7.1686)	(-11.0750)	(-6.3805)	(-11.1371)
TOP1	0.1190***	0.1234***	0.0776***	0.1318***
	(6.8221)	(7.8038)	(3.1642)	(9.9243)
NDTS	-0.0026***	-0.0021***	-0.0023***	-0.0023***
	(-4.7204)	(-3.9073)	(-3.5209)	(-4.9736)
VEBITTA	0.2199***	0.0602	0.0545	0.1352***
	(4.6853)	(1.5614)	(0.8358)	(4.0468)
VCF	-0.0279	-0.0764**	-0.0666	-0.0446
	(-0.8144)	(-2.0380)	(-1.1720)	(-1.5724)
_cons	0.0295**	0.0547***	0.0900***	0.0313***
	(2.5211)	(4.9410)	(5.2688)	(3.4442)
Firm FE	YES	YES	YES	YES
N	10,552	11582	4,684	17,450
R^2	0.0679	0.0854	0.0922	0.0739

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% statistical significance levels, respectively. All columns show the results of the OLS-FE model. Parenthetical numbers = *t* of the two-tailed test; R^2 = Pseudo R^2.

Table 10. The moderation effect of financing constraints.

Variable	(1) OLS-FE	(2) Logit-FE
	EXDA	*EXDA_dum*
OPU	-0.0791***	-2.0707***
	(-4.3950)	(-3.6471)
OPU×*KZ*	-0.0330***	-0.7629**
	(-3.6521)	(-2.4918)
KZ	0.0240***	0.5581***
	(16.3757)	(11.1686)
GROWTH	0.0468***	0.9399***
	(33.9629)	(18.8735)
FATA	-0.0070	-0.3137
	(-0.7344)	(-1.0683)
ETR	-0.0065	-0.2071
	(-1.5423)	(-1.5356)
ROA	-0.2600***	-3.4716***
	(-15.2035)	(-6.5779)
EXP	-0.1772***	-3.6314***
	(-10.9229)	(-7.2824)
MB	-0.0302***	-0.2981**
	(-6.6524)	(-2.1243)
TOP1	0.1254***	2.5060***
	(10.9422)	(7.1477)
NDTS	-0.0029***	-0.0589***
	(-7.8162)	(-4.8526)
VEBITTA	0.0952***	1.3533
	(3.2689)	(1.4094)
VCF	0.0251	0.4455
	(1.0047)	(0.5765)
_cons	-0.0024	
	(-0.3455)	
Firm FE	YES	YES
N	21,790	12,900
R^2	0.1208	

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% statistical significance levels, respectively. Parenthetical numbers in the first column = *t* of the two-tailed test; parenthetical numbers in the second column = *z* statistics; R^2 = Pseudo R^2.

Table 11. Subsample analysis of financing constraints in different enterprise scales and the SOE or not of enterprises.

Variable	**(1) Large size**	**(2) Small size**	**(3) State-owned**	**(4) Non-state-owned**
	EXDA	*EXDA*	*EXDA*	*EXDA*
OPU	0.0692**	-0.1157***	-0.0473*	-0.1157***
	(2.1502)	(-5.6398)	(-1.7592)	(-4.8001)
OPU×KZ	0.0033	-0.0425***	0.0392***	-0.0786***
	(0.1997)	(-4.1870)	(2.7028)	(-6.7919)
KZ	0.0052*	0.0271***	0.0120***	0.0316***
	(1.7991)	(16.5398)	(5.2154)	(16.6053)
GROWTH	0.0444***	0.0466***	0.0494***	0.0454***
	(18.1774)	(29.1292)	(21.8523)	(25.9511)
FATA	-0.0411*	-0.0088	-0.0019	-0.0087
	(-1.9250)	(-0.8066)	(-0.1423)	(-0.6300)
ETR	-0.0026	-0.0111**	-0.0024	-0.0118**
	(-0.3665)	(-2.3144)	(-0.4031)	(-2.0144)
ROA	-0.3199***	-0.2542***	-0.1804***	-0.2847***
	(-7.0797)	(-13.6732)	(-6.1983)	(-13.1830)
EXP	-0.1332**	-0.1607***	-0.1258***	-0.1783***
	(-2.0017)	(-9.2967)	(-4.1564)	(-8.8567)
MB	-0.0392***	-0.0257***	-0.0309***	-0.0304***
	(-3.8353)	(-4.9698)	(-4.6674)	(-4.9294)
TOP1	0.0796***	0.1391***	0.0390**	0.1771***
	(3.5996)	(9.9726)	(2.2460)	(11.3942)
NDTS	-0.0023***	-0.0030***	-0.0029***	-0.0032***
	(-4.0976)	(-6.8810)	(-6.0830)	(-5.7601)
VEBITTA	-0.1198**	0.1285***	0.0040	0.1414***
	(-2.0353)	(3.9262)	(0.0932)	(3.6177)
VCF	0.1486*	0.0068	-0.0339	0.0175
	(1.9324)	(0.2538)	(-0.7568)	(0.5626)
_cons	0.0081	-0.0033	0.0123	-0.0047
	(0.4799)	(-0.4152)	(1.1110)	(-0.5221)
Firm FE	YES	YES	YES	YES
N	3,401	18,389	8,651	13,139
R^2	0.1477	0.1237	0.0962	0.1401

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% statistical significance levels, respectively. All columns show the results of the OLS-FE model. Parenthetical numbers = *t* of the two-tailed test; R^2 = Pseudo R^2.

Table 12. Subsample analysis of financing constraints in different technology level enterprises and whether the enterprise is affiliated with energy enterprises.

Variable	**(1) High-tech**	**(2) Non-high-tech**	**(3) Energy**	**(4) Non-energy**
	EXDA	*EXDA*	*EXDA*	*EXDA*
OPU	-0.0663***	-0.0877***	-0.0333	-0.0861***
	(-2.6285)	(-3.4024)	(-0.8947)	(-4.1838)
OPU×KZ	-0.0356***	-0.0325**	-0.0213	-0.0342***
	(-2.7800)	(-2.5354)	(-1.0163)	(-3.3920)
KZ	0.0257***	0.0228***	0.0284***	0.0231***
	(12.2949)	(11.0058)	(8.5861)	(14.0913)
GROWTH	0.0451***	0.0487***	0.0550***	0.0458***
	(23.0372)	(25.0741)	(16.9259)	(29.8970)
FATA	-0.0150	-0.0047	-0.0751***	0.0196*
	(-0.9737)	(-0.3811)	(-4.5412)	(1.6852)
ETR	-0.0127**	-0.0007	0.0054	-0.0103**
	(-2.0750)	(-0.1121)	(0.6[illegible]0)	(-2.1386)
ROA	-0.1876***	-0.3380***	-0.3069***	-0.2450***
	(-7.9342)	(-13.5723)	(-6.0365)	(-12.7239)
EXP	-0.1984***	-0.1570***	-0.2272***	-0.1707***
	(-8.2011)	(-7.1663)	(-4.9698)	(-9.7622)
MB	-0.0116*	-0.0463***	-0.0276***	-0.0291***
	(-1.7735)	(-7.3373)	(-2.9169)	(-5.6149)
TOP1	0.1328***	0.1213***	0.0773***	0.1359***
	(7.7983)	(7.8062)	(3.2525)	(10.4181)
NDTS	-0.0034***	-0.0026***	-0.0030***	-0.0030***
	(-6.4297)	(-4.9832)	(-4.7369)	(-6.6019)
VEBITTA	0.2011***	0.0326	0.0622	0.1020***
	(4.3769)	(0.8611)	(0.9847)	(3.1080)
VCF	0.0622*	-0.0075	0.0516	0.0289
	(1.8342)	(-0.2012)	(0.9245)	(1.0269)
_cons	-0.0143	0.0091	0.0267*	-0.0100
	(-1.4339)	(0.9180)	(1.7825)	(-1.2671)
Firm FE	YES	YES	YES	YES
N	10,341	11,449	4,628	17,162
R^2	0.1224	0.1239	0.1548	0.1161

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% statistical significance levels, respectively. All columns show the results of the OLS-FE model. Parenthetical numbers = *t* of the two-tailed test; R^2 = Pseudo R^2.

Table 13. Robustness checks 1: Alternative sample period.

Variable	**(1)2010-2019 except 2013 and 2014**	**(2)2010-2019 except 2013 and 2014**	**(3) 2011-2019**	**(4) 2011-2019**
	EXDA	*EXDA_dum*	*EXDA*	*EXDA_dum*
OPU	-0.1022***	-2.7818***	-0.1071***	-2.5100***
	(-4.6792)	(-4.1806)	(-6.1622)	(-4.7262)
GROWTH	0.0421***	0.6483***	0.0352***	0.6025***
	(28.3286)	(13.2003)	(26.3643)	(13.8644)
FATA	0.0130	0.0784	0.0099	-0.0371
	(1.1651)	(0.2383)	(0.9640)	(-0.1230)
ETR	-0.0023	-0.1635	-0.0020	-0.0681
	(-0.4767)	(-1.0827)	(-0.4545)	(-0.4989)
ROA	-0.4668***	-7.7550***	-0.4469***	-7.3580***
	(-26.0555)	(-14.2066)	(-26.9069)	(-14.5565)
EXP	-0.1947***	-3.5566***	-0.1867***	-3.4664***
	(-10.2389)	(-6.4176)	(-10.9967)	(-6.9367)
MB	-0.0533***	-0.8144***	-0.0699***	-1.0871***
	(-10.5350)	(-5.4044)	(-14.6329)	(-7.5543)
TOP1	0.1204***	2.4112***	0.1313***	2.5638***
	(9.0926)	(6.1243)	(10.7941)	(7.1300)
NDTS	-0.0020***	-0.0295**	-0.0023***	-0.0476***
	(-4.6078)	(-2.1056)	(-5.9276)	(-3.8440)
VEBITTA	0.1232***	2.7214***	0.1192***	1.8926**
	(3.6692)	(2.7711)	(3.8550)	(2.0736)
VCF	-0.0238	-1.1487	-0.0500*	-1.8173**
	(-0.8397)	(-1.3881)	(-1.9287)	(-2.3783)
_cons	0.0335***		0.0411***	
	(4.1515)		(5.6648)	
Firm FE	YES	YES	YES	YES
N	17,838	9,785	20,815	11,850
R^2	0.0914		0.0793	

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% statistical significance levels, respectively. Columns (1) and (3) show the results of the OLS-FE model; parenthetical numbers in these columns are *t* of the two-tailed test. Columns (2) and (4) show the results of the Logit-FE model; parenthetical numbers in these columns are *z* statistics. R^2 = Pseudo R^2.

Table 14. Robustness checks 2: Alternative explanatory variable (Brent Crude Oil—Brentr).

Variable	**(1) OLS**	**(2) OLS-FE**	**(3) Logit**	**(4) Logit-FE**
	EXDA	*EXDA*	*EXDA_dum*	*EXDA_dum*
Brentr	-0.0565**	-0.0780***	-0.6776*	-1.9691***
	(-2.1862)	(-4.2859)	(-1.7820)	(-3.6429)
GROWTH	0.0405***	0.0351***	0.4848***	0.6001***
	(17.8229)	(26.8117)	(13.8944)	(14.2027)
FATA	-0.0110	0.0068	-0.1543*	-0.0816
	(-0.7781)	(0.6922)	(-1.7278)	(-0.2866)
ETR	-0.0028	-0.0020	0.0403	-0.0831
	(-0.3559)	(-0.4724)	(0.4989)	(-0.6323)
ROA	-0.6347***	-0.4474***	-7.1519***	-7.3504***
	(-20.6564)	(-27.4407)	(-25.1626)	(-15.1345)
EXP	-0.3846***	-0.1751***	-4.3747***	-3.3287***
	(-11.5735)	(-10.5595)	(-19.6602)	(-6.9967)
MB	-0.0543***	-0.0573***	-0.2761***	-0.8352***
	(-6.0123)	(-12.8036)	(-4.2480)	(-6.3580)
TOP1	0.0009	0.1192***	-0.0390	2.3503***
	(0.0605)	(10.1648)	(-0.4028)	(6.9557)
NDTS	-0.0002	-0.0023***	0.0095	-0.0431***
	(-0.3060)	(-6.0362)	(1.3258)	(-3.6342)
VEBITTA	0.5902***	0.1158***	7.6232***	1.8755**
	(10.4981)	(3.8988)	(14.8266)	(2.1906)
VCF	-0.1257**	-0.0619**	-2.3646***	-1.6754**
	(-2.3508)	(-2.4573)	(-4.9104)	(-2.2947)
_cons	0.0819***	0.0318***	0.6910***	
	(6.6706)	(4.5507)	(7.3468)	
Firm FE	YES	YES	YES	YES
N	22,134	22,134	22,134	13,150
R^2	0.1016	0.0736		

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% statistical significance levels, respectively. Parenthetical numbers in Columns (1) and (2) are *t* of the two-tailed test; parenthetical numbers in Columns (3) and (4) are *z* statistics; R^2 = Pseudo R^2.

Table 15. Robustness checks 3: Alternative Explanatory Variable (CBOE Crude Oil Volatility Index—OVX).

Variable	**(1) OLS**	**(2) OLS-FE**	**(3) Logit**	**(4) Logit-FE**
	EXDA	*EXDA*	*EXDA_dum*	*EXDA_dum*
OVX	-0.0428***	-0.0469***	-0.3913**	-1.0154***
	(-3.8603)	(-5.1374)	(-2.0309)	(-3.7330)
GROWTH	0.0406***	0.0352***	0.4853***	0.5987***
	(17.8762)	(26.8665)	(13.9166)	(14.1887)
FATA	-0.0105	0.0080	-0.1489*	-0.0459
	(-0.7436)	(0.8159)	(-1.6672)	(-0.1618)
ETR	-0.0026	-0.0020	0.0423	-0.0806
	(-0.3250)	(-0.4531)	(0.5240)	(-0.6130)
ROA	-0.6360***	-0.4462***	-7.1570***	-7.3088***
	(-20.7268)	(-27.4418)	(-25.1744)	(-15.0873)
EXP	-0.3861***	-0.1765***	-4.3895***	-3.3564***
	(-11.6147)	(-10.6496)	(-19.6872)	(-7.0559)
MB	-0.0556***	-0.0594***	-0.2839***	-0.3644***
	(-6.1141)	(-13.0981)	(-4.3382)	(-6.4817)
TOP1	0.0013	0.1227***	-0.0348	2.4425***
	(0.0864)	(10.5426)	(-0.3596)	(7.2683)
NDTS	-0.0002	-0.0023***	0.0095	-0.0432***
	(-0.3043)	(-6.0374)	(1.3278)	(-3.6412)
VEBITTA	0.5925***	0.1208***	7.6551***	2.0202**
	(10.5410)	(4.0730)	(14.8989)	(2.3620)
VCF	-0.1287**	-0.0616**	-2.3842***	-1.6665**
	(-2.4092)	(-2.4480)	(-4.9452)	(-2.2822)
_cons	0.0894***	0.0369***	0.7358***	
	(7.1716)	(5.1366)	(7.0763)	
Firm FE	YES	YES	YES	YES
N	22,134	22,134	22,134	13,150
R^2	0.1018	0.0740		

Note: *, **, and *** indicate the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% statistical significance levels, respectively. Parenthetical numbers in Columns (1) and (2) are t of the two-tailed test; parenthetical numbers in Columns (3) and (4) are z statistics; R^2 = Pseudo R^2.

Table 16. Endogenous problem: IV- GMM estimation results.

Variable	**(1)**
	lnEXDA
OPU	-0.7815**
	(-2.0780)
GROWTH	0.5635**
	(2.5680)
FATA	-0.2139
	(-0.5660)
ETR	-0.9690***
	(-2.6175)
ROA	-4.7253***
	(-4.7234)
EXP	-1.6994***
	(-3.6922)
MB	-0.7079***
	(-4.8589)
TOP1	0.0451
	(0.3176)
NDTS	0.0109
	(0.3594)
VEBITTA	-1.4588
	(-0.5228)
VCF	-4.9908**
	(-2.3999)
N	7475
Hausman	43.59[0.0000]
Hansen J	93.05[0.118]
P	0.289

Note: *, **, and *** indicate the 10%, 5% and 1% statistical significance levels, respectively. Numbers in parentheses = *z* statistics of the coefficients; numbers in brackets = *p* of the corresponding statistics; P is the number of AR (2).

Figures

Fig. 1. China's oil imports and crude oil dependence from 2016 to 2020

Fig. 2. Top 15 global crude oil import countries/regions in 2019

Fig. 3. Crude oil price and oil price uncertainty for the period 2010-2019

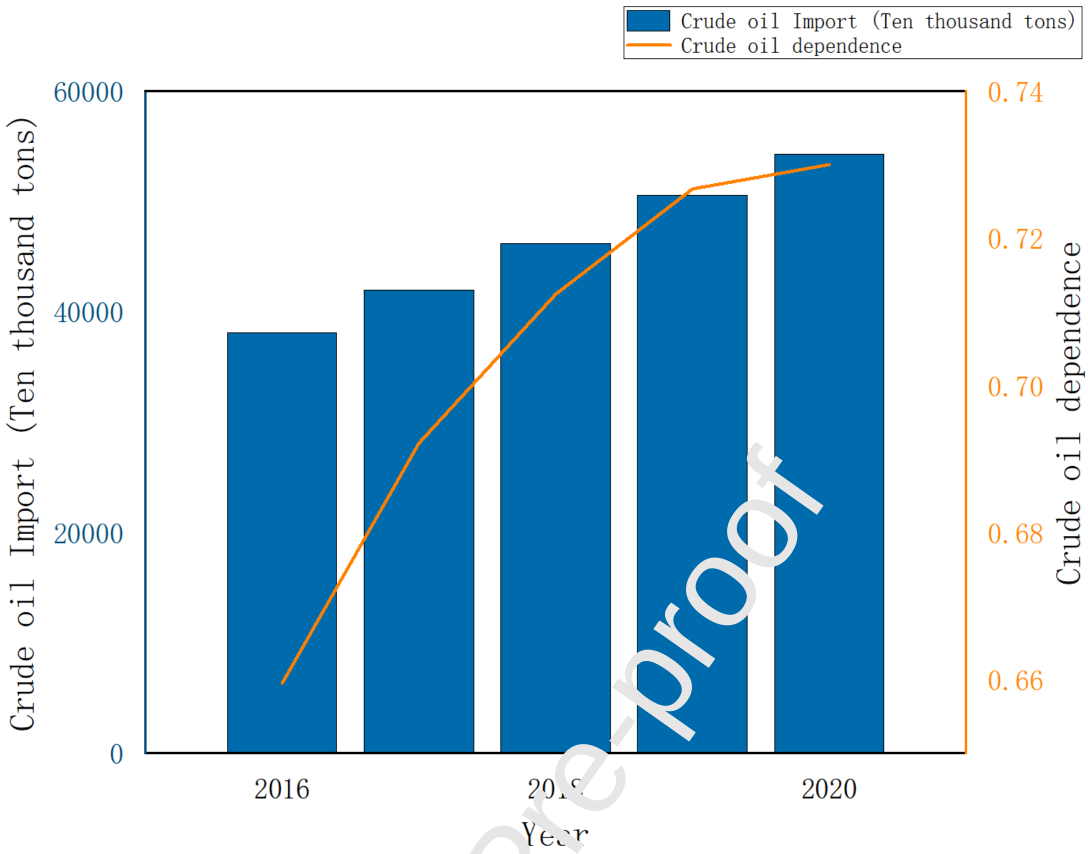


Fig. 1. China's Oil Imports and Crude Oil Dependence from 2016 to 2020

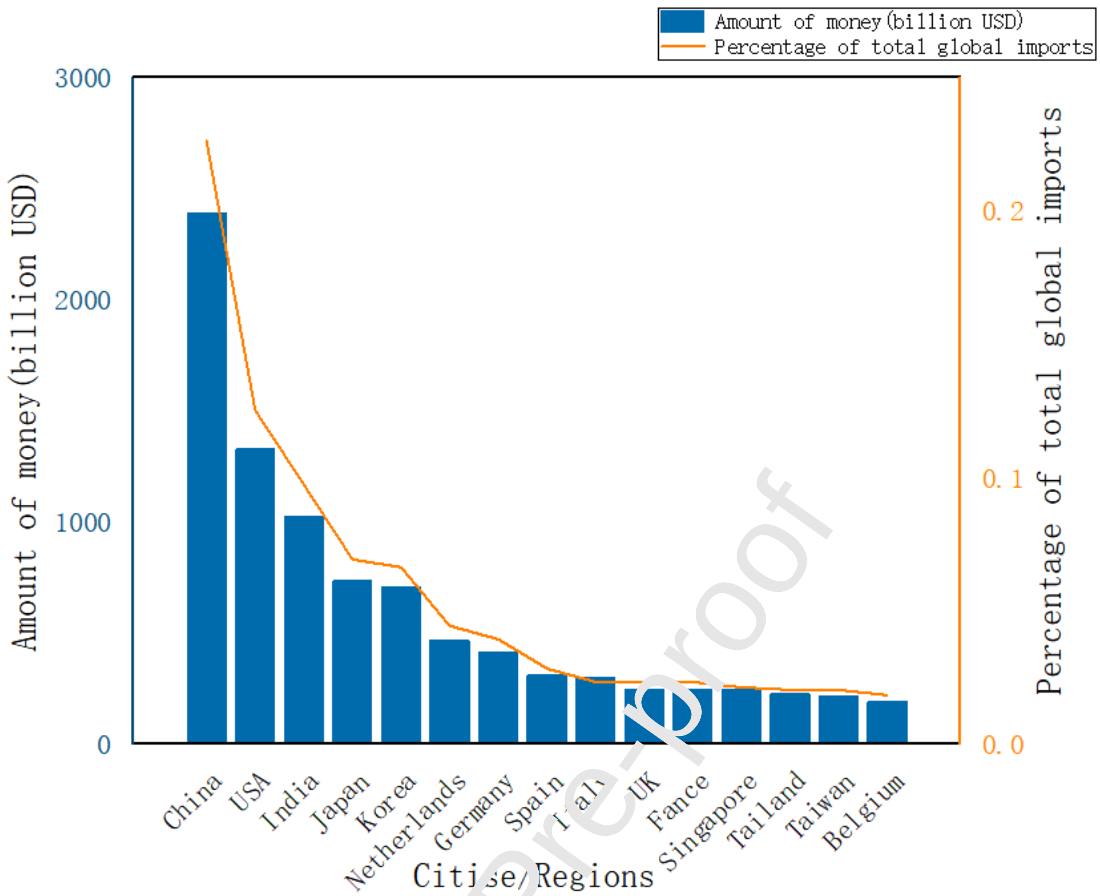


Fig. 2. Top 15 Global Crude Oil Import Countries/Regions in 2019

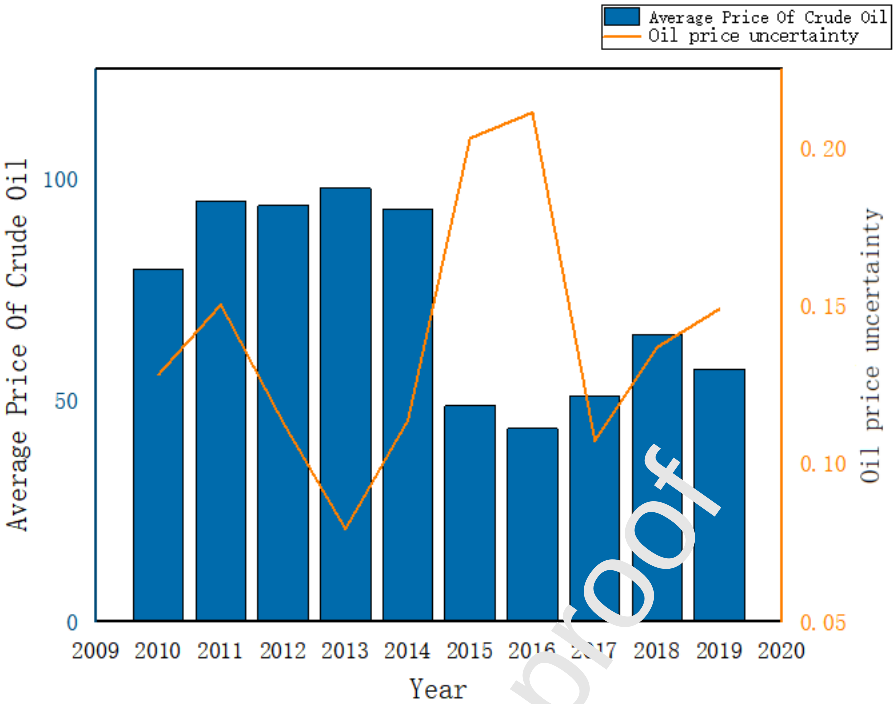


Fig. 3. Crude Oil Price and Oil Price Uncertainty for the Period 2010–2019

Author Statement

Xiaohang Ren: Methodology, Conceptualization, Analysis, Supervision and Writing – Reviewing and Editing

Jianing Qin: Analysis, Software, Writing – Original draft preparation

Chenglu Jin: Writing – Original draft preparation, and Writing - Editing

Cheng Yan: Writing - Reviewing

Highlights

- We explore the impact of oil price uncertainty (OPU) on corporate excessive debt (EXDA) in China.
- Our findings show that OPU significantly reduces EXDA.
- The impact of OPU on EXDA varies according to ownership type and industry type.
- Product-market demand and financing constraints are the mechanisms that OPU affects EXDA.