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# Does bargaining power mitigate the relationship between environmental regulation and firm performance? Evidence from China

Chunyang Wang, Yongjia Lin *

*School of Business, Macau University of Science and Technology, Avenida Wai Long, Taipa, Macao, China*

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ABSTRACT

With the increasing amount of attention given to ecological protection, the trade-off between environmental regulation and economic development is at the center of academic and policy debates. Using a sample of 1157 listed manufacturing firms for the period from 2012 to 2017, we investigate the relationships between different types of environmental regulations and both actual and expected firm performance and further assess the moderating effect of firm bargaining power on these relationships. The results indicate that (1) mandatory environmental regulation has negative effects on firm performance, whereas voluntary environmental regulation contributes to both actual and expected performance. (2) Comparing the expected performance with the actual performance, the results suggest that investors overreact to environmental regulation. Specifically, investors' expectations of the negative effects of mandatory regulation are worse than they actually are, whereas investors also overestimate the benefits of voluntary regulation. (3) The firm bargaining power mitigates the negative effects of mandatory environmental regulation on the firm performance. (4) There are regional heterogeneity and firm-level heterogeneity in the relationship between environmental regulation and firm performance. Finally, these findings confirm the Porter Hypothesis and provide some policy implications for China to optimize environmental regulation and promote firm performance.

## 1. Introduction

With the development of the world economy, global environmental problems are increasing rapidly (World Bank, 2020). As the largest developing country in the world, China is struggling with environmental problems as well. According to the China Statistical Yearbook (NBSC, 2020), China's emission of sulfur dioxide ($SO_2$) amounted to 6.96 million tons in 2017, and the total output of industrial solid waste was 3.87 billion tons. In 2019, 53.4% of 337 prefecture-level and larger cities in China exceeded the limits set by the established air quality standards. Although this reflected an improvement from these measures in 2018, pollution levels were still grim (MEE, 2020). Therefore, environmental protection is an important topic for governments and policymakers.

As a response to environmental pollution, the Chinese government decided to implement more stringent environmental regulations. In 2012, at the 18th National Congress of the Communist Party of China (NPC), it was proposed that ecological progress should be given a more prominent position by incorporating it into the country's overall development plan together with economic, political, cultural, and social progress. In 2013, the *Air Pollution Control Action Plan* was implemented and was called the strictest air pollution control measure in China's history. In 2014, the *Environmental Protection Law (revised)* published updated punishments and information disclosure methods, representing the strictest environmental law ever adopted in China. The *National List of Hazardous Waste* was released in 2016. In 2017, the State Council implemented the *Catalogue of Solid Wastes Forbidden to Import into China* to forbid the import of certain solid wastes. The State Council also issued the *Regulations on the Administration of Pollutant Discharge Permits (Trial)* in 2017, comprising legislative efforts associated with the national pollutant discharge permit system and specifying compliance obligations for firms. In 2018, the *Soil Pollution Prevention and Control Law* was passed by the NPC, aiming to improve the legal environmental protection system and help curb the current trend of environmental soil deterioration. In sum, the Chinese government has been committed to improving the ecological environment in recent years and has introduced a series of environmental protection policies that have led to increasingly strict environmental regulations.

Strict environmental regulations could improve innovation by the

* Corresponding author.
*E-mail address:* yjlin@must.edu.mo (Y. Lin).

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motivation of cost reduction (Popp, 2003) and competitive advantages (Lee et al., 2011), increase productivity by optimizing resource allocation and reconfiguring products and processes (Xie et al., 2017), and pressure firms to adopt proactive environmental strategies by attracting stakeholder concerns for environmental protection (Darnall et al., 2010). However, the effects of mandatory environmental regulation on the expected performance of firms have been insufficiently studied (Rassier and Earnhart, 2010, 2015). To the best of our knowledge, only Rassier and Earnhart (2015) investigated the effects of mandatory environmental regulation on both firms' actual and expected profitability in the U.S. Thus, we further explore the impacts of two types of environmental regulations on both actual and expected firm performance, assess the moderating effects of firm bargaining power and try to provide more comprehensive evidence for use as a reference by policymakers.

This study extends the existing literature in the following ways. First, previous studies have generally focused on the effects of mandatory (Hu et al., 2017; Wang et al., 2019) or voluntary (Palmer and Truong, 2017; Zhao et al., 2018) environmental regulations on firm performance. Different types of environmental regulations may have varying impacts on firm performance. Therefore, we exhibit the dimensions of environmental regulations and their impacts on firm performance. By analysing both mandatory and voluntary regulations, we can clearly compare the differences in the effects of these different types of environmental regulations on firm performance. Second, existing studies have only investigated the effect of mandatory environmental regulation (*U.S. Clean Water Act*) on the expected firm performance in the U.S. (Rassier and Earnhart, 2010, 2015). However, voluntary environmental regulation may lead to different expected performance, as it reflects investors' current expectations of a firm's operation in the future and includes the influence of investor sentiment (Zhu and Niu, 2016), which is the key factor in making investment decisions (Antonides and Van Der Sar, 1990). Thus, this paper tries to understand the effects of different types of environmental regulations on both the actual and expected performance of firms. Third, existing studies on bargaining power have focused on how bargaining power affects supply management, trading, and the labour market (Carluccio and Bas, 2015; Fabbri and Klapper, 2016; Gago-Rodríguez et al., 2021). Therefore, by analysing the moderating effects of bargaining power on the relationship between environmental regulation and firm performance, this research bridges the Porter Hypothesis and firm bargaining power, which enriches the literature on the consequences of environmental regulation and offers a new view for developing environmental policies that prior studies have failed to obtain.

The rest of this paper proceeds as follows: section 2 presents the theoretical framework and hypotheses; section 3 explains the methodology and data; section 4 presents the empirical results, robustness tests, and heterogeneity analyses; and section 5 includes the conclusions and implications.

## 2. Theoretical framework and hypotheses

Environmental regulations are mainly divided into two types: mandatory and voluntary (López-Gamero et al., 2010; Zhao et al., 2015). Mandatory regulation refers to a series of laws, norms, and standards implemented by governments that directly limit a firm's polluting behaviours and ultimately improve the ecological environment (Xie et al., 2017; You et al., 2019). The main characteristic of mandatory regulation is coerciveness which depends on administrative measures (Xie et al., 2017). Firms must comply with this type of regulation to avoid being fined or even forced to shut down. The implementation of mandatory regulation is rapid, which may obtain a certain effect in the short term (Peng et al., 2021). Voluntary regulation originates from top managers' concern for environmental protection (Quazi et al., 2001) and provides incentives but not mandates for pollution control (Ren et al., 2018). Bu et al. (2020) suggested voluntary regulation has two main characteristics: first, it provides more flexibility to firms since it only sets environmental goals and does not specify the approach; second, firms can have long-term profitability because it improves the firm's reputation and expands foreign markets. Voluntary regulation can reduce costs by better use of inputs, reduction of waste disposal costs, and removal of unnecessary steps in production processes, which provides firms with unique competitive advantages (López-Gamero et al., 2010). Table 1 shows summary of mandatory and voluntary environmental regulations.

The empirical studies show the different effects of mandatory and voluntary environmental regulations at region-level, industry-level, and firm-level, respectively. At the region-level, previous studies mainly access the effects of environmental regulations on both environmental protection and economic development, and indicate that mandatory environmental regulation is an important instrument for governments to improve $CO_2$ emission reduction (Cheng et al., 2017; Martin and Saikawa, 2017) as well as promote both productivity (Xie et al., 2017; Ren et al., 2018; Guo and Yuan, 2020) and investment (Yu and Li, 2020; Xie et al., 2021), while the effect of mandatory regulation on both environmental performance (Li and Ramanathan, 2018) and energy efficiency (Zhang and Song, 2021) is non-linear. However, the results on the effect of voluntary environmental regulation are mixed. By using state-level $CO_2$ emissions data in 2014 and 17 climate-related policies, Martin and Saikawa (2017) found that mandatory environmental regulation inhibited $CO_2$ emissions, whereas voluntary regulation did not. Cheng et al. (2017) verified these results and further suggested that voluntary regulation was conducive to improving technical progress, while mandatory regulation was not. Li and Ramanathan (2018) calculated a comprehensive index by using the emissions of several environmental pollutants to measure environmental performance and showed that the effects of both mandatory and voluntary regulations were "U-shaped" relative to environmental performance. Regarding productivity, Xie et al. (2017) found that both mandatory and voluntary regulations were capable of improving environmental total factor productivity, and the effect of voluntary regulation on productivity was better than that of mandatory regulation. Ren et al. (2018) suggested that both mandatory and voluntary environmental regulations improved eco-efficiency in general, while the results varied by region. Guo and Yuan (2020) used the Super-SBM model to estimate the total factor energy efficiency and found that it can be improved by both voluntary and mandatory environmental regulations. However, Zhang and Song (2021) revealed an inverted "U-shaped" relationship between environmental regulations and energy efficiency in China's metal industries and further suggested that voluntary regulation was more effective than mandatory regulation in improving the energy efficiency. With regard to investments, Yu and Li (2020) suggested that both mandatory and voluntary environmental regulations could improve the quality of foreign direct investment. Xie et al. (2021) suggested that only mandatory environmental regulation could improve the energy investment structure, while voluntary environmental regulation had no impact on the energy investment structure.

At the industry-level, existing studies mainly focus on productivity (Shen et al., 2019) and innovation efficiency (Zhang et al., 2021), and suggest that the effects of environmental regulations are complicated. Shen et al. (2019) suggested that both mandatory and voluntary

**Table 1**
Summary of mandatory and voluntary environmental regulations.

| Types | Characteristics | Advantages | Examples |
|---|---|---|---|
| Mandatory regulation | Coerciveness and authority. | Obtain a certain effect in the short term. | Cleaner production standard-Cement industry (HJ467-2009) |
| Voluntary regulation | Flexibility and long-term profitability. | Obtain unique competitive advantages. | China environmental labelling (ISO 14000) |

environmental regulations had inverted "U-shaped" relations to environmental total factor productivity (ETFP) in heavily polluting industries, mandatory regulation increased ETFP in moderately and slightly polluting industries, and there was a significant "N-shaped" relationship between voluntary environmental regulation and ETFP in slightly polluting industries. Zhang et al. (2021) pointed out that mandatory environmental regulation had a "U-shaped" effect on green innovation efficiency in the construction industry, but voluntary regulation adversely affected green innovation efficiency.

At the firm-level, an increasing number of studies consider the effects of both mandatory and voluntary environmental regulations on firms' environmental protection efforts, innovation, and efficiency. The results show that both mandatory regulation and voluntary regulation positively affect environmental responsibility (Han et al., 2021), technological innovation (Zhu et al., 2021), and innovation intention (Peng et al., 2021). However, the effects of environmental regulations on environmental governance efficiency (Li et al., 2019) and green investment (Huang and Lei, 2021) are mixed. Han et al. (2021) found that both mandatory and voluntary environmental regulations positively affected corporate environmental responsibility, especially in highly marketized regions and highly competitive industries. Zhu et al. (2021) suggested that both mandatory and voluntary regulations improved technological innovation. Peng et al. (2021) indicated that mandatory environmental regulation had a more significant positive effect on green innovation intention than did voluntary regulation. Li et al. (2019) found that there was an inverted "U-shaped" relationship between voluntary environmental regulation and environmental governance efficiency, while the effect of mandatory regulation was not significant. Huang and Lei (2021) suggested that voluntary environmental regulation increased corporate green investment; however, mandatory regulation had an inverted "U-shaped" relation with corporate green investment. The summary of related research is shown in Table 2.

### 2.1. Environmental regulation and firm performance

There has been a long debate about how mandatory environmental regulation affects firm performance. Previous studies have reviewed the effects of environmental regulations on firms' operations but have not reached a consistent conclusion (Ambec et al., 2013). Under the traditional view, environmental regulation may produce additional firm operation costs, undermining firms' performance or competitiveness (Gollop and Roberts, 1983; Gray, 1987). In an alternative view, the Porter Hypothesis (Porter, 1991; Porter and van der Linde, 1995) argues that more stringent but properly designed regulations can stimulate innovation, and the benefits of innovation may fully offset the costs in some instances. The key factor affecting whether firms achieve the Porter hypothesis is the way they respond to environmental regulation (Ramanathan et al., 2017). In general, environmental regulation increases firm performance through the innovation offset effect (Hu et al., 2017). In addition, Ramanathan et al. (2018) suggested that only flexible regulation could effectively increase financial performance via the innovation offset effect. However, studies have also provided evidence in support of the traditional view. Through the dynamic dimensions of the Porter hypothesis, Lanoie et al. (2008) found that there was a negative relationship between regulation and productivity. Beyond that, environmental regulation also affects investors. For instance, the *U.S. Clean Water Act* benefitted actual firm performance (Rassier and Earnhart, 2010), although it harmed expected performance (Rassier and Earnhart, 2015). In addition, mandatory environmental regulation has a negative effect on the stock return of heavily polluting firms, and higher investors' attention enhances this negative effect (Guo et al., 2020). Based on the above-cited literature, mandatory environmental regulation generally lacks flexibility and introduces high compliance costs, which may lead to the failure of the Porter hypothesis. Therefore, Hypothesis 1a is proposed.

**Hypothesis 1a**. Mandatory environmental regulation has negative effects on firm performance.

In contrast to mandatory environmental regulation, voluntary regulation provides firms with greater flexibility, allowing them to strategically select their timing of compliance depending on the external environment (Christmann and Taylor, 2006). Voluntary regulation encourages firms to adopt the proactive environmental management, increasing firm performance by providing a positive signal to investors (López-Gamero et al., 2010). Studies have also investigated the effects of voluntary regulation on firm performance in terms of specific forms of regulation. The introduction of new green products not only reduces adverse environmental impacts but also acts as a kind of financial incentive, improving firms' performance (Palmer and Truong, 2017). There is a positive relationship between environmental information disclosure and firm performance (Zhao et al., 2018; Wang et al., 2020). Moreover, environmental labels could significantly contribute to firm performance via the labelling effect and technical factors (Wen and Lee, 2020). Lastly, Xie et al. (2017) indicated that the current stringency of market-based regulation in China could stimulate green productivity growth. Considering the above-cited literature, we propose the

**Table 2**
Summary of studies about both mandatory and voluntary environmental regulations.

| Author (s) | Sample | Independent variables | Results | |
|---|---|---|---|---|
| | | | Mandatory | Voluntary |
| *Region-level* | | | | |
| Cheng et al. (2017) | 30 provinces in China from 1997 to 2014 | $CO_2$ emissions | + | + |
| Martin and Saikawa (2017) | 50 states in U.S. from 1990 to 2014 | $CO_2$ emissions | + | N.S. |
| Li and Ramanathan (2018) | 30 provinces in China from 2004 to 2014 | Environmental performance | U | U |
| Xie et al. (2017) | 30 provinces in China from 2000 to 2012 | Environmental total factor productivity | + | + |
| Ren et al. (2018) | 30 provinces in China from 2000 to 2013 | Eco-efficiency | + | + |
| Guo and Yuan (2020) | Industrial sector for thirty Chinese provinces form 2000–2017 | Total factor energy efficiency | + | + |
| Zhang and Song (2021) | 5 metal sub-industries in China's 30 provinces from 2006 to 2016 | Energy efficiency | I.U. | I.U. |
| Yu and Li (2020) | 30 provinces in China from 2009 to 2018 | Quality of foreign direct investment | + | + |
| Xie et al. (2021) | 29 provinces in China from 2007 to 2017 | Energy investment structure | + | N.S. |
| *Industry-level* | | | | |
| Shen et al. (2019) | Chinese industry in the period of 2000–2016 | Environmental total factor productivity | I.U. | N |
| Zhang et al. (2021) | China's 2000–2017 construction industry | Green innovation efficiency | U | - |
| *Firm-level* | | | | |
| Han et al. (2021) | Chinese listed firms between 2009 and 2016 | Environmental responsibility | + | + |
| Zhu et al. (2021) | 86 Chinese steel firms from 2005 2014 | Technological innovation | + | + |
| Peng et al. (2021) | Four leading firms in the four ecological parks | Green innovation intention | + | + |
| Li et al. (2019) | 86 China's iron and steel enterprises from 2005 to 2014 | Environmental governance efficiency | N.S. | I.U. |
| Huang and Lei (2021) | Chinese A shares listed companies for the period of 2008–2016 | Green investment | I.U. | + |

Notes: +, -, U, IU, and N.S. indicates environmental regulation positive, negative, U-shaped, inverted U-shaped, and no significant relation, respectively.

following Hypothesis.

**Hypothesis 1b.** Voluntary environmental regulation has positive effects on firm performance.

### 2.2. The moderating role of bargaining power

In response to additional costs and high expenditures introduced due to environmental regulation, firms try to reduce the negative effects of environmental regulation on firm performance. In general, some factors that can alleviate the negative impacts of regulation include organizational slack, political connections, and corporate social responsibility (Chen et al., 2018; You et al., 2019). In China, environmental regulations are usually issued by the central government and enforced by local governments. Article 16 of Chapter 3 of the *Environmental Protection Law* states that the local people's governments at various levels shall be responsible for the environmental quality of areas under their jurisdiction and shall take measures to improve the quality of the environment. Thus, the central government is usually the policymaker, while local governments are the enforcers of the environmental regulations (You et al., 2019), which leads to higher autonomy for local governments in implementing environmental policies and granting environmental subsidies.

Bargaining power is defined as the relative power of parties in a situation to exert influence over each other in order to gain more within an organization (Hicks, 1963), and it may force partners to do things they are not willing to do (Yan and Gray, 1994; Lavie, 2006). Competitive strategy theory argues that relative bargaining power could shift from the purchaser to the supplier under certain market conditions (Porter, 1980). Existing studies on bargaining power often focus on supply management, trading, and the labour market (Carluccio and Bas, 2015; Fabbri and Klapper, 2016; Gago-Rodríguez et al., 2021). However, firms with high bargaining power may also gain more benefits from local governments, such as subsidies and tax reductions.

Wang et al. (2003) suggested that firms with the following specific characteristics might have high bargaining power associated with local governments: first, firms that are owned by the government can easily obtain protection and access to policymakers; second, firms with more workers should have stronger bargaining power since it has given the government concerns about potential unemployment; and third, firms with superior reputation should have higher bargaining power because they have a less negative social impact.

We argue that high bargaining power has a positive moderating effect on the relationship between environmental regulation and firm performance for several reasons. Firms with higher bargaining power can avoid excessive compliance costs. For example, local governments have limited resources and the power to enforce environmental regulation, leading to polluters can effectively avoid paying pollution levies; further, a firm with high bargaining power may receive a maximum of 80% of the levy paid by the firm can be used to subsidize the environmental project proposed by the firm (Wang et al., 2003). High bargaining power also allows firms to claim more tax cuts, reducing their tax costs (Mills et al., 2013). In addition, tax cuts also increase firms' research and development (R&D) investments (Lan et al., 2020), thus improving firm performance. Therefore, the following hypotheses are proposed.

**Hypothesis 2a.** The bargaining power of firms mitigates the negative effects of mandatory environmental regulation on firm performance.

**Hypothesis 2b.** The bargaining power of firms enhances the positive effects of voluntary environmental regulation on firm performance.

## 3. Methodology and data

### 3.1. Methodology

To investigate the effect of different types of environmental regulations on firm performance and the moderating effect of bargaining power, we employed a dynamic panel data model with a system-generalized method-of-moments (system-GMMs) estimator. The advantages of employing the dynamic panel approach developed by Arellano-Bond (Arellano and Bond, 1991) and Arellano-Bover/Blundell-Bond (Arellano and Bover, 1995; Blundell and Bond, 1998) include: (1) this approach considers heteroskedasticity and autocorrelation within individuals and (2) addresses potential endogeneity problems that may arise from reverse causality and the confounding effects of unobserved variables (Wooldridge, 2015).[1] The general forms of our dynamic panel data model are as follows.

Main effect model:

$$Performance_{i,t} = \beta_0 + \beta_1 Performance_{i,t-1} + \beta_2 Regulations_{j,t} + \beta_3 Controls_{i,t} + \mu_i + \varepsilon_{i,t} \quad (1)$$

Moderating effect model:

$$Performance_{i,t} = \beta_0 + \beta_1 Performance_{i,t-1} + \beta_2 Regulations_{j,t} + \beta_3 Employee_{i,t} + \beta_4 Regulations_{j,t} * Employee_{i,t} + \beta_5 Controls_{i,t} + \mu_i + \varepsilon_{i,t} \quad (2)$$

where $i$, $j$, and $t$ represent firm, province, and year, respectively; $Performance_{i,t}$ represents the actual and expected performance; $Performance_{i,t-1}$ reflects the lagged dependent variables; $Regulations_{j,t}$ represents the mandatory and voluntary environmental regulations; $Employee_{i,t}$ is the bargaining power; $Controls_{i,t}$ are control variables, including the sales growth ($Sale_{i,t}$); the concentration of the top 10 shareholders ($Con10_{i,t}$); the firm size ($LNTA_{i,t}$); the asset structure of the firm ($Leverage_{i,t}$); the firm age ($FirmAge_{i,t}$); the age of the asset ($AssetAge_{i,t}$); a dummy variable with the state-owned firm corresponding to 1 and all other firms corresponding to 0 ($SOE_{i,t}$); the GDP growth rate ($GDP_t$); $\mu_i$ represent individual effects and $\varepsilon_{i,t}$ is the error term.

### 3.2. Measurements of variables

#### 3.2.1. Dependent variables: firm performance

To explore the influence of environmental regulations on firm performance, this paper employs two aspects of performance: actual performance and expected performance. The first indicator measures actual performance. Based on previous studies, such as those by Huang and Wright (2015) and Wang et al. (2019), earnings per share (EPS) is chosen as the indicator to measure the financial performance of firms. The calculation of this indicator is as follows:

$$EPS = (Net\ income\ after\ tax - \ dividends\ of\ preferred\ stocks) \,/\, Number\ of\ shares\ out\ standing \quad (3)$$

where *EPS* is an internal measurement for the firm that represents firm

[1] We thank the anonymous reviewer for pointing out the potential endogeneity problems between environmental regulation and firm performance from reverse causality. For example, the firm's financial performance may also affect the regional economy and then affect the intensity and adoption of environmental regulation.

performance. The higher this ratio is, the higher the profit earned by one outstanding share is, and vice versa.

The second indicator measures the expected performance. Analysts' forecasts can clearly reflect the impact of different information on investors' expectations, providing a measurement for investors' expectations (Brown and Rozeff, 1978; You et al., 2017). Moreover, considering the indicator we selected to represent the actual performance of firms, we utilized the EPS forecast by analysts as the indicator of expected performance. The detailed calculation of this indicator is as follows:

$$FEPS = \sum_{k=1}^{n}(Earnings\ per\ share\ forecast\ by\ analysts) \Big/ n,$$
$$\text{where}\ \ k = 1,\ 2,\ \ldots,\ n \tag{4}$$

where *FEPS* represents the expected performance. Analysts' forecast EPS is an external measurement for the firms, representing the influence of environmental regulation on investors' expectations of future firm performance. The implication of *FEPS* is the same as that of *EPS*: a higher *FEPS* value indicates that investors have higher firm performance expectations and vice versa.

#### 3.2.2. Independent variables: environmental regulation

Mandatory regulation. In the construction of new projects, the government forces firms to invest in environmental protection. Therefore, the higher the environmental investments in new construction projects are, the tighter the government's mandatory environmental regulation is. Following Xie et al. (2017) and You et al. (2019), we chose the ratio of the environmental investments in new construction projects to the GDP of the province (*MER*) as the mandatory regulation measurement. As this ratio increases, firms face more stringent mandatory environmental regulations.

Voluntary regulation. Following Ren et al. (2018) and Bu et al. (2020), we measured voluntary environmental regulation as the ratio of the number of firms in each province that have passed the certifications of the ISO14001 system to the total number of firms in the country (*ISO*). This ratio increases with stronger voluntary regulation.

#### 3.2.3. Moderating variable: bargaining power

A firm that provides higher levels of employment has a stronger bargaining power to negotiate with the local environmental protection bureau for tax cuts and policy support since it has given the government concerns about potential unemployment (Wang et al., 2003). Therefore, following Wang et al. (2003), we employ the ratio of the number of employees in a firm to the total number of employees in the province (*Employee*) as the firm bargaining power measurement. A higher index represents a higher firm bargaining power.

#### 3.2.4. Control variables

Following Rassier and Earnhart (2015) and Fu et al. (2020), we incorporate the following control variables into the models. The sales growth rate of a firm (*Sales*) reflects a firm's competition and ability to shield itself from market variations. The shareholder concentration (*Con10*) is the shareholding ratio of the top 10 shareholders of the firm; this variable indicates the ownership structure of the firm. A firm's asset size (*LNTA*) is defined as the natural logarithm of its total assets; this variable controls the influence of the firm size on the dependent variables. The ratio of total liabilities to total assets (*Leverage*) measures the asset structure of a firm. In general, the longer a firm has been established, the more experienced it is in its operations. Thus, we use the natural logarithm of the number of years a firm has been listed (*FirmAge*) to measure its maturity. Compared with older assets, newer assets cause the firm to possess higher productivity and bring higher depreciation. The ratio of the net property, plant, and equipment (PPE) to gross PPE (*AssetAge*) controls the effects of ageing assets. We employ a dummy variable (*SOE*) to reflect the ownership of firms; this variable takes a value of 1 for state-owned firm and 0 for all other firms. Last, the ratio of the real GDP growth (*RGDP*) measures the development of the macroeconomic environment. Table 3 illustrates the definitions and data sources of the variables considered in our model.

**Table 3**
Variable definitions.

| Variable | Definition | Data sources |
|---|---|---|
| *Dependent variables:* | | |
| EPS | Ratio of net income after tax and dividends of preferred stocks to number of shares out standing | CSMAR Database |
| FEPS | Average earnings per share forecasted by analysts | Wind Database |
| *Independent variables:* | | |
| MER | Ratio of environmental investments in new construction projects to the GDP of the province | China Statistical Yearbook on Environment |
| ISO | Ratio of the number of firms in each province which have passed the certifications of ISO14001 system to the total number of firms in the country | China National Accreditation Service for Conformity Assessment |
| Employee | Ratio of the number of employees in a firm to total employees in the province | CSMAR Database |
| Sales | Sales growth rate of the firm | CSMAR Database |
| Con10 | Shareholding ratio of top 10 shareholders of the firm | CSMAR Database |
| LNTA | Natural logarithm of the total assets | CSMAR Database |
| Leverage | Ratio of total liabilities to total assets | CSMAR Database |
| FirmAge | Natural logarithm of the number of years a firm has been listed | CSMAR Database |
| AssetAge | Ratio of net PPE to gross PPE | CSMAR Database |
| SOE | Dummy variable. A state-owned firm corresponds to 1 and 0 otherwise | CSMAR Database |
| RGDP | GDP growth rate | World Bank Database |

### 3.3. Data

The sample data focus on the manufacturing firms that are listed on China's A-share market during the period from 2012 to 2017. The firm-level data are collected from the China Stock Market and Accounting Research (CSMAR) database and Wind database; the mandatory environmental regulation data are obtained from the China Statistical Yearbook on the Environment; the voluntary environmental regulation data come from the China National Accreditation Service for Conformity Assessment; and the real GDP growth rate data are from the World Bank database.

After excluding (1) firms with abnormal financial conditions (ST, *ST), (2) firms missing the value of earnings per share, (3) firms missing the value of analysts' forecast earnings per share, and (4) firms missing a value for the control variables, our empirical sample includes unbalanced panel data with 5922 observations from 1157 manufacturing firms for the period from 2012 to 2017.

**Table 4**
Descriptive statistics.

| Variable | Obs. | Mean | Std. dev. | Min | Max |
|---|---|---|---|---|---|
| EPS | 5922 | 0.4310 | 0.5176 | −0.8245 | 2.6822 |
| FEPS | 5922 | 0.6975 | 0.5335 | 0.0285 | 2.9719 |
| MER | 5922 | 0.0115 | 0.0063 | 0.0030 | 0.0424 |
| ISO | 5922 | 0.0731 | 0.0401 | 0.0009 | 0.1320 |
| Employee | 5922 | 0.0195 | 0.0389 | 0.0003 | 0.2380 |
| Sales | 5922 | 0.1921 | 0.4756 | −0.7438 | 3.1597 |
| Con10 | 5922 | 0.6011 | 0.1465 | 0.2546 | 0.8936 |
| LNTA | 5922 | 22.1338 | 1.1716 | 19.0976 | 27.3074 |
| Leverage | 5922 | 0.3897 | 0.1903 | 0.0508 | 0.8252 |
| FirmAge | 5922 | 2.7025 | 0.3743 | 1.0986 | 3.9253 |
| AssetAge | 5922 | 0.9192 | 0.0235 | 0.8390 | 0.9683 |
| SOE | 5922 | 0.2582 | 0.4377 | 0 | 1 |
| RGDP (%) | 5922 | 7.2210 | 0.4587 | 6.7 | 7.9 |

Note: Definitions of the variables are presented in Table 3.

## 4. Results

### 4.1. Descriptive statistics

Table 4 shows the descriptive statistics for all variables used in this research. We find that the mean expected performance value is 0.6975, which is higher than the actual performance value (0.4310). However, the standard deviations of actual and expected performance are 0.5176 and 0.5335, respectively. Regarding the independent variables, the mean value of environmental investments in new construction projects accounts for 1.15% of the GDP of the province. Moreover, the mean value of voluntary environmental regulation is 0.0731. In addition, the mean, standard deviation, minimum and maximum bargaining power, sales growth, shareholder concentration, firm size, asset structure, firm age, asset age, ownership, and GDP growth values illustrate the characteristics of the sample observations.

### 4.2. Empirical results

We first investigate the main effects of environmental regulations on firm performance and then exhibit the moderating effects of firm bargaining power. To ensure that there is no multicollinearity in our models, Appendix A presents the Pearson correlation coefficients for all dependent and independent variables used in the empirical analysis. The results suggest that our models do not suffer from multicollinearity problems. To address potential endogeneity problems in our models, we employ the two-step system GMM estimators and specify firm characteristic proxies as endogenous and predetermined variables separately and use lagged levels and differences as instruments (Roodman, 2009). We inspect the relevance and validity of the instruments using the Hansen's J test. The Hansen statistics are insignificant, suggesting the joint validity of the instruments. Then, we utilize the F statistic to confirm the joint significance of all independent variables. The Arellano-Bond test for AR (1) in first differences rejects the null of no first-order serial correlation, but the test for AR (2) does not reject the null that there is no second-order serial correlation. The results support the use of the two-step system GMM estimators.

#### 4.2.1. Main effects

Table 5 shows the main effects of two types of environmental regulations on the firm performance based on the two-step system GMM estimators. The results show that mandatory environmental regulation has significantly negative effects on both actual ($\beta = -0.0264$, $p < 0.05$) and expected ($\beta = -0.0427$, $p < 0.01$) performance, suggesting that tighter mandatory environmental regulation leads to lower financial performance and investor expectations. Nevertheless, voluntary environmental regulation has a positive effect on both actual ($\beta = 0.0260$, $p < 0.01$) and expected ($\beta = 0.0278$, $p < 0.01$) performance. These results indicate that strong voluntary regulation helps to improve both firms' actual and investors' expectations of firms' performance. Therefore, both Hypothesis 1a and Hypothesis 1b are supported. By comparing the standardized coefficients, we obtain an interesting conclusion: the coefficients on *FEPS* are higher than those on *EPS*, indicating that investors may overreact to environmental regulation. Specifically, investors tend to overestimate the negative impact of mandatory environmental regulation as well as the benefits of voluntary regulation.

The results of the preceding analysis clearly show that mandatory environmental regulation has negative effects on both the actual and expected performance of firms, which is consistent with the traditional view of environmental regulation. There are several reasons for these findings. From the perspective of actual performance, first, because of tighter mandatory environmental regulation, firms face higher compliance costs than benefits from innovation (Hu et al., 2017; Wang et al., 2019). Second, mandatory environmental regulation distracts managers' attention from technological innovation to meet types of environmental inspections, which in turn reduces the management efficiency and corrodes the firm performance (Zhao et al., 2018). From the perspective of expected performance, behavioural biases may contribute to the negative effect of mandatory environmental regulation. According to behavioural finance, individuals make complicated investment decisions poorly or irrationally due to built-in biases and misperceptions. As Rassier and Earnhart (2015) mentioned, investors initially believe that stricter regulation is costly even which may be diluted by prompting innovation. Therefore, tighter regulation means a potential loss from investor expectations. To compensate for this potential loss, investors require a higher return based on prospect theory. Built-in biases and misperceptions are also the reason that investors overestimate the negative impact of mandatory regulation.

Alternatively, voluntary environmental regulation has a positive effect on the firm performance, supporting the narrow version of the Porter Hypothesis. Voluntary regulation benefits the actual firm performance in two ways. On the one hand, the firm performance benefits from the flexibility of voluntary regulation since firms can choose their own strategies to meet the regulatory requirements (Rondinelli and Vastag, 1996), thus avoiding unnecessary compliance costs. On the other hand, voluntary environmental regulation could significantly encourage innovation (Bu et al., 2020), and innovation promotes firm performance (Porter and van der Linde, 1995). In addition, voluntary regulation also raises investors' expectations of a firm's performance by improving its reputation. Firms participate in voluntary regulation to signal their environmental protection efforts to external stakeholders under high environmental impact opacity (Jiang and Bansal, 2003). This helps firms gain reputation benefits by appealing to stakeholders as environmental leaders (Christmann and Taylor, 2002). Reputation is a perceptual representation of a firm's past behaviour and future

**Table 5**
Environmental regulation and firm performance.

| Dependent variables | Mandatory regulation | | Voluntary regulation | |
|---|---|---|---|---|
| | (1) EPS | (2) FEPS | (3) EPS | (4) FEPS |
| MER | −0.0264** | −0.0427*** | | |
| | (0.0115) | (0.0160) | | |
| ISO | | | 0.0260*** | 0.0278*** |
| | | | (0.0095) | (0.0100) |
| $Y_{t-1}$ | 0.6573*** | 0.6441*** | 0.7340*** | 0.7737*** |
| | (0.0430) | (0.0452) | (0.0669) | (0.0544) |
| Sales | 0.2444*** | 0.3116*** | 0.1865** | 0.0916*** |
| | (0.0652) | (0.0869) | (0.0729) | (0.0181) |
| Con10 | 0.0327** | −0.0054 | 0.0250* | 0.0125 |
| | (0.0134) | (0.1100) | (0.0149) | (0.0172) |
| LNTA | 0.1879*** | 0.3291*** | 0.1613*** | 0.1145*** |
| | (0.0257) | (0.1229) | (0.0307) | (0.0320) |
| Leverage | −0.1114*** | −0.1897*** | −0.0857*** | −0.0739 |
| | (0.0225) | (0.0642) | (0.0257) | (0.0493) |
| FirmAge | 0.0467*** | 0.0402* | 0.0469*** | 0.0436*** |
| | (0.0113) | (0.0215) | (0.0103) | (0.0107) |
| AssetAge | −0.0282** | −0.0286** | −0.0246* | −0.0170 |
| | (0.0132) | (0.0131) | (0.0127) | (0.0113) |
| SOE | −0.0072 | −0.1149 | −0.0028 | −0.0221 |
| | (0.0369) | (0.0960) | (0.0326) | (0.0283) |
| RGDP | 0.0382*** | 0.1122*** | 0.0300** | 0.0594*** |
| | (0.0121) | (0.0218) | (0.0137) | (0.0141) |
| Cons. | −0.0065 | −0.0246 | −0.0154 | −0.0424*** |
| | (0.0148) | (0.0274) | (0.0145) | (0.0154) |
| Year dummy | Yes | Yes | Yes | Yes |
| Obs. | 4366 | 4366 | 4366 | 4366 |
| P-AR(1) | 0.000 | 0.000 | 0.000 | 0.000 |
| P-AR(2) | 0.136 | 0.459 | 0.112 | 0.388 |
| F-test | 75.06 | 37.27 | 102.42 | 72.15 |
| P-Hansen | 0.223 | 0.128 | 0.194 | 0.187 |

Note: The table shows the main effects of two types of environmental regulations on firm performance based on the two-step system GMM estimators. Definitions of the variables are presented in Table 3. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Robust standard errors are provided in parentheses.

prospects (Roberts and Dowling, 2002). Superior reputation significantly enhances investors' firm performance expectations (Raithel and Schwaiger, 2014), which is even higher than the actual benefits of voluntary regulation.

#### 4.2.2. Moderating effects

Table 6 reports the moderating effects of firm bargaining power on the relationships between different types of environmental regulations and firm performance. The results show that firm bargaining power mitigates the negative impact of mandatory environmental regulation on actual performance ($\beta = 0.3350$, $p < 0.05$), and the coefficient between the bargaining power and analysts' forecast earnings per share is positive ($\beta = 0.6545$, $p < 0.05$). This implies that firm bargaining power effectively mitigates the negative effects of mandatory environmental regulation on both the actual and expected performance. However, we find that the interaction term does not have a significant effect on either the actual ($\beta = 0.0239$, $p > 0.1$) or expected ($\beta = 0.0283$, $p > 0.1$) performance. These results suggest that firm bargaining power cannot moderate the impacts of voluntary environmental regulation on firm performance. Thus, the above findings support Hypothesis 2a, while Hypothesis 2b is not supported.

Bargaining power could mitigate the negative relationship between mandatory environmental regulation and actual performance since firms with higher bargaining power can reduce compliance costs by paying lower compliance fees and receiving tax reductions (Wang et al., 2003; Mills et al., 2013). In addition, bargaining power mitigates the negative effect of mandatory environmental regulations on expected performance. Tax cuts obtained with bargaining power can increase firms' investment in research and development (Lan et al., 2020), which may lead to more new technologies and equipment that will help firms achieve higher productivity in the future and give investors higher expectations of future earnings. However, bargaining power has no significant effect on the relationship between voluntary environmental regulation and firm performance. Voluntary environmental regulation is motivated by top managers' concern for environmental protection (Quazi et al., 2001), which is a self-motivated activity of a firm. Thus, the benefits from bargaining power may not significantly influence the effect of voluntary environmental regulation on firm performance.

**Table 6**
Moderating effect of bargaining power.

| Dependent variables | Mandatory regulation | | Voluntary regulation | |
|---|---|---|---|---|
| | (1) EPS | (2) FEPS | (3) EPS | (4) FEPS |
| MER | −0.0945** | −0.1441** | | |
| | (0.0375) | (0.0628) | | |
| MER*Employee | 0.3350** | 0.6545** | | |
| | (0.1601) | (0.2601) | | |
| ISO | | | 0.0206** | 0.0216* |
| | | | (0.0104) | (0.0114) |
| ISO* Employee | | | 0.0239 | 0.0283 |
| | | | (0.0230) | (0.0244) |
| Employee | −0.2411 | −0.6839** | −0.0120 | 0.0004 |
| | (0.1465) | (0.2797) | (0.0177) | (0.0195) |
| $Y_{t-1}$ | 0.6480*** | 1.3161*** | 0.7248*** | 0.7808*** |
| | (0.0462) | (0.2321) | (0.0642) | (0.0517) |
| Sales | 0.2384*** | 0.0868 | 0.2125*** | 0.2174*** |
| | (0.0706) | (0.1605) | (0.0706) | (0.0594) |
| Con10 | 0.0403** | −0.1415* | 0.0240 | 0.0032 |
| | (0.0155) | (0.0769) | (0.0148) | (0.0177) |
| LNTA | 0.1775*** | 0.1509 | 0.1535*** | 0.0837** |
| | (0.0422) | (0.1894) | (0.0311) | (0.0337) |
| Leverage | −0.1073*** | −0.5672 | −0.0881*** | −0.0812* |
| | (0.0235) | (0.3573) | (0.0245) | (0.0491) |
| FirmAge | 0.0490*** | 0.0807*** | 0.0475*** | 0.0482*** |
| | (0.0142) | (0.0302) | (0.0105) | (0.0108) |
| AssetAge | −0.1025* | 0.0007 | −0.0260** | −0.0255** |
| | (0.0545) | (0.0203) | (0.0123) | (0.0116) |
| SOE | −0.0165 | 0.3837** | 0.0002 | 0.0185 |
| | (0.0417) | (0.1848) | (0.0325) | (0.0317) |
| RGDP | 0.0403*** | 0.0203 | 0.0303** | 0.0536*** |
| | (0.0143) | (0.0365) | (0.0136) | (0.0144) |
| Cons. | −0.0024 | −0.1430*** | −0.0164 | −0.0468*** |
| | (0.0167) | (0.0542) | (0.0140) | (0.0150) |
| Year dummy | Yes | Yes | Yes | Yes |
| Obs. | 4366 | 4366 | 4366 | 4366 |
| P-AR(1) | 0.000 | 0.000 | 0.000 | 0.000 |
| P-AR(2) | 0.139 | 0.547 | 0.117 | 0.395 |
| F-test | 55.09 | 15.13 | 87.53 | 63.22 |
| P-Hansen | 0.200 | 0.595 | 0.260 | 0.106 |

Notes: The results from system-GMM estimations explain the moderating effects of firm bargaining power on the relationship between different types of environmental regulations and firm performance. Definitions of the variables are presented in Table 3. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Robust standard errors are provided in parentheses.

### 4.3. Robustness tests

We undertake robustness tests on our models in different ways. First, firms with high tax payments are more likely to receive government subsidies than firms with lower tax payments (Bai et al., 2019) because taxes help the local government solve budget deficits and promote local economic development. Therefore, we also utilize the ratio of a firm's tax payments to the total tax payment in the province (*Tax*) to measure bargaining power. Table 7 shows the moderating effect of bargaining power (measured by *Tax*).

Second, a firm that operates in concentrated industries has more bargaining power since they face low current competition due to few alternatives and higher barriers to entry (Mills et al., 2013). The Herfindahl Index measures the concentration of an industry, as the index higher, the stronger firm bargaining power. Following Mills et al. (2013), we employ the Herfindahl index as the measurement of firm bargaining power, which is calculated as the sum of the squares of the individual firm market shares of all the firms in the sub-industries in the manufacturing industry. Table 8 shows the moderating effect of bargaining power (measured by *HHI*).

Third, following Chen and Lin (2011) and Al-ahdal et al. (2020), we replace the earnings per share (*EPS*) and analysts' forecast earnings per

**Table 7**
Moderating effect of bargaining power (using proportion of Tax).

| Dependent variables | Mandatory regulation | | Voluntary regulation | |
|---|---|---|---|---|
| | (1) EPS | (2) FEPS | (3) EPS | (4) FEPS |
| MER | −0.0098 | −0.0155 | | |
| | (0.0120) | (0.0164) | | |
| MER*Tax | 0.0730* | 0.0659* | | |
| | (0.0391) | (0.0355) | | |
| ISO | | | 0.1273** | 0.0745** |
| | | | (0.0639) | (0.0370) |
| ISO*Tax | | | 0.4216 | 0.1969 |
| | | | (0.2807) | (0.1585) |
| Tax | −0.3185** | −0.2778** | 0.5798 | 0.2922 |
| | (0.1452) | (0.1221) | (0.3693) | (0.2128) |
| $Y_{t-1}$ | 0.7278*** | 0.5952*** | 0.6716*** | 0.7117*** |
| | (0.0767) | (0.1084) | (0.0439) | (0.1455) |
| Cons. | −0.0275 | −0.0569** | 0.0035 | −0.0259 |
| | (0.0173) | (0.0230) | (0.0206) | (0.0192) |
| Control variables | Yes | Yes | Yes | Yes |
| Year dummy | Yes | Yes | Yes | Yes |
| Obs. | 4366 | 4366 | 4366 | 4366 |
| P-AR(1) | 0.000 | 0.000 | 0.000 | 0.000 |
| P-AR(2) | 0.111 | 0.494 | 0.102 | 0.360 |
| F-test | 55.07 | 30.23 | 57.72 | 46.75 |
| P-Hansen | 0.435 | 0.313 | 0.190 | 0.195 |

Notes: The results from system-GMM estimations explain the moderating effects of firm bargaining power (measured by proportion of tax) on the relationship between different types of environmental regulations and firm performance. Definitions of the variables are presented in Table 3. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Robust standard errors are provided in parentheses.

**Table 8**
Moderating effect of bargaining power (using *HHI*).

| Dependent variables | Mandatory regulation | | Voluntary regulation | |
|---|---|---|---|---|
| | (1) EPS | (2) FEPS | (3) EPS | (4) FEPS |
| MER | −0.0142 | −0.0037 | | |
| | (0.0190) | (0.0152) | | |
| MER*HHI | 0.1164* | 0.0722** | | |
| | (0.0624) | (0.0360) | | |
| ISO | | | 0.0252*** | 0.0205** |
| | | | (0.0095) | (0.0101) |
| ISO*HHI | | | −0.0039 | −0.0100 |
| | | | (0.0097) | (0.0108) |
| HHI | −0.0500 | −0.1131*** | 0.0126 | 0.0075 |
| | (0.0703) | (0.0277) | (0.0111) | (0.0119) |
| $Y_{t-1}$ | 0.6035*** | 0.6328*** | 0.7337*** | 0.7829*** |
| | (0.1907) | (0.0958) | (0.0670) | (0.0530) |
| Cons. | −0.0032 | −0.0135 | −0.0156 | −0.0441*** |
| | (0.0171) | (0.0181) | (0.0145) | (0.0150) |
| Control variables | Yes | Yes | Yes | Yes |
| Year dummy | Yes | Yes | Yes | Yes |
| Obs. | 4366 | 4366 | 4366 | 4366 |
| P-AR(1) | 0.000 | 0.000 | 0.000 | 0.000 |
| P-AR(2) | 0.230 | 0.411 | 0.111 | 0.394 |
| F-test | 54.84 | 34.67 | 91.70 | 68.68 |
| P-Hansen | 0.488 | 0.272 | 0.194 | 0.104 |

Notes: The results from system-GMM estimations explain the moderating effects of firm bargaining power (measured by Herfindahl index) on the relationship between different types of environmental regulations and firm performance. Definitions of the variables are presented in Table 3. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Robust standard errors are provided in parentheses.

**Table 10**
Moderating effect of bargaining power (using return on equity).

| Dependent variables | Mandatory regulation | | Voluntary regulation | |
|---|---|---|---|---|
| | (1) ROE | (2) FROE | (3) ROE | (4) FROE |
| MER | −0.0239 | −0.0304* | | |
| | (0.0150) | (0.0170) | | |
| MER*Employee | 0.0732* | 0.0853** | | |
| | (0.0374) | (0.0424) | | |
| ISO | | | 0.0479** | 0.0636*** |
| | | | (0.0210) | (0.0208) |
| ISO* Employee | | | 0.0473 | 0.0514 |
| | | | (0.0494) | (0.0424) |
| Employee | −0.0788 | −0.0236 | 0.0787 | 0.0992 |
| | (0.0643) | (0.0629) | (0.0717) | (0.0602) |
| $Y_{t-1}$ | 0.6131*** | 0.3697*** | 0.6049*** | 0.5845*** |
| | (0.0474) | (0.0825) | (0.0834) | (0.0491) |
| Cons. | 0.0159 | 0.0318 | 0.0274 | −0.0135 |
| | (0.0218) | (0.0271) | (0.0204) | (0.0205) |
| Control variables | Yes | Yes | Yes | Yes |
| Year dummy | Yes | Yes | Yes | Yes |
| Obs. | 3110 | 3110 | 3110 | 3110 |
| P-AR(1) | 0.000 | 0.000 | 0.000 | 0.000 |
| P-AR(2) | 0.361 | 0.300 | 0.388 | 0.407 |
| F-test | 41.03 | 15.92 | 20.27 | 24.71 |
| P-Hansen | 0.464 | 0.372 | 0.652 | 0.536 |

Notes: The results from system-GMM estimations explain the moderating effects of firm bargaining power on the relationship between different types of environmental regulations and firm performance (measured by return on equity). Definitions of the variables are presented in Table 3. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Robust standard errors are provided in parentheses.

share (*FEPS*) with the return on equity (*ROE*) and analysts' forecast return on equity (*FROE*) as firm performance measurements. We rerun the models specified in Equation (1) using the same system GMM estimators to test the robustness of our main findings (see Table 9).

Moreover, we use the return on equity and forecast return on equity to test the moderating effects (Equation (2)), and the results are presented in Table 10. The moderating effect of bargaining power is measured by *Employee*.

Fourth, based on an assumption of efficient capital markets, Tobin's Q measures the present value of future profit as determined by investors since investors should be able to process all public information, including information relating to environmental regulation (Rassier and Earnhart, 2015). Thus, the measurement of expected performance in our main model (*FEPS*) is replaced by Tobin's Q. The results are exhibited in Table 11.

In addition, we also show the moderating effects of bargaining power on the relationship between environmental regulation and Tobin's Q by using the proportion of employees (*Employee*) (see Table 12). Overall, the results of the robustness tests are consistent with those reported above.

**Table 9**
Environmental regulation and firm performance (using return on equity).

| Dependent variables | Mandatory regulation | | Voluntary regulation | |
|---|---|---|---|---|
| | (1) ROE | (2) FROE | (3) ROE | (4) FROE |
| MER | −0.0354** | −0.0383** | | |
| | (0.0163) | (0.0172) | | |
| ISO | | | 0.0325** | 0.0406*** |
| | | | (0.0150) | (0.0155) |
| $Y_{t-1}$ | 0.6463*** | 0.5621*** | 0.6050*** | 0.6117*** |
| | (0.0539) | (0.0874) | (0.0515) | (0.0603) |
| Cons. | 0.0009 | 0.0011 | 0.0209 | −0.0157 |
| | (0.0261) | (0.0392) | (0.0197) | (0.0216) |
| Control variables | Yes | Yes | Yes | Yes |
| Year dummy | Yes | Yes | Yes | Yes |
| Obs. | 3110 | 3110 | 3110 | 3110 |
| P-AR(1) | 0.000 | 0.000 | 0.000 | 0.000 |
| P-AR(2) | 0.549 | 0.304 | 0.298 | 0.252 |
| F-test | 19.39 | 17.84 | 39.17 | 32.79 |
| P-Hansen | 0.723 | 0.295 | 0.152 | 0.344 |

Note: The table shows the main effects of two types of environmental regulations on firm performance (measured by return on equity) based on the two-step system GMM estimators. Definitions of the variables are presented in Table 3. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Robust standard errors are provided in parentheses.

### 4.4. Heterogeneity analyses

This paper also considers heterogeneities to explore whether environmental regulation has different effects on firm performance among different regions, firm sizes, and firm ages. The results are exhibited in Tables 11–13.

**Table 11**
Environmental regulations and firm performance (using Tobin's Q).

| Dependent variable: Tobin's Q | Mandatory regulation | Voluntary regulation |
|---|---|---|
| | (1) | (2) |
| MER | −0.0441* (0.0259) | |
| ISO | | 0.1125* (0.0637) |
| $Y_{t-1}$ | 0.5593*** (0.0826) | 0.6756*** (0.1965) |
| Cons. | −0.1256*** (0.0355) | −0.2466*** (0.0441) |
| Control variables | Yes | Yes |
| Year dummy | Yes | Yes |
| Obs. | 4960 | 4960 |
| P-AR(1) | 0.000 | 0.000 |
| P-AR(2) | 0.830 | 0.749 |
| F-test | 66.66 | 78.42 |
| P-Hansen | 0.339 | 0.265 |

Note: The table shows the main effects of two types of environmental regulations on firm performance (measured by Tobin's Q) based on the two-step system GMM estimators. Definitions of the variables are presented in Table 3. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Robust standard errors are provided in parentheses.

**Table 12**
Moderating effect of bargaining power (using Tobin's Q).

| Dependent variable: Tobin's Q | Mandatory regulation | Voluntary regulation |
|---|---|---|
| | (1) | (2) |
| MER | −0.2199** (0.1060) | |
| MER*Employee | 0.8149** (0.3820) | |
| ISO | | 0.1053** (0.0504) |
| ISO* Employee | | 0.1541 (0.1518) |
| Employee | −0.9613* (0.4896) | −0.0179 (0.0703) |
| $Y_{t-1}$ | 0.4709*** (0.1252) | 0.4786*** (0.1329) |
| Cons. | 0.3578*** (0.0556) | 0.1668*** (0.0554) |
| Control variables | Yes | Yes |
| Year dummy | Yes | Yes |
| Obs. | 4960 | 4960 |
| P-AR(1) | 0.000 | 0.000 |
| P-AR(2) | 0.251 | 0.966 |
| F-test | 52.92 | 98.18 |
| P-Hansen | 0.816 | 0.344 |

Notes: The results from system-GMM estimations explain the moderating effects of firm bargaining power on the relationship between different types of environmental regulations and firm performance (measured by Tobin's Q). Definitions of the variables are presented in Table 3. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Robust standard errors are provided in parentheses.

#### 4.4.1. Region

To investigate the effect of regional heterogeneity on both the direct effect of different types of environmental regulations on firm performance and the moderating effect of bargaining power, we categorize various provinces in China into two subsamples. Considering the differences in the levels of economic development and environmental regulation enforcement, we follow Zhu et al. (2014) to divide the 31 provinces and municipalities in mainland China into coastal regions and inland China. The coastal regions consist of Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan. Inland China includes Jilin, Heilongjiang, Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan, Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Shanxi, Gansu, Qinghai, Ningxia, Xinjiang, and Tibet. In our sample, coastal regions account for 74.74% of the observations, while the remaining 25.26% of observations are inland China. In Table 13, columns (1) to (4) and columns (5) to (8) report the firm performance results obtained from estimations in coastal regions and inland China, respectively. Compared to inland China, we find that the positive effect of voluntary regulation on firm performance is higher in coastal regions. With regard to coastal regions, the environmental management standards are more stringent than those at the national level (Xie et al., 2021), and the intensity of voluntary regulation is stronger than that in inland China (Ren et al., 2018). Thus, laws and regulations are comparable sound in coastal regions, which may lead to lower incremental benefit of voluntary regulation than that in coastal regions.

#### 4.4.2. Firm size

Table 14 shows the effects of environmental regulations on firm performance and the moderating effect of the bargaining power for large and small firms. The results show that there is size heterogeneity. For large firms, the results show that voluntary environmental regulation improves both actual and expected performance, while mandatory environmental regulation inhibits them. The moderating effect of bargaining power mitigates the negative effects of mandatory regulation on firm performance but does not influence the relationship between voluntary regulation and firm performance. For small firms, only voluntary environmental regulation enhances firm performance, while neither the effect of mandatory environmental regulation nor the moderating effect of the bargaining power is significant. The possible reasons for size heterogeneity are that small firms, relative to large firms, have flexibility and responsiveness to external environmental changes because of their entrepreneurial alertness and simpler capital structure (Yu, 2001), allowing them to adjust rapidly to mandatory environmental regulation. In addition, small firms have output flexibility (Fiegenbaum and Karnani, 1991), allowing them to avoid the high compliance costs of mandatory environmental regulation by adjusting their output volumes. Thus, mandatory environmental regulation does not significantly affect small firms' performance.

#### 4.4.3. Firm age

As shown in Table 15, voluntary environmental regulation can strongly improve firm performance for both mature and young firms. The effect of mandatory environmental regulation on the performance of mature firms is negative, while for young firms, the effect of

**Table 13**
Environmental regulations, firm performance, and bargaining power by region.

| Dependent variables | Coastal regions | | | | Inland China | | | |
|---|---|---|---|---|---|---|---|---|
| | Mandatory regulation | | Voluntary regulation | | Mandatory regulation | | Voluntary regulation | |
| | (1) EPS | (2) FEPS | (3) EPS | (4) FEPS | (5) EPS | (6) FEPS | (7) EPS | (8) FEPS |
| *Panel A: The effect of environmental regulations on firm performance* | | | | | | | | |
| MER | −0.0569** | −0.0609** | | | −0.0437** | −0.0794* | | |
| | (0.0277) | (0.0265) | | | (0.0214) | (0.0435) | | |
| ISO | | | 0.0230** | 0.0380** | | | 0.2143* | 0.2358** |
| | | | (0.0117) | (0.0170) | | | (0.1232) | (0.0996) |
| Obs. | 3425 | | 3425 | | 1118 | | 1118 | |
| *Panel B: The moderating effect of bargaining power* | | | | | | | | |
| MER | −0.1928** | −0.1825** | | | −0.1883** | −0.2464** | | |
| | (0.0825) | (0.0718) | | | (0.0860) | (0.1105) | | |
| MER*Employee | 1.6546** | 2.1498*** | | | 0.3871** | 0.4133** | | |
| | (0.8329) | (0.7836) | | | (0.1862) | (0.2043) | | |
| ISO | | | 0.0780** | 0.1174** | | | 1.1826** | 1.0606** |
| | | | (0.0381) | (0.0553) | | | (0.5784) | (0.5190) |
| ISO* Employee | | | −0.0900 | −0.1537 | | | −0.4501 | −0.5107 |
| | | | (0.0904) | (0.1019) | | | (0.2804) | (0.3171) |
| Employee | −1.7283** | −1.7152*** | 0.2272* | 0.3705* | −0.2665 | −0.2336 | 0.5484* | 0.4921** |
| | (0.8199) | (0.6386) | (0.1363) | (0.1995) | (0.1619) | (0.1948) | (0.2831) | (0.2365) |
| Obs. | 3425 | | 3425 | | 1118 | | 1118 | |

Notes: Results are from system-GMM estimations explain the effects of environmental regulations on firm performance and the moderating effect of the bargaining power for both coastal regions and inland China. The Hansen's J test, the F statistic, the Arellano-Bond test for AR (1) and the test for AR (2) meet the requirements. The control variables and year dummy are employed in all models. Definitions of the variables are presented in Table 3. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Robust standard errors are provided in parentheses.

**Table 14**
Environmental regulations, firm performance, and bargaining power by firm size.

| Dependent variables | Large firms | | | | Small firms | | | |
|---|---|---|---|---|---|---|---|---|
| | Mandatory regulation | | Voluntary regulation | | Mandatory regulation | | Voluntary regulation | |
| | (1) EPS | (2) FEPS | (3) EPS | (4) FEPS | (5) EPS | (6) FEPS | (7) EPS | (8) FEPS |
| *Panel A: The effect of environmental regulations on firm performance* | | | | | | | | |
| MER | −0.0504*** | −0.0507** | | | −0.0074 | 0.0137 | | |
| | (0.0191) | (0.0157) | | | (0.0136) | (0.0155) | | |
| ISO | | | 0.0579*** | 0.1140*** | | | 0.0318** | 0.0619** |
| | | | (0.0218) | (0.0425) | | | (0.0161) | (0.0294) |
| Obs. | 2103 | | 2103 | | 1944 | | 1944 | |
| *Panel B: The moderating effect of bargaining power* | | | | | | | | |
| MER | −0.2058*** | −0.2778* | | | −0.0148 | −0.0311 | | |
| | (0.0783) | (0.1453) | | | (0.0289) | (0.0466) | | |
| MER*Employee | 0.4579** | 0.5991** | | | 0.2135 | 0.6869 | | |
| | (0.2151) | (0.3037) | | | (0.2558) | (0.6695) | | |
| ISO | | | 0.2210** | 0.1036** | | | 0.0481** | 0.0704** |
| | | | (0.0998) | (0.0490) | | | (0.0241) | (0.0307) |
| ISO* Employee | | | −0.2724 | 0.0660 (0.0407) | | | 0.5299 | 0.1982 |
| | | | (0.1655) | | | | (0.4227) | (0.1342) |
| Employee | −0.2967* | −0.3622** | 0.2521 (0.1544) | −0.0083 | −0.0804 | −0.9909 | 0.3099** | 0.0657 |
| | (0.1669) | (0.1803) | | (0.0446) | (0.1600) | (0.9072) | (0.1242) | (0.0720) |
| Obs. | 2103 | | 2103 | | 1944 | | 1944 | |

Notes: Results are from system-GMM estimations explain the effects of environmental regulations on firm performance and the moderating effect of the bargaining power for both large and small firms. The Hansen's J test, the F statistic, the Arellano-Bond test for AR (1) and the test for AR (2) meet the requirements. The control variables and year dummy are employed in all models. Definitions of the variables are presented in Table 3. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Robust standard errors are provided in parentheses.

**Table 15**
Environmental regulations, firm performance, and bargaining power by firm age.

| Dependent variables | Mature firms | | | | Young firms | | | |
|---|---|---|---|---|---|---|---|---|
| | Mandatory regulation | | Voluntary regulation | | Mandatory regulation | | Voluntary regulation | |
| | (1) EPS | (2) FEPS | (3) EPS | (4) FEPS | (5) EPS | (6) FEPS | (7) EPS | (8) FEPS |
| *Panel A: The effect of environmental regulations on firm performance* | | | | | | | | |
| MER | −0.0801*** | −0.0420*** | | | −0.0152 | −0.0210 | | |
| | (0.0270) | (0.0155) | | | (0.0160) | (0.0170) | | |
| ISO | | | 0.0643*** | 0.0408** | | | 0.0330** | 0.0333** |
| | | | (0.0230) | (0.0183) | | | (0.0158) | (0.0164) |
| Obs. | 1991 | | 1991 | | 2013 | | 2013 | |
| *Panel B: The moderating effect of bargaining power* | | | | | | | | |
| MER | −0.3402*** | −0.1000** | | | −0.0407 | −0.0113 | | |
| | (0.1264) | (0.0397) | | | (0.0269) | (0.0287) | | |
| MER*Employee | 1.0482** | 0.2449** | | | 0.2055 | 0.3100 | | |
| | (0.4389) | (0.1221) | | | (0.1851) | (0.1988) | | |
| ISO | | | 0.1456** | 0.1523** | | | 0.1111** | 0.0408** |
| | | | (0.0688) | (0.0653) | | | (0.0561) | (0.0204) |
| ISO* Employee | | | −0.2714 | −0.1719 | | | −0.1740 | 0.0733 |
| | | | (0.2142) | (0.1301) | | | (0.1136) | (0.0503) |
| Employee | −1.3122** | −0.3396** | 0.2136 (0.1322) | 0.2695* | −0.2917 | −0.4184 | 0.3068 | 0.0418 |
| | (0.5199) | (0.1518) | | (0.1542) | (0.2719) | (0.2641) | (0.2150) | (0.0489) |
| Obs. | 1991 | | 1991 | | 2013 | | 2013 | |

Notes: Results are from system-GMM estimations explain the effects of environmental regulations on firm performance and the moderating effect of the bargaining power for both mature and young firms. The Hansen's J test, the F statistic, the Arellano-Bond test for AR (1) and the test for AR (2) meet the requirements. The control variables and year dummy are employed in all models. Definitions of the variables are presented in Table 3. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. Robust standard errors are provided in parentheses.

mandatory regulation is not significant. Bargaining power mitigates the negative effect of mandatory regulation on both the actual and expected performance of mature firms, but it cannot influence the effect of mandatory regulation on young firms or the effect of voluntary regulation on the performance of both mature and young firms. This may be because young firms are more likely to invest in R&D than mature firms since young firms, as challengers, need new technology to survive in the market (Czarnitzki and Kraft, 2004; Huergo and Jaumandreu, 2004). R&D investment results in an increase in productivity through technical improvement (Lichtenberg and Siegel, 1991; Ortega-Argilés et al., 2015), increasing firm performance. Moreover, young firms are more likely to adopt new methods than mature firms. Since mature firms make tremendous investments in physical and human capital, adopting a new method may often create a conflict of interest within the organization and incur high opportunity costs (Yu, 2001). Therefore, the relationship between mandatory environmental regulation and the performance of young firms is not significant.

## 5. Conclusions and implications

### 5.1. Conclusions

In this paper, we investigate the effects of mandatory and voluntary environmental regulations on the actual and expected performance of firms by assessing the moderating effects of firm bargaining power. With a sample of 1157 listed manufacturing firms for the period from 2012 to

2017 and based on the two-step system GMM estimators, we find that mandatory environmental regulation has negative effects on both the actual and expected performance of firms. In contrast, voluntary environmental regulation improves both actual and expected performance. These findings support the narrow version of the Porter Hypothesis. The results also indicate that investors overreact to environmental regulation. Specifically, investors overestimate both the negative effects of mandatory regulation and the benefits of voluntary regulation. Bargaining power mitigates the negative relationship between mandatory environmental regulation and firm performance. However, the moderating effects of bargaining power on the relationship between voluntary regulation and firm performance are not significant. We further consider regional and firm-level heterogeneities. For regional heterogeneity, we find that the effects of environmental regulations on firm performance and the moderating effect of bargaining power show the same pattern in both coastal regions and in inland China as in the entire sample, while the positive effect of voluntary environmental regulation on firm performance in inland China is higher than that in coastal regions. With regard to firm-level heterogeneity such as firm size and age, both the effect of mandatory environmental regulation and the moderating effect of bargaining power is not significant for small firms or young firms, whereas mandatory environmental regulation undermines the performance of both large firms and mature firms and bargaining power could mitigate this negative relationship for both large firms and mature firms. However, neither the effect of voluntary environmental regulation nor the moderating effect of bargaining power is affected by firm size or age.

### 5.2. Practical implications

Our study has several practical implications. For policymakers, they should set clear environmental objectives, provide flexible compliance approaches, and increase the discretionary space of local governments in environmental enforcement when designing mandatory environmental regulations. Doing so would allow local governments to make appropriate adjustments for environmental regulation, especially for large firms and mature firms, to avoid inhibiting their performance. In addition, policymakers should provide technical assistance, organize training courses, and improve public recognition for participants to motivate firms to participate in voluntary regulation. For investors, they should correctly and comprehensively understand the impacts of both mandatory and voluntary environmental regulations on firm performance to avoid overreactions. For firm managers, they should actively participate in voluntary environmental regulation, which may improve firm performance. Firm managers should also improve the bargaining power of their firms, which may in turn help them obtain more support from local governments (e.g., through government subsidies or policies) to reduce the negative effects of mandatory regulation.

### 5.3. Limitations and future research opportunities

There are some limitations that could be addressed in future research. First, firm performance depends on various external and internal factors, such as investor sentiment, intellectual capital, macroeconomic cycle, and so on. However, this paper investigated the effects of different types of environmental regulations on firm performance and the moderating effect of firm bargaining power. Second, our findings were based on the manufacturing firms listed in China stock market, which may apply only to listed manufacturing firms in emerging economies, but not to non-listed firms and developed economies. Future studies should cover and compare firms from different scales and different economies.

## CRediT authorship contribution statement

**Chunyang Wang:** Conceptualization, Writing – original draft, Writing – review & editing, Methodology, Data curation, Resources, Formal analysis, Software, Investigation. **Yongjia Lin:** Conceptualization, Writing – original draft, Writing – review & editing, Methodology, Data curation, Resources, Formal analysis, Software, Investigation.

## 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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