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Article

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Does environmental labeling exacerbate heavily polluting firms' financial constraints? Evidence from China



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ABSTRACT

The Chinese Ministry of Environmental Protection has enacted an environmental policy that restricts the investment activities of heavily polluting firms by increasing their financial constraints. In this paper, we examine the impact of environmental labeling on firms' financial constraints. We document that the financial constraints of heavily polluting firms increase more than those of other firms after the issuance of environmental labeling. The debt and equity financing channels of heavily polluting firms are restricted, with smaller bank loans and less equity issuance in the future. The effect is stronger in firms that make a smaller contribution to the local government's gross domestic product, receive greater media coverage, and are located in heavily polluted provinces. The environmental regulation is effective in increasing the environmentally friendly practices and decreasing the performance growth of heavily polluting firms. Our findings not only contribute to the growing literature on the factors influencing financial constraints, identifying the effects of non-monetary factors on financial constraints, but also provide more evidence for the underlying mechanism of efficient environmental policy. Our results also provide practical suggestions for investors and institutions on evaluating firms and for regulatory authorities on further implementing environmental policy.

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1. Introduction

China has achieved rapid economic development since the beginning of the 21st century; its gross domestic product (GDP) growth soared from 8.5% in 2000 to 14.2% in 2007. However, the consumption of resources and energy and emissions of pollutants have also increased. Industrial waste water discharge, for example, rose from 19.4 billion tons in 2000 to 24.7 billion tons in 2007.¹ Average emissions of sulfur dioxide (SO₂) and atmospheric particulate matter with a diameter of less than 2.5 μm (PM_{2.5}) have also been increasing since 2000 (Fig. 1). The degree and scale of environmental pollution continue to expand, and there have been serious incidents of pollution every year. In 2002, for instance, the collapse of a dam of a lead-zinc mine tailings pond contaminated Qingshui River, making the water in Guizhou province undrinkable. In recent years, water pollution events, toxic leaks, and many other incidents have occurred in several provinces. These events have threatened rare animals with extinction and damaged the health of millions of people. This has all resulted in huge economic losses and harm to human life and the environment. The purpose of promoting economic development is to improve people's lives, yet it can often make them worse off. It is thus urgently necessary to intensify environmental protection efforts in China.

To transform its pattern of economic development to promote social and economic sustainability, China must increase its environmental protection efforts. The Chinese government has enacted a series of environmental protection regulations to encourage firms to be environmentally conscious. These include laws, such as the Law on the Prevention and Control of Environmental Pollution by Solid Waste (2004) and Law on Energy Conservation (2007); market-based policies, such as Administrative Regulations on Levy and Use of Pollutant Discharge Fee (2003); and voluntary policies, such as Measures on Open Environmental Information (Trial) (2007) (detailed information on these regulations is provided in Appendix Table A.1). Although many environmental regulations have been implemented, little improvement in environmental protection was evident at the beginning of the 21st century; the effect of governance only began to appear in around 2008.

The initial lack of efficiency of China's environmental laws was due to a lack of definite direction. The regulations neither defined the list of heavily polluting firms clearly nor implemented direct control of heavily polluting firms' production and operations. However, in 2008, the Chinese Ministry of Environmental Protection issued Administrative Measures on Use of China Environmental Labeling (Administrative Measures), which provided a classification of heavily polluting industries and outlined requirements for environmental protection verification. Administrative Measures provided a list of heavily polluting firms, making it clear for both the relevant departments and the firms themselves that they would be strictly monitored and regulated by previous environmental laws. Administrative Measures also specified that classified heavily polluting firms must pass the environmental protection verification process before trying to raise funds in the capital market through initial public offerings or secondary equity offerings. Thus firms labeled as heavily polluting firms now face fiercer financial constraints and have less funding to invest in polluting projects. Our study examines the change in firms' financial constraints after the issuance of environmental labeling.

Many studies focus on the effectiveness of environmental policy. Researchers examine capital markets' reaction to the disclosure of environmental information in other countries, such as the U.S. (Badrinath and Bolster, 1996; Hamilton, 1995; Konar and Cohen, 1997) and Canada (Foulon et al., 2002; Lanoie et al., 1998). In China, only a few recent studies demonstrate the impact of environmental events on the stock market, with mixed results. Xu et al. (2012) find a weak impact, while Ren et al. (2018); Viard and Fu (2015); Xu et al. (2016), and Zhang et al. (2018) find a stronger market reaction for related firms. However, there is little empirical evidence of the underlying mechanism by which environmental policy affects financing decisions. We examine the impact of environmental regulation on the financial constraints of Chinese listed firms. We focus on three topics: how environmental regulation influences firms' financial constraints; the mechanism by which the relationship between financial constraints and regulation differs between firms; and whether the regulation is an effective method of pollution control.

To examine whether financial constraints are affected by environmental labeling, we follow the methodology in Kaplan and Zingales (1997) and Lamont et al. (2001) to construct a Kaplan-Zingales (KZ) index to

¹ Data from the China Environmental Statistics Bulletin.

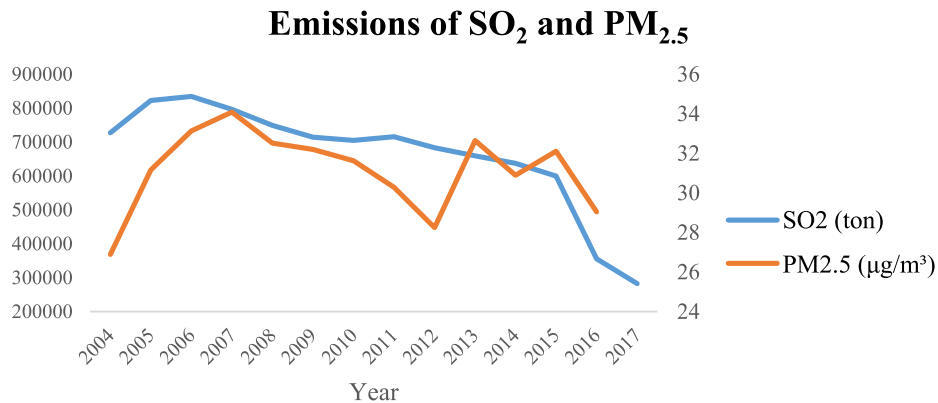


Fig. 1. Emissions of SO₂ and PM_{2.5}(Data from the National Bureau of Statistics of China.) in China from 2004 to 2017.

measure financial constraints. As omitted trends may be correlated with financial constraints, and may be the result of unobserved differences between heavily polluting firms and other firms, we use a difference in differences (DiD) approach to determine the influence of environmental labeling on the KZ index, and reach our main conclusion that environmental policy has a significant negative impact on the financial constraints of heavily polluting firms. To determine in detail how environmental labeling affects firms' financing channels, we use several kinds of bank loans and equity issuance as the dependent variables to test how the debt and equity financing channels of heavily polluting firms change. We verify that both the bank loans provided for heavily polluting firms and their future equity issuance decrease more than those of non-polluting firms. The heavily polluting firms are punished by receiving reduced capital due to the environmental policy. In addition, in light of the differential effect of environmental labeling on financial constraints, we regress the baseline DiD model partitioned by three adjustment variables and find that the impact is mainly concentrated in heavily polluting firms that make a smaller contribution to the local government's GDP, receive greater media coverage, and are located in heavily polluted provinces. Moreover, to assess the effectiveness of the environmental policy, we focus on both direct and indirect effects. The PM_{2.5} emissions of heavily polluting firms decrease more than those of non-polluting firms, and revenue growth also decreases after the policy. We conclude that the environmental policy is effective, resulting in higher financial constraints, lower revenue growth, and more environmentally responsible behavior for heavily polluting firms. As a robustness check, we use alternative measurements for financial constraints, conduct a placebo test and a more standard DiD test, and check that the parallel trend assumption is satisfied.

Our study contributes in several ways to the growing literature on financial constraints and on environmental policy. First, most studies examine the internal factors influencing financial constraints, such as firm size (Almeida et al., 2004; Hadlock and Pierce, 2010) and political connection (Cull et al., 2015; Li et al., 2008); only a few take a theoretical perspective on the relationship between financial constraints and external factors (Beaudry et al., 2001). Our study complements this stream of the literature by providing empirical evidence of the relationship between national policy and financial constraints. Second, researchers generally focus on the external economic factors that influence financial constraints. Our paper identifies how non-monetary factors affect financial constraints. Previous studies explain the mechanism by which monetary policy and industrial policy affect financial constraints. Compared with Murphy et al. (1989), who present industrialization as a big push that drives coordinated investment, and Beaudry et al. (2001), who show that monetary instability adversely affects the allocation of investment, our study explains the mechanism through the non-monetary policy side and provides the first evidence for the link between environmental regulation and changes in firms' financial constraints. Third, we add to existing studies on the efficiency of environmental policy in view of firm-level behavior. Fowlie et al. (2012) and Konar and Cohen (1997) directly investigate the consequences of the environmental program, documenting that heavily polluting firms reduce their emissions after the disclosure of pollution information. We provide possible reasons for the environmental policy's success by examining the mechanism by which the heavily polluting firms are affected and why they choose to reduce polluting

activities by showing that heavily polluting firms are more likely to be financially constrained and find it harder to invest further in polluting projects. Lastly, our study provides guidance for individual and institutional investors on evaluating environmental policy and regulation for heavily polluting firms. Our results also provide evidence that will assist regulatory authorities in implementing environmental policy.

The remainder of this paper proceeds as follows. Section 2 presents the literature review. Section 3 develops the hypotheses. Section 4 discusses the research design. Section 5 presents the empirical results, and Section 6 contains the robustness tests. Section 7 concludes the paper.

2. Literature review

2.1. Research on the factors affecting financial constraints

Financial constraints are a type of financial friction caused by information asymmetry between issuers and investors (Tirole, 2006). Financial constraints make it difficult for firms to raise adequate funding, and are an important factor in firms' investment and financing decisions. The factors influencing financial constraints can be classified into two categories: firm characteristics (internal factors) and external financing environment characteristics (external factors).

In terms of internal factors, firm size and age, political connection, and reputation are important factors affecting financing constraints. Firm size and age are particularly useful predictors of financial constraint levels. As small firms have less collateral and lower information transparency, they have higher frictional costs and thus are more likely to encounter financing constraints (Almeida et al., 2004). Financial constraints drop sharply as young and small firms mature and grow (Hadlock and Pierce, 2010). In developing countries, especially in regions with weaker market institutions and weaker legal protection, political connections help firms to obtain loans from banks or other state institutions and to gain more financial resources in the capital market (Cull et al., 2015; Li et al., 2008). Firms with political connections enjoy a lower cost of equity capital (Boubakri et al., 2012), have preferential access to bank credit (Charumilind et al., 2006; Claessens et al., 2008), borrow more and have a higher default rate (Khwaja and Mian, 2005), and gain more subsidies (Johnson and Mitton, 2003), thus facing lower financial constraints. In addition, there are effective alternative financing channels based on reputation and relationships (Allen et al., 2005).

From the perspective of the external financing environment, financial constraints are affected mainly by financial development. Countries with more developed financial markets generally have a better external financing environment. Financial development lowers the cost of external financing for firms. In less financially developed countries with weaker investor protection, companies often face severe financing constraints that distort the efficient allocation of investment, thereby increasing the gap between firms' internal and external funding costs (Khurana et al., 2006; LaPorta et al., 1997; Love, 2003; Rajan and Zingales, 1998). Firms' financing choice also depends on competition within their industry, such as the number of firms in the industry, elasticity of demand, and convexity of production costs (Adam et al., 2007).

2.2. Research on the effect of national policy on firms' financing behavior

Government and national policies have important external impacts on firms' financing and investment behavior. Political and economic factors affect firms' behavior in seeking financing. The offer price, share allocation, and other terms are affected when governments privatize state-owned enterprises via a public share offering (Jones et al., 1999). Some researchers find that public policy can complement the capital market. Industrialization is a big push that drives coordinated investment across sectors under an imperfectly competitive economy (Murphy et al., 1989). However, national policy may also have the opposite effect on firms' investment and financing. Monetary instability adversely affects the allocation of investment (Beaudry et al., 2001). In Finland, government funding of small to medium-sized enterprises disproportionately helps firms from industries that are dependent on external financing (Hyytinen and Toivanen, 2005). An increase in policy instability will in the short run lead firms to reduce their R&D efforts (Greenwald and Stiglitz, 1990). In emerging markets, especially in China, the influence of government intervention on the national

economy is huge. Government regulation plays an active role as an alternative mechanism in an incomplete legal environment (Pistor and Chenggang, 2002).

Aside from macroeconomic policies, environmental regulations have an indirect influence on firms' financial constraints. As more environmental policies are implemented and more efforts are made to monitor the environmental performance of companies, studies are increasingly examining the economic consequences of these regulations in various countries. In the U.S., many environmental programs, such as the Regional Clean Air Incentives Market and the Toxics Release Inventory, have been shown to be effective (Fowlie et al., 2012; Konar and Cohen, 1997). Researchers show that capital markets react to the disclosure of environmental information and penalize environmentally unfriendly firms by decreasing their firm value, thus creating additional strong incentives for pollution control in developed countries, such as the U.S. (Badrinath and Bolster, 1996; Hamilton, 1995; Konar and Cohen, 1997), Canada (Foulon et al., 2002; Lanoie et al., 1998), and European countries (Lundgren and Olsson, 2010), in addition to developing countries (Gupta and Goldar, 2005). In China, environmental events had a weak impact on the stock market in the first few years of the 21st century (Xu et al., 2012). More recently, Chinese environmental regulations and information have become more effective and have caused market reactions affecting the related firms (Ren et al., 2018; Viard and Fu, 2015; Xu et al., 2016; Zhang et al., 2018).

3. Hypothesis development

National policy has a major impact on firms' financing and investment activities. In China, this effect is particularly significant because of the government's strong intervention. Firms often face incomplete external information when making investment decisions. As the government specifically defines in its policies which kinds of firms are likely to receive major support and which kinds of firms will be strictly monitored or punished, the issuance of policies and regulations substantially changes firms' investment environment. Increasing attention has been paid to environmental protection in recent years; consequently, the issuance of environmental policy acts as a signal for financial institutions and investors, altering their decisions following the regulation and thus changing firms' financing channels. First, the issuance of classification reduces financial institutions' and investors' market expectations and valuation of firms in heavily polluting industries; thus the affected firms are less able to raise funds in the capital market. Second, due to government pressure and the low valuation of firms, the policy reduces banks' willingness to provide loans for heavily polluting firms. Therefore, in our first hypothesis, we propose that the financial constraints of heavily polluting firms increase more after the issuance of environmental policy.

H1. The financial constraints of heavily polluting firms increase more than those of non-polluting firms after the issuance of environmental policy.

Because the environmental policy stipulates that all firms classified as heavily polluting have to pass environmental protection verification before applying for listing or refinancing, the policy directly regulates the financing channels of heavily polluting firms, acting as a negative signal for these firms. We wish to identify the underlying mechanism by which firms' financing channels are constrained by environmental policy. Firms finance projects using internal funds, debt, and new equity (Fazzari et al., 1988). However, firms that have received bad news are less likely to seek external debt and equity financing (Autore et al., 2014). Bank loans and equity issuance reflect firms' debt and equity financing channels, respectively. Therefore, we examine how firms' bank loan and equity issuance behaviors are affected by the environmental policy.

While the behavior of government-owned banks is affected by the central government (Dinc, 2005; Sapienza, 2004), banks must follow local governments' directives. To comply with national environmental policy, local governments limit the financing channel of heavily polluting firms by urging banks to provide less loans to them. Moreover, on top of mandatory directives from local governments, banks themselves are less willing to lend to heavily polluting firms, because they are less viable after the environmental policy. Firms negatively affected by the environmental policy tend to have worse development prospects, leading to lower credit guarantees, so banks are less willing to lend to them because of the increased default rate. This leads to the next hypothesis.

H2a. Banks provide smaller loans for heavily polluting firms than non-polluting firms after the issuance of environmental policy.

Concerning the equity financing channel, we focus on firms' equity issuance in the capital market. The issuance of classification indicates that firms in heavily polluting industries are less capable of sustainable development. As a result, not only will investors' market expectations and financial institutions' valuation of heavily polluting firms drop, but credit rating agencies and analysts will downgrade their ratings and recommendations. Considering the possible lower returns of heavily polluting firms in the future, both individual and institutional investors are less likely to invest in the affected firms. It is thus more difficult for the affected firms to raise funds through the capital market. The equity issuance of heavily polluting firms will decrease. This leads to the next hypothesis.

H2b. The frequency and amount of the equity issuance of heavily polluting firms are lower than those of non-polluting firms after the issuance of environmental policy.

Although the release of environmental labeling by the Ministry of Environmental Protection (MEP) and the government's requirement that firms become more environmentally friendly afford heavily polluting firms equal treatment, the effect of the policy still varies among related firms, even in the same industry. Due to the different considerations of different stakeholders, the effect of the environmental policy varies with firm characteristics and other external factors. There are thus variations in the association of environmental policy with financial constraints across firms partitioned by various adjustment variables.

Given the importance of GDP as a comprehensive indicator of economic performance, local governments in China always seek to increase GDP to show their greater competitiveness. Local governments will always give stronger support to firms that contribute more to local GDP, and will seldom decrease support for them. Even if the MEP attempts to enforce environmental protection and some firms that make a large contribution to GDP are classified as heavily polluting firms, local governments will continue to support these firms to sustain their high performance and high growth and thus guarantee their GDP contribution, either through local bank loans or through government subsidies. However, to demonstrate that they are abiding by the national environmental policy, local governments still need to decrease their support for heavily polluting firms. As a result, they will reduce their support of heavily polluting firms that contribute less to GDP. Therefore, we expect that such firms will be more financially constrained. Based on the above analysis, we propose research hypothesis H3a:

H3a. The financial constraints of heavily polluting firms increase more for firms that make a smaller GDP contribution than for firms with a larger GDP contribution.

Environmental protection in China is typically regarded as more urgent in more heavily polluted provinces. For example, in 2006 the provincial Environmental Protection bureau in Shanxi province declared that Shanxi could not increase its GDP at the expense of the environment; its air quality and discharge of solid waste ranked last in China, and its surface water quality (inferior category V) ranked second to last. Previously, for economic reasons, the local governments of polluted provinces had allowed enterprises to violate environmental laws and regulations, resulting in severe ecological damage. The State Environmental Protection Administration (SEPA) has frequently urged heavily polluted provinces to alleviate or eliminate this practice. Thus, more attention is paid to heavily polluting firms located in heavily polluted provinces, and heavily polluted provinces are subject to greater environmental protection pressure and stricter monitoring. Due to the frequent SEPA announcements to improve the environment, the local governments of heavily polluted provinces have tried to reduce the production and investment of heavily polluting firms by constraining their financial channels. However, heavily polluting firms in less polluted provinces receive less attention and are under less pressure, meaning that restrictions on these firms are more moderate. Based on this analysis, we propose research hypothesis H3b:

H3b. The financial constraints of heavily polluting firms increase more for firms located in heavily polluted provinces than for firms located in less polluted provinces.

The effect of the financial constraints of heavily polluting firms also varies with public pressure. Previous studies demonstrate that public pressure can have different economic consequences. Media coverage in Russia increases the probability of a corporate governance violation being reversed (Dyck et al., 2008). The press performs a monitoring role for accounting fraud by rebroadcasting information from other information intermediaries (analysts, auditors, and the courts) and by undertaking original investigation and analysis (Dyck et al., 2010; Miller, 2006). Heavily polluting firms with greater media coverage receive more investor attention. As the phrase has it, “evil news rides post, while good news baits”; once bad news is reported about a firm, such as being classified as heavily polluting, greater media coverage offers faster dissemination, and investor expectation will drop much more dramatically. Firms with greater media coverage will thus be affected by bad news more seriously and will experience a greater increase in financial constraints. Based on the above analysis, we propose research hypothesis H3c:

H3c. The financial constraints of heavily polluting firms increase more for firms with greater media coverage than for firms with less media coverage.

4. Research and design

4.1. Institutional background, sample selection, and data collection

This study focuses on the effect of environmental labeling on firms' financial constraints. We choose the issuance of *Administrative Measures on Use of China Environmental Labeling (2008)*² by the Chinese Ministry of Environmental Protection on June 24th, 2008, as a quasi-natural experiment.

To encourage listed companies in heavily polluting industries to conscientiously implement national environmental protection laws, regulations, and policies, to avoid investment risks due to environmental pollution, and to regulate firms' investment in social fundraising, SEPA issued the Notice of Environmental Protection Verification for Enterprises Applying for Listing and Refinancing³ in 2003 and Notice on Further Standardizing Environmental Protection Verification for Enterprises in Heavily Polluting Industries Applying for Listing or Refinancing⁴ in 2007, according to the relevant provisions of the China Securities Regulatory Commission. These two environmental policies required heavily polluting firms to pass environmental protection verification before applying for listing or refinancing, and clearly illustrated the content of, requirements for, and procedure of verification: for instance, the main pollutants discharged must meet national discharge standards, and the firm must have a pollutant discharge permit and a safe disposal rate (nearly 100%) for industrial solid waste and hazardous waste. However, the two policies only briefly defined heavily polluting firms and did not clearly state the relevant firms. For this reason, to better define heavily polluting firms, *Administrative Measures on Use of China Environmental Labeling* further specified the classification of heavily polluting industries for environmental protection verification. These measures defined heavily polluting firms and listed all heavily polluting industries in detail, making it clear for related departments and firms what kind of firms must pass environmental protection verification before submitting applications for listing or refinancing. We regard all of the firms in the heavily polluting industries listed in the *Administrative Measures* as heavily polluting firms. The affected firms are under stricter monitoring and regulation by the above environmental laws. Thus firms labeled as heavily polluting firms face fiercer financial constraints and lack funds to invest in polluting projects.

We take 2009 as the event year of the financial outcome of the environmental protection verification policy, select the companies listed on the Shanghai and Shenzhen Stock Exchanges as the research objects, and collect

² http://www.gov.cn/gzdt/2008-07/07/content_1038083.htm

³ http://www.csrc.gov.cn/pub/shenzhen/xxfw/tzsyd/ssgs/scgkfx/scxx/201410/t20141010_261520.htm

⁴ http://www.csrc.gov.cn/pub/shenzhen/xxfw/tzsyd/ssgs/scgkfx/scxx/201410/t20141008_261334.htm

Table 1

Sample selection. The sample is taken from companies listed on the Shanghai and Shenzhen Stock Exchanges from 2004 to 2013 (five years before and after the event year 2009) for empirical analysis. The financial data are from the CSMAR database and the bank loan data from the WIND database. The initial firm-year sample has 18,480 observations and the final full sample includes 15,838 complete observations, and represents 2426 non-financial firms.

	Observations
A-share listed companies from 2004 to 2013	18,480
Minus: firms in financial industries	494
Minus: observations with non-positive assets, liabilities, or equity	438
Minus: incomplete observations missing main control variables	1710
Final observations	15,838

the financial data of A-share listed companies in non-financial industries from 2004 to 2013 (five years before and after the event year) for empirical analysis. The financial data used in this paper are from the CSMAR database, and the bank loan data are from the WIND database. The initial firm-year sample has 18,480 observations and the final full sample includes 15,838 observations with non-missing main control variables, and represents 2,426 firms. Table 1 shows the sample selection procedure.

4.2. Variable definitions

1. Heavily polluting firms

We classify the heavily polluting industries stipulated in the Administrative Measures into eight categories based on the Guidelines for the Industry Classification of Listed Companies (2001) published by the Securities Supervision Commission: the mining, textile, garment and fur, metal and non-metal, petrochemical and plastic, food and beverage, hydropower and gas, biomedical, and paper printing industries (details in Appendix Table A.2). Firms in these eight industries are heavily polluting firms.

2. Kaplan and Zingales (KZ) index

Theoretically, the degree of financing constraints is indirectly reflected by many key corporate financial variables. Kaplan and Zingales (1997) classify their sample of U.S. firms into five groups on the basis of their degree of financial constraint, based on qualitative information in their annual reports from management's discussion of liquidity and capital resources, together with quantitative information in the companies' financial statements and notes. As the model in Kaplan and Zingales (1997) contains three variables that they collect by hand and that are not available through the COMPUSTAT database, later literature (Almeida et al., 2004; Baker et al., 2003; Lamont et al., 2001) uses the regression coefficients to construct the KZ index, consisting of a linear combination of five accounting ratios (cash flow to total capital, Tobin's Q, debt to total capital, dividends to total capital, and cash holdings to capital), resulting from a restricted version of the central regression of Kaplan and Zingales (1997), the ordered logit model without hand-collecting variables and without year dummies.⁵

China differs from most countries in that its legal and financial systems and institutions are underdeveloped, but its economy is growing rapidly. La Porta et al. (2002) and La Porta et al. (2000) find that firms in countries with poorer protection of outside shareholders tend to have lower dividend ratios and a lower Tobin's Q due to more severe agency problems. Allen et al. (2005) examine Chinese firms and verify that listed Chinese firms tend to underpay dividends to their shareholders, have a lower Tobin's Q on average, and rely more heavily on debt than firms in LLSV-sample countries (La Porta et al., 2002; La Porta et al., 2000;

⁵ The regression model is $KZ = -1.002 CF_{it}/A_{it-1} + 0.283 TobinQ_{it} + 3.319 LEV_{it} - 39.368 DIV_{it}/A_{it-1} - 1.315 C_{it}/A_{it-1}$

LaPorta et al., 1997). There are thus fundamental differences between Chinese and U.S. firms, especially in dividends, Tobin's Q, and debt, which are used to construct the KZ index.

Kaplan and Zingales (1997) generate their regression model using U.S. firms from 1970 to 1984. We follow the methodology in Kaplan and Zingales (1997) to construct the regression model using Chinese firms in our sample. First, we use the five financial ratios in the KZ model to classify the firm-year level sample into six categories to roughly define the level of firms' financial constraints. Following the signs of coefficients in the KZ model, we find that the higher the firm's Tobin's Q and debt, the more financially constrained it is; the lower the firm's cash flow, dividend, and cash holdings, the more financially constrained it is. We then construct KZ_{sum} as the sum of KZ_1 to KZ_5 , where KZ_1 equals 1 if CF_{it}/A_{it-1} is lower than the median; KZ_2 equals 1 if DIV_{it}/A_{it-1} is lower than the median; KZ_3 equals 1 if C_{it}/A_{it-1} is lower than the median; KZ_4 equals 1 if LEV_{it} is higher than the median; and KZ_5 equals 1 if Q_{it} is higher than the median. KZ_{sum} is the rough classification. Second, we use an ordered logit model to regress KZ_{sum} on CF_{it}/A_{it-1} , DIV_{it}/A_{it-1} , C_{it}/A_{it-1} , LEV_{it} and Q_{it} and estimate the coefficients to obtain a more accurate estimation. Finally, we use the estimated ologit model⁶ to re-estimate the KZ index for each firm to obtain a more accurate financial constraint status. Listed companies in China with low cash flow, low cash holdings, low dividends, high leverage, and more investment opportunities usually face severe financing constraints. The higher the KZ index, the more financially constrained the firm (see Table 2).

4.3. Test model

To further assess whether there is a difference between the influence of the environmental labeling on the financial constraints of heavily polluting firms and non-polluting firms in China, we first use the DiD approach as the baseline model to determine the influence of environmental labeling on the KZ index. This methodology compares the financial constraints of a sample of treatment firms classified as heavily polluting firms with those of control firms classified as non-polluting firms, before and after policy changes that cause an exogenous shock to financial constraints.

The DiD methodology has several key advantages. First, it rules out omitted trends that are correlated with financial constraints in both the treatment and control groups. Second, it helps establish causality, as tests are conducted surrounding the issuance of environmental labeling, which causes exogenous variation in the change in financial constraints (the main independent variable). Lastly, the DiD approach controls for constant unobserved differences between the treatment and control groups.

We follow the literature and control for various firm characteristics that affect financial constraints. First, we use the firm size, ROA, growth, and property, plant, and equipment (PPE) to control for firm characteristics. Second, within China's system, a firm's ownership type greatly influences its financial decision-making and the economic consequences. "Soft budget constraints" (i.e. State-owned enterprises can survive even if they lose money, because the state always provides assistance to them.) (Kornai, 1986) of state-owned enterprises and their innate advantages in obtaining resources mean that the financing constraints they face are weaker than those of non-state-owned enterprises. We thus use SOE to control for the correlation between type of ownership and local governments' financing. Third, we use *Risk* to control for market risk and to eliminate the influence of market risk on financial constraints. Lastly, we control for year, industry, and province fixed effects. This methodology fully controls for fixed differences between treated and nontreated firms via industry and province fixed effects. The year dummies control for aggregate fluctuations. Our estimate of the effect of environmental labeling is β_1 .

The model is as follows:

$$KZ_{i,t} = \beta_0 + \beta_1 Pollute_i \times Post_t + \beta_2 Size_{i,t} + \beta_3 ROA_{i,t} + \beta_4 Growth_{i,t} + \beta_5 PPE_{i,t} + \beta_6 SOE_{i,t} + \beta_7 Risk_{i,t} + \beta_8 Year_t + \beta_9 Industry_{i,t} + \beta_{10} Province_{i,t} + \varepsilon \quad (1)$$

⁶ Our ologit regression model is estimated as $KZ = -9.2947 CF_{it}/A_{it-1} - 37.2426 DIV_{it}/A_{it-1} - 4.0485 C_{it}/A_{it-1} + 3.9520 LEV_{it} + 0.5092 Tobin\ Q_{it} + \varepsilon$ (Appendix 3). The sign of each coefficient is the same as that of the KZ model provided in Lamont, O., C. Polk, and J. Saarekuejo, 2001, Financial constraints and stock returns, *Review of Financial Studies* 14, 529–554.

Table 2
Variable definitions and calculations.

<i>Panel A: dependent variables</i>	
<i>KZ</i>	Measurement of financial constraint, based on cash flow, dividend, cash, leverage, and Tobin's Q
<i>Panel B: key testing variables (KeyProxy)</i>	
<i>Pollute</i>	Dummy variable, equal to 1 if the firm is classified as a heavily polluting firm, and 0 otherwise
<i>Post</i>	Dummy variable, equal to 1 if the observation happens after 2009, and 0 otherwise
<i>Panel C: additional test variables</i>	
<i>TotalLoan</i>	Total loans (long-term loans + short-term loans)/revenue
<i>ShortLoan</i>	Short-term loans, short-term loans/revenue
<i>LongLoan</i>	Long-term loans, long-term loans/revenue
<i>EquityIssuanceFrequency</i>	The number of equity issuances by the firm in year t (Gustafson and Iliev, 2017)
<i>EquityIssuanceAmount</i>	Natural logarithm of 1 plus the annual amount of equity issuance, in millions of RMB (Gustafson and Iliev, 2017)
<i>ΔCash</i>	(Cash - lagged cash)/lagged total assets
<i>Investment</i>	(PPE - lagged PPE + depreciation)/lagged total assets (Erel et al., 2015)
<i>Panel D: control variables</i>	
<i>Size</i>	Firm size, ln (total assets)
<i>ROA</i>	Profitability, net profit/total assets
<i>Growth</i>	Firm growth, (revenue - lagged revenue)/lagged revenue
<i>PPE</i>	Tangibility of assets, (inventory + fixed assets)/lagged total assets
<i>SOE</i>	Nature of ownership, equal to 1 if the firm is a state-owned enterprise, and 0 otherwise
<i>Risk</i>	Market risk, standard deviation of the firm's daily market return per year
<i>HHI</i>	Herfindahl-Hirschman Index
<i>GDP</i>	Natural logarithm of total GDP of a city, in billions of RMB
<i>Population</i>	Natural logarithm of total city population, in ten thousands
<i>Coastal</i>	Dummy variable, equal to 1 if the city is coastal, and 0 otherwise
<i>Num of Industrial Firms</i>	The total number of listed industrial firms in a city
<i>Year</i>	Annual dummy variable
<i>Province</i>	Province dummy variable
<i>Industry</i>	Industry dummy variable, based on Guidelines for the Industry Classification of Listed Companies (2001)

To verify hypothesis H2a, we change the dependent variable to the firms' bank loans, and test total loans, short-term loans, and long-term loans respectively. The model is as follows:

$$\begin{aligned} Loan_{i,t} = & \beta_0 + \beta_1 Pollute_i \times Post_t + \beta_2 Size_{i,t} + \beta_3 ROA_{i,t} + \beta_4 Growth_{i,t} + \beta_5 PPE_{i,t} + \beta_6 SOE_{i,t} + \beta_7 Risk_{i,t} \\ & + \beta_8 Year_t + \beta_9 Industry_{i,t} + \beta_{10} Province_{i,t} + \varepsilon \end{aligned} \quad (2)$$

To verify hypothesis H2b, we use a similar model. The dependent variables change to the equity issuance variables, including both the frequency and the amount of equity issuance. The model is as follows:

$$\begin{aligned} EquityIssuance_{i,t} = & \beta_0 + \beta_1 Pollute_i \times Post_t + \beta_2 Size_{i,t} + \beta_3 ROA_{i,t} + \beta_4 Growth_{i,t} + \beta_5 PPE_{i,t} + \beta_6 SOE_{i,t} \\ & + \beta_7 Risk_{i,t} + \beta_8 Year_t + \beta_9 Industry_{i,t} + \beta_{10} Province_{i,t} + \varepsilon \end{aligned} \quad (3)$$

5. Empirical results and analysis

5.1. Sample description and descriptive statistics

Table 3 describes the sample distribution by fiscal year and by province. The percentage of heavily polluting firms begins to decrease in 2009, meaning that the issuance of administrative measures is effective, and the

Table 3

Sample distribution. This table presents the sample distribution by fiscal year and by province. Panel A reports the number of heavily polluting firms and non-polluting firms per year, showing a decreasing trend in the percentage of heavily polluting firms by year. Panel B reports the number of observations of heavily polluting firms and non-polluting firms in every province.

Panel A: Sample distribution by fiscal year

Year	Observations	Polluting Observations	Polluting/Total	Non-polluting Observations	Non-polluting/Total
2004	1181	497	42.08%	684	57.92%
2005	1235	526	42.59%	709	57.41%
2006	1225	514	41.96%	711	58.04%
2007	1267	538	42.46%	729	57.54%
2008	1413	586	41.47%	827	58.53%
2009	1461	602	41.20%	859	58.80%
2010	1600	640	40.00%	960	60.00%
2011	1944	755	38.84%	1189	61.16%
2012	2200	852	38.73%	1348	61.27%
2013	2312	887	38.37%	1425	61.63%
Total	15,838	6397	40.39%	9441	59.61%

Panel B: Sample distribution by province

Province	Observations	Polluting Observations	Polluting/Total	Non-polluting Observations	Non-polluting/Total
Anhui	536	242	45.15%	294	54.85%
Beijing	1106	349	31.56%	757	68.44%
Chongqing	281	125	44.48%	156	55.52%
Fujian	580	173	29.83%	407	70.17%
Gansu	199	134	67.34%	65	32.66%
Guangdong	2008	612	30.48%	1396	69.52%
Guangxi	229	126	55.02%	103	44.98%
Guizhou	182	102	56.04%	80	43.96%
Hainan	215	68	31.63%	147	68.37%
Hebei	345	211	61.16%	134	38.84%
Heilongjiang	264	74	28.03%	190	71.97%
Henan	411	266	64.72%	145	35.28%
Hubei	605	205	33.88%	400	66.12%
Hunan	456	201	44.08%	255	55.92%
Jiangsu	1286	441	34.29%	845	65.71%
Jiangxi	253	133	52.57%	120	47.43%
Jilin	326	171	52.45%	155	47.55%
Liaoning	509	187	36.74%	322	63.26%
Inner Mongolia	206	156	75.73%	50	24.27%
Ningxia	99	79	79.80%	20	20.20%
Qinghai	81	52	64.20%	29	35.80%
Shandong	936	485	51.82%	451	48.18%
Shanxi	243	198	81.48%	45	18.52%
Shaanxi	265	68	25.66%	197	74.34%
Shanghai	1368	348	25.44%	1020	74.56%
Sichuan	667	335	50.22%	332	49.78%
Sinkiang	303	168	55.45%	135	44.55%
Tianjin	272	85	31.25%	187	68.75%
Tibet	76	48	63.16%	28	36.84%
Yunnan	243	136	55.97%	107	44.03%
Zhejiang	1288	419	32.53%	869	67.47%
Total	15,838	6397	40.39%	9441	59.61%

Table 4

Summary statistics. This table presents the descriptive characteristics at the firm-year level of the total firms (Panel A), polluted firms (Panel B), and non-polluted firms (Panel C). All of the continuous variables are 1–99% tailed (winsorized).

Panel A: Full Sample

	Obs	Mean	Std. Dev.	Min	P25	P50	P75	Max
<i>KZ</i>	15,838	2.438	0.967	0	2	2	3	5
<i>TotalLoan</i>	11,500	0.56	0.699	0.002	0.138	0.335	0.69	4.247
<i>ShortLoan</i>	10,982	0.308	0.32	0.002	0.09	0.214	0.413	1.794
<i>LongLoan</i>	8288	0.367	0.635	0	0.038	0.13	0.394	4.033
<i>EquityIssuanceFrequency</i>	15,838	0.084	0.289	0	0	0	0	3
<i>EquityIssuanceAmount</i>	15,838	0.056	0.221	0	0	0	0	1.419
<i>Size</i>	15,838	21.69	1.2	19.29	20.84	21.54	22.36	25.39
<i>ROA</i>	15,838	0.035	0.058	−0.213	0.012	0.034	0.062	0.197
<i>Growth</i>	15,838	0.226	0.55	−0.627	−0.005	0.14	0.313	3.963
<i>PPE</i>	15,838	0.279	0.18	0.008	0.137	0.249	0.398	0.762
<i>SOE</i>	15,838	0.56	0.496	0	0	1	1	1
<i>Pollute</i>	15,838	0.404	0.491	0	0	0	1	1
<i>Risk</i>	15,838	0.03	0.008	0.015	0.024	0.029	0.035	0.056
<i>HHI</i>	15,838	0.067	0.091	0.015	0.03	0.043	0.07	0.798
<i>GDP</i>	15,015	5.782	1.139	3.13	4.964	5.839	6.685	7.678
<i>Population</i>	15,275	6.327	0.701	4.456	5.872	6.414	6.822	8.094
<i>Coastal</i>	15,569	0.336	0.472	0	0	0	1	1
<i>Num of Industrial Firms</i>	15,472	4421	4484	19	921	2750	6344	18,792

Panel B: Treatment group

	Obs	Mean	Std. Dev.	Min	P25	P50	P75	Max
<i>KZ</i>	6397	2.407	0.956	0	2	2	3	5
<i>TotalLoan</i>	4766	0.575	0.654	0.002	0.174	0.388	0.715	4.247
<i>ShortLoan</i>	4617	0.326	0.304	0.002	0.113	0.249	0.433	1.794
<i>LongLoan</i>	3656	0.337	0.566	0	0.049	0.144	0.362	4.033
<i>EquityIssuanceFrequency</i>	6397	0.082	0.283	0	0	0	0	3
<i>EquityIssuanceAmount</i>	6397	0.053	0.214	0	0	0	0	1.419
<i>Size</i>	6397	21.8	1.211	19.29	20.93	21.64	22.5	25.39
<i>ROA</i>	6397	0.037	0.062	−0.213	0.01	0.034	0.067	0.197
<i>Growth</i>	6397	0.217	0.486	−0.627	0.008	0.144	0.309	3.963
<i>PPE</i>	6397	0.356	0.169	0.008	0.224	0.341	0.477	0.762
<i>SOE</i>	6397	0.596	0.491	0	0	1	1	1
<i>Risk</i>	6397	0.03	0.009	0.015	0.023	0.028	0.034	0.056
<i>HHI</i>	6397	0.076	0.129	0.019	0.029	0.035	0.057	0.798
<i>GDP</i>	5967	5.447	1.161	3.13	4.546	5.411	6.33	7.678
<i>Population</i>	6083	6.237	0.7	4.456	5.795	6.298	6.667	8.094
<i>Coastal</i>	6222	0.24	0.427	0	0	0	0	1
<i>Num of Industrial Firms</i>	6177	3380	3968	22	579	1695	5247	18,792

Panel C: Control Group

	Obs	Mean	Std. Dev.	Min	P25	P50	P75	Max
<i>KZ</i>	9441	2.459	0.974	0	2	2	3	5
<i>TotalLoan</i>	6734	0.55	0.729	0.002	0.118	0.302	0.667	4.247
<i>ShortLoan</i>	6365	0.296	0.33	0.002	0.077	0.189	0.391	1.794
<i>LongLoan</i>	4632	0.39	0.684	0	0.032	0.117	0.421	4.033
<i>EquityIssuanceFrequency</i>	9441	0.087	0.297	0	0	0	0	2
<i>EquityIssuanceAmount</i>	9441	0.059	0.231	0	0	0	0	1.419
<i>Size</i>	9441	21.62	1.188	19.29	20.77	21.47	22.27	25.39
<i>ROA</i>	9441	0.034	0.055	−0.213	0.013	0.033	0.059	0.197
<i>Growth</i>	9441	0.232	0.589	−0.627	−0.018	0.137	0.318	3.963
<i>PPE</i>	9441	0.228	0.169	0.008	0.098	0.193	0.319	0.762

(continued on next page)

Table 4 (continued)

Panel C: Control Group								
	Obs	Mean	Std. Dev.	Min	P25	P50	P75	Max
<i>SOE</i>	9441	0.535	0.499	0	0	1	1	1
<i>Risk</i>	9441	0.03	0.008	0.015	0.024	0.029	0.035	0.056
<i>HHI</i>	9441	0.061	0.051	0.015	0.033	0.047	0.073	0.424
<i>GDP</i>	9048	6.002	1.068	3.13	5.286	6.091	6.828	7.678
<i>Population</i>	9192	6.387	0.695	4.456	5.934	6.469	6.901	8.094
<i>Coastal</i>	9347	0.4	0.49	0	0	0	1	1
<i>Num of Industrial Firms</i>	9295	5113	4671	19	1365	4032	6637	18,792

firms engage in more environmentally friendly behavior after the issuance. Shanxi, Ningxia, and Inner Mongolia are the provinces with the most heavily polluting firms, accounting for more than 70% of them.

Table 4 reports the descriptive characteristics at the firm-year level of the total firms (Panel A), heavily polluting firms (Panel B), and non-polluting firms (Panel C). All of the continuous variables are 1–99% tailed (winsorized). Fig. 2 shows the KZ index of the heavily polluting firms and non-polluting firms. The financial constraints of heavily polluting firms were low before 2009 but surpassed those of non-polluting firms after 2009.

5.2. Impact of environmental labeling on financial constraints

Table 5 presents the results of estimating Eq. (1). To evaluate whether the heavily polluting firms were constrained after being labeled, we focus on the coefficients on the interaction term (*Pollute*Post*). These coefficients are both positive and statistically significantly different from 0. In Column 1, where we only include industry, year, and province fixed effects, the coefficient on the interaction term is 0.10. This coefficient equals 0.06 when we include other firm-level control variables in Column 2. For the control variables, there is a significant positive correlation between a company's financial constraints (*KZ*) and both state-owned-enterprise status (*SOE*) and market risk (*Risk*), and significant negative correlations between profitability (*ROA*) and firm growth (*Growth*). The results show that after the issuance of environmental labeling, the financial constraints (*KZ* index) of the heavily polluting firms increase 0.06 more than those of non-polluting firms. Heavily polluting firms' investment decisions are discouraged, so their financing channels are restricted and they are

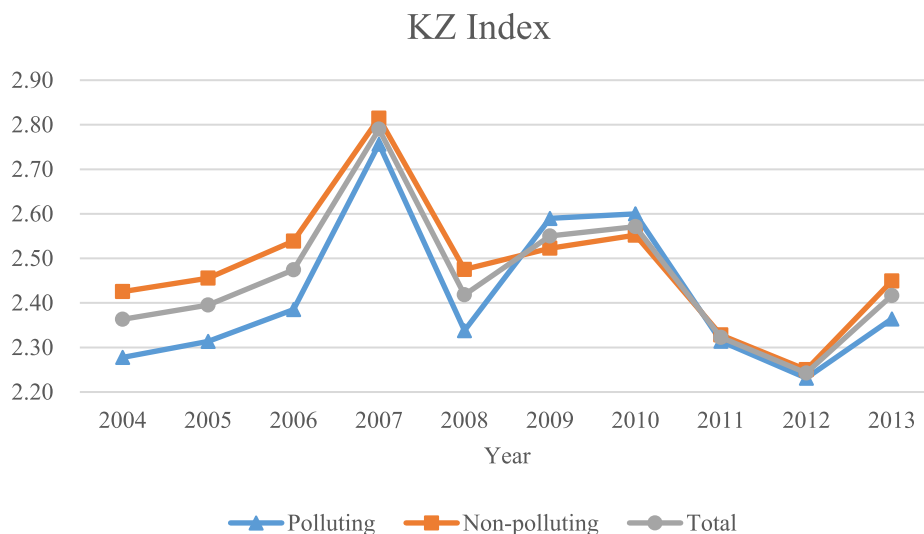


Fig. 2. Trend of the KZ index for the treatment group and control group.

Table 5

Impact of environmental labeling on financial constraints. Columns 1 and 2 report the results of DiD tests examining how the issuance of environmental labeling, the exogenous change, affects firms' financial constraints. The regression model is $KZ = Pollute * Post + Controls$. Columns 3 and 4 report changes in financial constraints after the environmental labeling of both heavily polluting firms and non-polluting firms. t-values are given in parentheses below the coefficients. *** (**) (*) indicate significance at the 1% (5%) (10%) two-tailed level.

	KZ			
	(1)	(2)	(3)	(4)
Pollute*Post	0.10*** (2.58)	0.06** (2.09)		
Post			0.25*** (9.16)	0.11*** (4.54)
Size		0.00 (0.23)	-0.03* (-1.75)	0.02 (1.24)
ROA		-7.78*** (-45.57)	-8.00*** (-33.13)	-7.09*** (-30.11)
Growth		-0.06*** (-3.10)	-0.02 (-0.46)	-0.06** (-2.52)
PPE		0.05 (0.70)	0.26** (2.53)	-0.00 (-0.04)
SOE		0.07*** (3.03)	0.08** (2.08)	0.09*** (2.84)
Risk		13.14*** (7.90)	17.13*** (12.81)	14.51*** (11.33)
HHI		0.11 (0.59)	0.10 (0.45)	-0.21 (-0.47)
Constant	2.22*** (19.64)	1.95*** (7.20)	2.39*** (6.48)	1.61*** (4.85)
Year	Yes	Yes	No	No
Industry	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm
Observations	15,838	15,838	6397	9441
R-squared	0.09	0.32	0.36	0.27

forced to stop polluting. Firms with higher profitability, higher growth rates, and lower market risk have lower financial constraints, which is consistent with common sense. The results verify hypothesis H1.

To examine the main cause of the difference in the change of financial constraints between heavily polluting firms and non-polluting firms, we separate the whole sample into two subsamples. In Column 3 (Column 4), we test how the financial constraints of heavily polluting firms (non-polluting firms) change after the issuance of environmental labeling. We hope to identify whether the difference between two groups is caused by the increasing financial constraints of heavily polluting firms or by the decreasing financial constraints of non-polluting firms. The coefficients of the term *Post* are significantly positive in both Column 3 and Column 4, showing that the financial constraints of both groups increased after environmental labeling. The coefficient is 0.25 in Column 3 but 0.11 in Column 4, indicating a higher increase in the financial constraints of polluting versus non-polluting firms. The government tends to limit financial support for heavily polluting firms after the issuance of environmental labeling rather than providing more support for non-polluting firms. In general, local governments decrease their financial support for heavily polluting firms to show that they are abiding by the environmental policy and urge heavily polluting firms to improve the environment.

5.3. Impact of environmental labeling on bank loans and annual return

To further assess how environmental labeling affects firms' debt and equity financing channel, we test how the bank loans and equity issuance of heavily polluting firms change. We first replace the dependent variable in the baseline model with total loans, short-term loans and long-term loans and estimate Eq. (2) separately to test for the debt financing channel. The results reported in Table 6 show that there are significant negative

Table 6

Impact of environmental labeling on bank loan and equity issuance. This table reports DiD tests examining how the issuance of environmental labeling affects firms' bank loans and equity issuance in the stock market. The regression model is $Loan (EquityIssuance) = Pollute + Post + Pollute * Post + Controls$. The dependent variable *Loan* indicates total bank loans (*TotalLoan*), short-term loans (*ShortLoan*) and long-term loans (*LongLoan*). The dependent variable *EquityIssuance* indicates the frequency (*EquityIssuanceFrequency*) and amount (*EquityIssuanceAmount*) of equity issuance. t-values are given in parentheses below the coefficients. *** (**) (*) indicate significance at the 1% (5%) (10%) two-tailed level.

	(1)	(2)	(3)	(4)	(5)
	Total Loan	Short Loan	Long Loan	Equity Issuance Frequency	Equity Issuance Amount
Pollute*Post	-0.05** (-2.05)	-0.01 (-0.92)	-0.04* (-1.76)	-0.02** (-2.52)	-0.02*** (-3.03)
Size	0.09*** (13.95)	0.00 (0.11)	0.06*** (9.99)	0.04*** (16.50)	0.04*** (18.49)
ROA	-3.06*** (-22.36)	-1.79*** (-25.30)	-1.66*** (-12.05)	-0.04 (-1.07)	-0.07*** (-2.78)
Growth	-0.04** (-2.29)	-0.03*** (-4.79)	-0.02 (-1.07)	0.11*** (15.12)	0.10*** (14.34)
PPE	0.02 (0.34)	-0.02 (-0.92)	-0.01 (-0.24)	-0.02 (-1.29)	0.00 (0.11)
SOE	-0.10*** (-7.62)	-0.06*** (-8.46)	-0.07*** (-4.64)	-0.01 (-1.62)	-0.00 (-1.32)
Risk	2.44** (2.15)	1.41** (2.45)	0.49 (0.42)	1.00** (2.17)	1.35*** (3.58)
HHI	0.58** (2.15)	0.15 (1.10)	0.28* (1.66)	0.03 (0.58)	-0.00 (-0.09)
Constant	-1.35*** (-8.90)	0.41*** (5.42)	-1.29*** (-8.02)	-0.80*** (-14.33)	-0.98*** (-17.85)
Year	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes	Yes
Observations	11,500	10,982	8,288	15,838	15,838
R-squared	0.29	0.18	0.29	0.08	0.13

correlations between the interaction term (Pollute*Post) and a company's total bank loans (Column 1) and long-term loans (Column 3), while there is no significant correlation between the interaction term (Pollute*Post) and a company's short-term loans (Column 2), indicating that after the issuance of environmental labeling, the total bank loans of the heavily polluting firms decrease by 0.05 more than those of non-polluting firms, and the long-term loans decrease by 0.04 more than those of non-polluting firms. Changes in the short-term loans make little difference for either type of firm. Local governments reduce the total loans of heavily polluting firms more by reducing their long-term loans more. The results confirm hypothesis H2a. If a firm's cash holdings are insufficient for an investment project, long-term loans are a major funding source for it. Banks make short-term loans to firms only to maintain their daily production and operation. Thus, local governments still provide heavily polluting firms with short-term loans to help them operate smoothly, but local governments make smaller long-term loans to heavily polluting firms to discourage their investment in polluting projects.

We then use Eq. (3), where the dependent variable changes to firms' equity issuance variables, to test for the equity financing channel. Listed firms can raise new funds through public offerings, private placements, and rights issues. We therefore include three types of equity issuance when calculating the frequency and amount. The results reported in Table 6, Columns 4 and 5 show that there are significant negative correlations between the interaction term (Pollute*Post) and firms' equity issuance, indicating that both the frequency and amount of the equity issuance behavior of heavily polluting firms decrease by 0.02 more than those of non-polluting firms after the issuance of environmental labeling. Heavily polluting firms are less likely than non-polluting firms to raise funds from the capital market. The results confirm hypothesis H2b.

Table 7

Cross-sectional variation in the association of environmental labeling and financial constraints. This table reports DiD tests partitioned by firms' contribution to GDP, firm's media coverage, and the province where firms are headquartered, conducted to examine the differences in the effect of environmental labeling on financial constraints. The regression model is $KZ = Pollute + Post + Pollute * Post + Controls$. t-values are given in parentheses below the coefficients. *** (**) (*) indicate significance at the 1% (5%) (10%) two-tailed level.

Dependent variable = KZ	Contribution to GDP		Forest Coverage		Media Coverage	
	Small	Large	Small	Large	Small	Large
Pollute*Post	0.09** (2.46)	0.02 (0.44)	0.08** (2.07)	0.04 (0.99)	0.05 (1.27)	0.11*** (2.80)
Size	0.01 (1.01)	-0.01 (-0.81)	-0.01 (-1.35)	0.01 (1.24)	-0.03** (-2.34)	0.03*** (2.68)
ROA	-7.06*** (-36.85)	-8.44*** (-43.19)	-7.86*** (-39.05)	-7.61*** (-41.55)	-7.05*** (-33.53)	-7.80*** (-39.37)
Growth	0.06** (2.05)	-0.15*** (-6.30)	-0.07** (-2.30)	-0.06** (-2.33)	-0.05* (-1.88)	-0.11*** (-3.84)
PPE	0.36*** (5.44)	-0.16*** (-2.65)	0.11 (1.62)	0.02 (0.40)	0.11 (1.62)	0.09 (1.39)
SOE	0.13*** (6.30)	-0.00 (-0.02)	0.09*** (4.24)	0.06*** (2.77)	0.09*** (3.94)	0.02 (0.95)
Risk	9.88*** (4.65)	16.19*** (8.00)	17.41*** (8.00)	9.07*** (4.57)	11.23*** (4.41)	17.34*** (8.02)
HHI	0.43 (1.28)	-0.11 (-0.54)	-0.16 (-0.77)	0.57** (1.98)	0.04 (0.16)	0.31 (1.16)
Constant	1.63*** (6.56)	2.50*** (9.88)	2.11*** (8.18)	2.12*** (9.20)	2.58*** (8.81)	1.36*** (5.20)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,921	7,917	7,148	8,690	6,797	6,729
R-squared	0.29	0.37	0.32	0.32	0.29	0.35
F test	F = 6.47, p = 0.000***		F = 1.56, p = 0.002***		F = 34.03, p = 0.000***	

5.4. Cross-sectional variation in the effect of environmental labeling on financial constraints

We hope to identify the varying effects of environmental labeling on financial constraints partitioned by different adjustment variables. We regress Eq. (1) in subsamples partitioned by firms' contribution to GDP, firms' media coverage, and the province where firms are headquartered.

Local governments tend to support firms that make a greater contribution to GDP, so they will seldom restrain the financial channels of heavily polluting firms that contribute greatly to local GDP. However, to demonstrate their abidance by national environmental policy, local governments will increase the financial constraints of heavily polluting firms that contribute less to local GDP. Based on the income formula approach to GDP,⁷ the higher the sales taxes a firm pays, the more the firm contributes to GDP. We thus classify firms with above median taxes payable as firms making a greater contribution to GDP, and the firms with below median taxes payable as firms making a smaller contribution to GDP. In Columns 1 and 2 of Table 7 we estimate Eq. (1) separately for the groups making a small versus a large contribution to GDP. The coefficient of the interaction term (Pollute*Post) for firms making a greater contribution to GDP is insignificant, while the coefficient for firms making a smaller contribution to GDP is significantly positive, indicating that heavily polluting firms in this group suffer 0.09 more financial constraints after the issuance of environmental labeling. The difference between the two coefficients is significant, consistent with our hypothesis H3a.

As heavily polluted provinces are under higher environmental protection pressure, their local governments will increase the financial constraints of heavily polluting firms more prominently than the governments of less polluted provinces, to follow the newly announced environmental policy and improve the environment. We

⁷ The income approach formula to GDP is: Total national income = Sales Taxes + Depreciation + Net foreign factor income

predict that the more heavily polluted province a heavily polluting firm is located in, the higher the financial constraints the firm will have compared with other firms. Forests are important to a healthy environment. They protect soil, provide habitat for wildlife and purify the air by absorbing noxious fumes and generating oxygen. The higher the forest coverage a province has, the more the province is environmentally friendly. To measure the degree of pollution in a province, we use forest coverage as a measurement of the level of provincial environmental protection. The data on forest coverage are collected from the main results of China's Seventh National Forest Resources Inventory. The higher the forest coverage, the less polluted the province. We classify the firms into two groups: firms located in provinces with forest coverage below the median (heavily polluted provinces, small group) and firms located in provinces with forest coverage above the median (weakly polluted provinces, large group). In Columns 3 and 4 of Table 7, we estimate Equation (1) separately for the small and large groups. The coefficient of the interaction term (Pollute*Post) for firms in the small group is significantly positive, showing that heavily polluting firms in heavily polluted provinces suffer 0.08 more financial constraints after the issuance of environmental labeling. The coefficient for firms in less polluted provinces is insignificant and the difference between the coefficients of the two subsamples is significant. The results are consistent with our hypothesis H3b.

Firms with greater media coverage receive more investor attention. Investors will be reluctant to finance heavily polluting firms with greater media coverage and will turn to investing in more sustainable firms. We thus expect that heavily polluting firms with greater media coverage will experience an increase in financial constraints. To measure the media coverage of each firm, we use the number of news reports on a firm per year. The news data are from the Financial News Database of Chinese Listed Companies (CFND) from China Research Data Services. We divide the firms into a small group of firms whose media coverage is below the median and a large group of firms whose media coverage is above the median. In Columns 5 and 6 of Table 7 we estimate Eq. (1) separately for the two groups. The coefficient of the interaction term (Pollute*Post) for firms with more media coverage is significantly positive, showing that heavily polluting firms with more media coverage suffer 0.11 more financial constraints after the issuance of environmental labeling. The coefficient for firms with less media coverage is insignificant and the comparison between two coefficients is significant. The results are consistent with hypothesis H3c.

5.5. Effect of environmental labeling

We aim to evaluate the issuance of environmental labeling in China and to determine whether the policy has achieved its goals. The environmental policy is designed to encourage firms to be environmentally friendly. First we focus on the direct effect. We attempt to determine whether heavily polluting firms will take action to improve their environmental record. In the spirit of Ebenstein et al. (2017), we use the $PM_{2.5}$ ⁸ in the city where a firm is located as a firm-level environmental indicator and test the changes in $PM_{2.5}$ concentration between different firms. In Table 8, Panel A, we test how environmental labeling affects firms' $PM_{2.5}$ emissions. We also include city-level control variables, such as GDP, population, whether the city is a coastal city, and the number of industrial firms in the city.⁹ Only the coefficient of the interaction term (Pollute*Post) in the concentrated sample (firms that contribute less to GDP, are located in heavily polluted provinces, and receive greater media coverage) is significantly negative, indicating that the $PM_{2.5}$ emissions of heavily polluting firms decrease 1.31 more than those of non-polluting firms after environmental labeling. However, the other interaction term coefficients are insignificant, suggesting that the direct effect of environmental policy only exists in the firms that receive the most attention.

In Panel B, we then examine the indirect effect of environmental labeling. Because the issuance of environmental labeling defined heavily polluting firms in detail and required that classified heavily polluting firms pass environmental protection verification if they wish to raise funds or refinance in the capital market, heavily polluting firms may face fiercer financial constraints and lack funds to invest in projects, resulting in a decline in

⁸ Data from Global Annual $PM_{2.5}$ Grids from MODIS, MISR, and SeaWiFS Aerosol Optical Depth (AOD), with GWR provided by the Socioeconomic Data and Applications Center (<https://sedac.ciesin.columbia.edu/data/set/sdei-global-annual-gwr-pm2-5-modis-misr-seawifs-aod/data-download>)

⁹ Data from the China City Statistical Yearbook

Table 8

Effect of environmental labeling. This table reports the results of DiD tests of the full sample and also tests partitioned by firms' contribution to GDP, firms' media coverage, and the province where firms are headquartered, to examine differences in the effect of environmental labeling on financial constraints. The regression model is $PM_{2.5} (Growth) = Pollute + Post + Pollute * Post + Controls$. t-values are given in parentheses below the coefficients. *** (**) (*) indicate significance at the 1% (5%) (10%) two-tailed level.

Dependent variable = $PM_{2.5}$	Full Sample	Contribution to GDP		Forest Coverage		Media Coverage		Concentrated Sample
		Small	Large	Small	Large	Small	Large	
<i>Pollute*Post</i>	0.17 (0.80)	0.44 (1.42)	-0.21 (-0.68)	0.24 (0.73)	0.10 (0.39)	0.08 (0.24)	0.05 (0.17)	-1.31* (-1.81)
<i>Size</i>	-0.06 (-1.30)	-0.10 (-1.54)	-0.04 (-0.55)	0.07 (0.89)	-0.09* (-1.72)	-0.06 (-0.89)	-0.01 (-0.18)	0.26 (1.36)
<i>ROA</i>	-2.68*** (-3.00)	-3.67*** (-2.82)	-0.88 (-0.69)	-0.14 (-0.10)	-3.68*** (-3.57)	-3.66*** (-2.66)	-2.07 (-1.58)	-2.30 (-0.72)
<i>Growth</i>	0.00 (0.05)	0.11 (0.82)	-0.06 (-0.59)	-0.06 (-0.45)	-0.00 (-0.03)	0.06 (0.55)	-0.10 (-0.72)	-0.43 (-0.72)
<i>PPE</i>	0.53 (1.57)	0.62 (1.31)	0.34 (0.72)	0.62 (1.11)	0.52 (1.38)	0.76 (1.54)	-0.21 (-0.42)	-1.18 (-0.88)
<i>SOE</i>	-0.02 (-0.22)	0.00 (0.01)	-0.02 (-0.13)	-0.29* (-1.67)	-0.17 (-1.29)	0.14 (0.80)	-0.26 (-1.53)	-0.40 (-1.10)
<i>HHI</i>	0.55 (0.34)	4.96** (2.26)	-1.68 (-0.80)	1.71 (0.69)	0.77 (0.45)	-0.08 (-0.03)	1.25 (0.58)	-1.29 (-0.24)
<i>GDP</i>	3.97*** (34.04)	3.65*** (22.64)	4.18*** (24.96)	1.15*** (5.24)	5.33*** (39.39)	4.29*** (24.27)	3.76*** (20.52)	0.46 (0.94)
<i>Population</i>	-0.06 (-0.38)	-0.39* (-1.78)	0.14 (0.60)	2.12*** (6.97)	-0.60*** (-3.45)	-0.43* (-1.91)	0.45* (1.77)	2.63*** (3.86)
<i>Coastal</i>	-4.74*** (-19.00)	-5.08*** (-15.44)	-4.31*** (-11.06)	-9.27*** (-21.60)	-1.84*** (-5.97)	-4.05*** (-10.76)	-5.08*** (-13.16)	-9.48*** (-10.66)
<i>Num of Industrial Firms</i>	-0.00*** (-11.38)	-0.00*** (-6.97)	-0.00*** (-8.51)	-0.00*** (-5.54)	-0.00*** (-13.72)	-0.00*** (-7.73)	-0.00*** (-7.12)	-0.00 (-1.14)
Constant	31.90*** (22.27)	34.37*** (17.44)	32.89*** (15.64)	22.06*** (8.69)	8.75*** (5.17)	33.17*** (15.28)	28.85*** (12.98)	18.37*** (3.52)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,754	7,347	7,407	6,629	8,125	6,291	6,261	1,200
R-squared	0.84	0.84	0.84	0.84	0.72	0.84	0.84	0.85

Panel B: Effect of environmental labeling on growth

Dependent variable = <i>Growth</i>	Full Sample	Contribution to GDP		Forest Coverage		Media Coverage		Concentrated Sample
		Small	Large	Small	Large	Small	Large	
<i>Pollute*Post</i>	-0.03* (-1.87)	-0.01 (-0.55)	-0.04 (-1.34)	-0.05* (-1.90)	-0.02 (-0.74)	-0.01 (-0.52)	-0.06** (-2.34)	-0.09** (-2.14)
<i>Size</i>	0.03*** (6.38)	0.02*** (2.98)	0.04*** (4.56)	0.03*** (3.98)	0.03*** (4.86)	0.03*** (3.43)	0.04*** (4.84)	0.02* (1.87)
<i>ROA</i>	1.97*** (24.10)	1.94*** (17.87)	1.90*** (14.96)	1.83*** (15.63)	2.11*** (18.37)	2.08*** (15.03)	2.11*** (18.47)	1.63*** (8.24)
<i>PPE</i>	-0.05* (-1.66)	-0.03 (-0.59)	-0.06 (-1.33)	-0.07 (-1.38)	-0.04 (-0.84)	-0.11** (-2.14)	0.00 (0.03)	0.06 (0.63)
<i>SOE</i>	-0.04*** (-4.16)	-0.04*** (-3.03)	-0.05*** (-2.93)	-0.05*** (-3.37)	-0.03** (-2.35)	-0.03* (-1.80)	-0.05*** (-3.20)	-0.01 (-0.65)
<i>Risk</i>	9.28*** (7.78)	4.34*** (3.08)	14.06*** (7.38)	7.32*** (4.19)	10.81*** (6.60)	7.64*** (3.83)	10.69*** (5.93)	3.11 (1.05)
<i>HHI</i>	-0.10 (-0.79)	-0.10 (-0.57)	-0.10 (-0.62)	-0.15 (-0.95)	-0.04 (-0.17)	-0.25 (-1.23)	0.03 (0.18)	0.35 (0.97)

(continued on next page)

Table 8 (continued)

Panel B: Effect of environmental labeling on growth									
Dependent variable = <i>Growth</i>	Full Sample	Contribution to GDP		Forest Coverage		Media Coverage		Concentrated Sample	
		Small	Large	Small	Large	Small	Large		
		Constant	−0.60*** (−4.66)	−0.24 (−1.36)	−0.82*** (−3.99)	−0.51*** (−2.62)	−0.64*** (−3.61)		−0.44** (−2.02)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Province	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	15,838	7,921	7,917	7,148	8,690	6,797	6,729	1,303	
R-squared	0.08	0.09	0.08	0.08	0.08	0.08	0.10	0.16	

their future growth. If the heavily polluting firms foresee less sustainable development, they will try to improve their pollution control to obtain more financial support, and thus the environmental policy can achieve its goals. We test the change in firms' revenue growth after environmental labeling. The coefficient of the interaction term in the full sample is significantly negative, indicating that heavily polluting firms experience a decrease in growth after environmental labeling. The coefficients are also significantly negative in the subsamples located in heavily polluted provinces (Column 4) or with greater media coverage (Column 7). Moreover, firms that satisfy all three characteristics (Column 8) have a much lower growth. The coefficient is -0.09 , much lower than other coefficients. The environmental policy is effective, resulting in higher financial constraints, lower revenue growth, and more environmentally conscious behavior among heavily polluting firms.

6. Robustness check

6.1. Alternative measurements for financial constraints

Starting with Fazzari et al. (1988), a large number of studies estimate the sensitivity of investment to cash flow, and use the estimated sensitivity as a measure of financial constraints. They suggested that firms that do not have sufficient access to external capital markets cannot respond to investment incentives. If firms are constrained in their ability to raise funds externally, investment spending may be sensitive to the availability of internal finance. Investment may display “excess sensitivity” to movements in cash flow.

Almeida et al. (2004) suggest that one can measure financial constraints from how firms save cash from incremental cash flow. In their model, the effect of financial constraints is captured by the firm's propensity to save cash out of cash flows. Constrained firms should tend to save cash from cash flow, while unconstrained firms can invest at the first-best level and do not need to adjust their savings behavior.

To avoid our results being driven by our measurement of financial constraints, we use both cash–cash flow sensitivity and investment–cash flow sensitivity as alternative measures of financial constraints to examine the effect of environmental labeling on firms' financial constraints. The results are consistent with the previous finding. In Columns 1 and 2 of Table 9, both three-way interaction terms ($Pollute*Post*CF$) are significantly positive, showing that the financial constraints increase after the issuance of environmental labeling.

6.2. Parallel trends assumption

DiD estimation requires a parallel trends assumption; that is, there must be similar trends in the outcome variables (the KZ index in our setting) during the pre-event period for both the treatment and the control groups. Only when they are similar before the policy can the DiD method extract the causal effect of the policy. Fig. 3 shows the evolution of the differences in financial constraints between the treatment and control groups before and after the issuance of environmental labeling. The difference between the two groups fluctuates around 0 before the policy and is significantly greater than 0 in the year of adoption and one year after,

Table 9

Cash flow sensitivities. This table reports the effect of environmental labeling on the cash–cash flow and investment–cash flow sensitivities. The regression model is $\Delta Cash(Investment) = Pollute * Post + CF + Pollute * CF + Post * CF + Pollute * Post * CF + Controls$. $\Delta Cash$ is measured as (Cash – lagged cash)/lagged total assets. $Investment$ is measured as (PPE – lagged PPE + depreciation)/lagged total assets, based on (Erel et al., 2015). t-values are given in parentheses below the coefficients. *** (**) (*) indicate significance at the 1% (5%) (10%) two-tailed level.

	$\Delta Cash$	Investment
<i>Pollute*Post</i>	−0.07*** (−2.77)	−0.14* (−1.66)
<i>CF</i>	−0.24 (−0.86)	0.06 (1.19)
<i>Pollute*CF</i>	0.75** (2.31)	0.73*** (3.81)
<i>Post*CF</i>	0.09 (0.31)	−0.07 (−1.26)
<i>Pollute*Post*CF</i>	0.70** (2.03)	2.38* (1.65)
<i>Size</i>	0.02*** (3.01)	0.02*** (3.41)
<i>ROA</i>	−0.42** (−2.35)	−1.01** (−1.98)
<i>Growth</i>	0.27*** (3.46)	0.29*** (4.60)
<i>PPE</i>	−0.14*** (−4.06)	0.29*** (4.36)
<i>SOE</i>	−0.01 (−0.74)	−0.00 (−0.20)
<i>Risk</i>	2.86 (1.37)	−1.30 (−0.40)
<i>HHI</i>	0.04 (0.66)	0.37* (1.66)
Constant	−0.48*** (−2.95)	−0.61*** (−4.40)
Year	Yes	Yes
Industry	Yes	Yes
Province	Yes	Yes
Observations	15,838	15,794
R-squared	0.65	0.35

indicating that the two groups follow parallel trends in the pre-treatment period and that the KZ index increases after a firm is labeled a heavily polluting firm.

We also show the dynamics in a regression framework (reported in Table 5). In the spirit of Bertrand and Mullainathan (2003) and Fang et al. (2014), we test the significance of the difference between the treatment and control groups before and after the event. We add the interaction term between the year dummy variables and treatment dummy variables to the regression. The comparison is made five years before and two years after the policy. Before(n) is a dummy that equals 1 if a firm-year observation is from the nth year before the issuance of environmental labeling and 0 otherwise; Current is a dummy that equals 1 if a firm-year observation is from the event year and 0 otherwise; After(n) is a dummy that equals 1 if a firm-year observation is from the nth year after the issuance of environmental labeling and 0 otherwise. The interaction terms can capture the differences between the two groups in each year to see whether there is a parallel trend between the two groups.

$$\begin{aligned}
 KZ_{i,t} = & \beta_0 + \beta_1 Before5_t \times Pollute_i + \beta_2 Before4_t \times Pollute_i + \beta_3 Before3_t \times Pollute_i + \beta_4 Before2_t \\
 & \times Pollute_i + \beta_5 Before1_t \times Pollute_i + \beta_6 Current_t \times Pollute_i + \beta_7 After1_t \times Pollute_i + \beta_8 After2_t \\
 & \times Pollute_i + \beta_9 Control\ Variables_{i,t} + \beta_{10} Year_t + \beta_{11} Industry_{i,t} + \beta_{12} Province_{i,t} + \varepsilon
 \end{aligned}$$

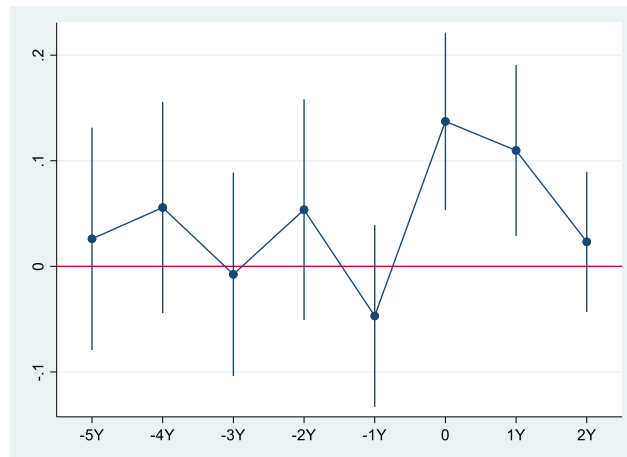


Fig. 3. Trend of the difference between the treatment group and control group (Fig. 3 shows the point estimates and 90% confidence interval of the differences in financial constraints (KZ) between the treatment firms and control firms around the issuance of environmental labeling.)

In Table 10, the interaction term before the adoption of environmental labeling is insignificant but it is significantly positive in the adoption year and one year after, suggesting that the treatment and control group can indeed be compared, and the policy effect may appear one year after the issuance of environmental labeling, and then disappear soon after.

6.3. Placebo test

To verify that the results are not caused by the time trend, we conduct a placebo test. We extend the event year back to 2006 for the placebo test. We set the pre-event period as 2003 to 2005 and the post-event period as 2006 to 2008; the treatment and control groups are still heavily polluting firms and non-polluting firms. This restriction of the sample makes it possible to check that the results are not driven by the time trend. We re-regress the baseline DiD model. The results are reported in Table 11. The coefficients of the interaction term ($Pollute*Post$) are no longer significant, indicating that the hypothesis of parallelism is valid and it is the true event that leads to the final results.

6.4. DiD test with firm fixed effect

To enhance the reliability of the DiD test, following Bertrand and Mullainathan (2003), we further conduct a more standard generalized DiD test, including year and firm fixed effects. In Table 12, the coefficients of the interaction term ($Pollute*Post$) in Columns 1 and 2 are significantly positive and the coefficients of the term $Post$ in Columns 3 and 4 are also significantly positive, similar to Table 5. The results of our baseline model are robust.

6.5. Elimination of the influence of industrial policy

Since China launched its industrial policy in the 11th Five Year Plan (2006–2010) and 12th Five Year Plan (2011–2015), firms in the industries mentioned in the policy have been supported by the government. As an important means for the government to intervene in the economy, industrial policy involves not only traditional trade policy but policies that affect other aspects of firms' costs, such as trade taxes, output taxes, policy-based loans, and government subsidies. The launch of an industrial policy potentially affects firms' financial constraints (Eaton and Grossman, 1986; Kollmann and Roeger, 2012; Musacchio et al., 2015).

One concern is that some of the firms labeled as heavily polluting firms are also not supported by industrial policy; thus the results would be driven by the industrial policy rather than the environmental labeling. To verify that our results are not driven by the industrial policy, we first split the treatment sample into supported

Table 10

Parallel trends assumption. This table reports the trend of the KZ index before and after the issuance of environmental labeling. We add the interaction term between the year dummy variables and treatment dummy variables. The comparison is made five years before and two years after the policy. t-values are given in parentheses below the coefficients. *** (**) (*) indicate significance at the 1% (5%) (10%) two-tailed level.

	KZ
<i>Before5*Pollute</i>	0.02 (0.42)
<i>Before4*Pollute</i>	0.05 (1.01)
<i>Before3*Pollute</i>	−0.01 (−0.21)
<i>Before2*Pollute</i>	0.05 (1.00)
<i>Before1*Pollute</i>	−0.05 (−1.06)
<i>Current*Pollute</i>	0.14*** (3.20)
<i>After1*Pollute</i>	0.11*** (2.65)
<i>After2*Pollute</i>	0.02 (0.68)
<i>Size</i>	−0.09*** (−3.36)
<i>ROA</i>	−4.34*** (−24.73)
<i>Growth</i>	−0.16*** (−8.83)
<i>PPE</i>	0.67*** (6.93)
<i>SOE</i>	−0.05 (−0.86)
<i>Risk</i>	4.10*** (2.81)
<i>HHI</i>	0.06 (0.27)
Constant	3.88*** (6.90)
Year	Yes
Industry	Yes
Province	Yes
Observations	15,838
Number of firms	2,426
R-squared	0.18

and not-supported groups to test how the financial constraints of the heavily polluting firms are affected by industrial policy. Next, we test whether the effect of environmental labeling still exists in firms supported by industrial policy. We use two classifications from the industrial policy, “supported firms” and “key supported firms,” according to the industry development plan in the five-year plan.

In Table 13, Columns 1 and 2, we use “support” as the criterion, while in Columns 3 and 4, we use “key support” as the criterion. The coefficients of *Post* are significantly positive in Columns 1 to 4, showing that regardless of whether the heavily polluting firms are supported by industrial policy, the financial constraints still increase significantly after the issuance of environmental labeling. In Column 5 (Column 6), we select all firms with support (key support) from industrial policy as a sample. The coefficients of the interaction term (*Pollute*Post*) are significantly positive, suggesting that the financial constraints of heavily polluting firms increase more than those of non-polluting firms within firms supported by industrial policy. Even if the firms are supported by the industrial policy, the effects of environmental labeling still exist. The results in Table 13 thus indicate that industrial policy is not the driving force and our previous results are robust.

Table 11

Placebo test. This table reports the results of DiD tests of the baseline model, changing the event year to 2006 and the period to 2003 to 2008. t-values are given in parentheses below the coefficients. *** (**) (*) indicate significance at the 1% (5%) (10%) two-tailed level.

	KZ	
	(1)	(2)
<i>Pollute*Post</i>	0.05 (1.42)	0.01 (0.37)
<i>Size</i>		-0.07*** (-4.35)
<i>ROA</i>		-5.95*** (-30.60)
<i>Growth</i>		-0.06** (-2.54)
<i>PPE</i>		0.22*** (2.76)
<i>SOE</i>		-0.06** (-2.04)
<i>Risk</i>		10.45*** (5.12)
<i>HHI</i>		0.05 (0.22)
Constant	1.88*** (13.51)	3.26*** (8.57)
Year	Yes	Yes
Industry	Yes	Yes
Province	Yes	Yes
Observations	7,450	7,450
R-squared	0.12	0.33

Table 12

DiD test with firm and year fixed effects. This table reports the results of DiD tests of the baseline model (Table 5) with firm and year fixed effects. t-values are given in parentheses below the coefficients. *** (**) (*) indicate significance at the 1% (5%) (10%) two-tailed level.

	KZ			
	(1)	(2)	(3)	(4)
<i>Pollute*Post</i>	0.10*** (3.91)	0.04* (1.74)		
<i>Post</i>			0.35*** (14.05)	0.26*** (10.94)
<i>Size</i>		-0.09*** (-4.64)	-0.06** (-2.30)	-0.03 (-1.18)
<i>ROA</i>		-4.33*** (-29.19)	-4.97*** (-22.48)	-3.32*** (-16.30)
<i>Growth</i>		-0.16*** (-8.99)	-0.12*** (-3.64)	-0.16*** (-7.64)
<i>PPE</i>		0.67*** (8.70)	0.58*** (5.55)	0.66*** (5.84)
<i>SOE</i>		-0.04 (-1.06)	0.05 (0.90)	-0.18*** (-2.95)
<i>Risk</i>		4.19*** (3.02)	12.60*** (10.53)	9.86*** (8.61)
<i>HHI</i>		0.09 (0.59)	-0.14 (-0.77)	0.35 (0.96)
Constant	2.16*** (94.23)	3.87*** (9.61)	3.13*** (5.41)	2.65*** (5.49)
Year	Yes	Yes	No	No
Firm	Yes	Yes	Yes	Yes
Observations	15,838	15,838	6,397	9,441
R-squared	0.56	0.62	0.62	0.59

Table 13

Impact of environmental labeling on the financial constraints of firms with industrial policy support. The regression model is $KZ = Post + Controls$, with the sample restricted to heavily polluting firms in Columns 1–4. Column 1 (Column 2) contains heavily polluting firms supported (not supported) by industrial policy after the issuance of environmental labeling. Column 3 (Column 4) contains heavily polluting firms with (without) key support from industrial policy. The regression model is $KZ = Pollute * Post + Controls$, with the sample restricted to all firms with support (key support) from industrial policy in Column 5 (Column 6). t-values are given in parentheses below the coefficients. *** (**) (*) indicate significance at the 1% (5%) (10%) two-tailed level.

	KZ					
	Heavily polluting firms with support	Heavily polluting firms without support	Heavily polluting firms with key support	Heavily polluting firms without key support	All firms with support	All firms with key support
<i>Post</i>	0.29*** (10.52)	0.20*** (3.86)	0.25*** (2.90)	0.24*** (9.39)		
<i>Pollute*Post</i>					0.13*** (3.79)	0.18*** (2.87)
<i>Size</i>	-0.04*** (-2.98)	-0.00 (-0.20)	-0.03 (-0.75)	-0.04*** (-3.12)	-0.01 (-1.24)	0.04*** (2.70)
<i>ROA</i>	-7.93*** (-35.19)	-7.88*** (-19.89)	-6.78*** (-10.39)	-8.05*** (-39.63)	-8.01*** (-48.55)	-8.13*** (-28.34)
<i>Growth</i>	-0.03 (-0.84)	0.02 (0.25)	-0.14 (-1.44)	0.00 (0.07)	-0.05** (-2.15)	-0.04 (-0.95)
<i>PPE</i>	0.34*** (4.12)	0.03 (0.22)	0.11 (0.58)	0.27*** (3.56)	0.22*** (3.85)	0.02 (0.22)
<i>SOE</i>	0.05 (1.63)	0.19*** (4.73)	-0.04 (-0.57)	0.09*** (3.64)	0.05*** (2.75)	0.05 (1.35)
<i>Risk</i>	17.18*** (10.96)	17.70*** (7.45)	14.85*** (3.67)	16.71*** (11.80)	10.33*** (5.41)	9.76*** (2.80)
<i>HHI</i>	0.10 (0.50)	3.58** (2.04)	11.53** (2.01)	0.03 (0.15)	0.10 (0.51)	-0.44 (-0.51)
Constant	2.72*** (9.62)	1.28** (2.30)	1.89** (2.28)	2.66*** (9.56)	2.23*** (10.70)	1.18*** (3.27)
Year	No	No	No	No	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,516	1,881	723	5,674	9,666	3,015
R-squared	0.35	0.39	0.40	0.36	0.34	0.37

7. Conclusions

In this paper, we examine the effect of China's environmental policy on firms' financial constraints. We use the issuance of Administrative Measures on Use of China Environmental Labeling (2008) as the external shock, and use a DiD approach to test the effect and mechanism. The findings reveal that environmental policy has a significant negative impact on the financial constraints of heavily polluting firms. Both the bank loans and the equity issuance of heavily polluting firms decrease more, suggesting that their debt and equity financing channels are restricted. Further, we find that heavily polluting firms that make a smaller contribution to the local government's GDP, receive greater media coverage, and are located in heavily polluted (versus non-polluted) provinces are more likely to be financially constrained. Lastly, environmental regulation has an effect both directly and indirectly, as the firm-level PM_{2.5} emissions and revenue growth of heavily polluting firms decrease more than those of non-polluting firms. Therefore, the environmental policy is effective, resulting in higher financial constraints, lower revenue growth, and more environmentally conscious behavior in heavily polluting firms.

Our study makes a number of practical contributions. From the perspective of financial constraints, we analyze the impact of environmental policy on microeconomic entities and supplement the research by considering environmental policy as a noneconomic external factor. In addition, we evaluate the efficiency of the environmental policy through different mechanisms and enrich the literature related to environmental policy. Our conclusion is that environmental policy constrains the investment activities of heavily polluting firms. However, the effect does not cover all heavily polluting firms; only selected firms are financially constrained. Our study also provides guidance for individual investors and institutions on evaluating firms, and for regulatory authorities on implementing further environmental policy.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Tables A1–A3.

Table A1
Environmental policies.

Launch Year	Laws and Regulations in English	Laws and Regulations in Chinese
2003	Administrative Regulations on Levy and Use of Pollutant Discharge Fee	排污费征收使用管理条例
2004	Law on the Prevention and Control of Environmental Pollution by Solid Waste	固体废物污染环境防治法
2007	Law on Energy Conservation	中华人民共和国节约能源法
2007	Measures on Open Environmental Information (Trial)	环境信息公开办法(试行)
2008	Circular Economy Promotion Law	循环经济促进法
2008	Administrative Measures for the Use of China Environmental Labeling	上市公司环保核查行业分类管理名录
2010	Measures for Environmental Administrative Punishment	环境行政处罚办法
2011	Notice on the Adjustment of the Subsidies for Energy-efficient Vehicles	关于调整节能汽车推广补贴政策的通知
2014	Guiding Opinions on Further Promoting Compensable Use and Pilot Tests of Emissions Trading	关于进一步推进排污权有偿使用和交易试点工作的指导意见
2015	Atmospheric Pollution Prevention and Control Law	大气污染防治法
2015	Measures for the Public Participation in Environmental Protection	环境保护公众参与办法

Table A2
Heavily polluting industries.

Industry Code	English Name	Chinese Name
B	Mining industry	采掘业
C0	Food and beverage industry	食品饮料业
C1	Textile, garment, and fur industry	纺织服装皮毛业
C3	Paper printing industry	造纸印刷业
C4	Petrochemical and plastic industry	石化塑胶业
C6	Metal and non-metal industry	金属非金属业
C8	Biomedical industry	生物医药业
D	Hydropower and gas industry	水电煤气业

Table A3

Ordered logit model from Kaplan and Zingales. This table reports the results of the ordered logit model in the calculation of the KZ index (Lamont et al., 2001). The number of observations is 15,838. t-values are in parentheses.

CF_{it}/A_{it-1}	-9.2947*** (-50.70)
DIV_{it}/A_{it-1}	-37.2426*** (-37.57)
C_{it}/A_{it-1}	-4.0485*** (-39.54)
LEV_{it}	3.9520*** (43.34)
Tobin Q_{it}	0.5092*** (40.86)
cut1	-4.9371*** (-49.54)
cut2	-1.0333*** (-16.08)
cut3	1.0860*** (17.34)
cut4	3.0201*** (45.21)
cut5	5.5830*** (66.12)
Log likelihood	-18766.526
Pseudo- R^2	0.2343

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