参赛队员姓名： Tianqin Long

中学：深圳中学

省份：广东省

国家/地区：中国，南方赛区

指导教师姓名：王奕君

指导教师单位：深圳中学

论 文 题 目 ：How Environmental Regulation Affects Labor Demand: Evidence from the Implementation of China's New Environmental Protection Law

How Environmental Regulation Affects Labor Demand: Evidence from the Implementation of China's New Environmental Protection Law

Tianqin Long

Shenzhen Middle School, Guangdong, China

14 September, 2023

Abstract

The balance between environmental enforcement and full employment is crucial——the former is related to people’s health, and the latter is related to improving people’s income and living standards——especially in developing countries with large populations. Based on enterprise-level data, this paper uses China’s most comprehensive coverage of government-led environmental regulation policy——the implementation of the new Environmental Protection Law (the NEPL) in 2015——as a quasi-experiment to identify the causal relationship between environmental regulation and enterprises’ labor demand using the difference-in-differences method. Based on the steps outlined above, we find that the implementation of the NEPL reduces the labor employment of heavily polluting enterprises. The main reduction in employment is observed in low-skilled labor, with no significant impact on high-skilled labor. Further, we conducted a series of robustness tests including the parallel trend test, no anticipation test, and the other policies’ effect, and find that the above conclusion still holds. Finally, we conduct the heterogeneity analysis, and find that the decrease in employment after the NEPL is more significant in non-state-owned enterprises, new enterprises, and enterprises in regions with higher environment enforcement intensity. These discussions can serve as a reference for developing countries in formulating environmental regulation policies.

Key words: Environment Regulation, Difference-In-Differences Method (DID), Labor Demand, Employment Structure, Policy Implications

Content

1 Introduction

How to achieve a balance between environmental enforcement and full employment is an important issue faced by the government when formulating environmental regulations. As the world's largest developing economy, China has undergone more than 40 years of Reform and Opening-up, achieving rapid development with a "polluting first and cleaning up later" development model. According to China's National Bureau of Statistics, the average annual growth rate is approximately 10%, and GDP grows 33.5 times from 1979 to 2022. However, this development model has also led to serious pollution problems. With national development and an increasingly affluent population, environmental pollution has not only negatively impacted economic sustainability but also severely affected people's health. Since the 19th National Congress of the Communist Party of China, the country's main social problem has been the imbalance between insufficient development and people's growing needs for a better life. Reducing environmental pollution has become an essential part of the people's aspirations for a better life and a top priority for the government. Tracing back to the 18th National Congress of the Communist Party of China, President Xi Jinping has started and continued the fight against pollution. Starting with addressing prominent ecological and environmental issues, he has emphasized a combination of focus and comprehensiveness, treating both symptoms and root causes, and a significant shift from targeted rectification to systematic governance to achieve environmental improvement and a green transformation of the economic development mode. According to official data from China, air quality has improved, with the annual average concentration of key pollutants decreasing. Specifically, the annual average concentration of PM2.5 has decreased by 34.8% since 2015, reaching 30 micrograms per cubic meter. Water quality has also improved significantly, with surface water quality reaching 84.9% in 2021, and increase of 23.3 percentage points since 2012. Efforts to tackle soil pollution have been successful, with more than 90% of contaminated arable and more than 93% of contaminated sites safely used in 2021.

However, the implementation of environmental regulation is not free. One of the major concerns is its impact on manufacturing industries. This is particularly worrying in terms of its effects on the employment of a significant number of low-income and low-skilled laborers within the manufacturing sector. According to the 2020 China Census Yearbook, the manufacturing sector employs close to 30% of the total workforce, which is a fairly large population of about 220 million people. Heavily polluting enterprises, as a focal point of environmental governance, are characterized by relatively low technological level and a significant employment for low-skilled labor. Some research proposes that environmental policies may increase production costs for these companies, potentially leading to unemployment issues (Walker, 2011[i]; Sheriff, 2019[ii]). Therefore, as the intensity of environmental regulation increases, the government needs to continuously generate new job opportunities to counteract any possible reduction in employment. Nevertheless, the impact of environmental governance on employment remains inconclusive. Some research suggests that environmental regulations do not substantially impede employment levels and could even foster job creation (Morgenstern, 2002[iii]). This is due to the reason that environmental regulations can incentivize companies to develop clean technologies or introduce advanced pollution control measures. This, in turn, could lead to enhanced employment opportunities related to technological innovation and environmental management activities (Ren, 2020[iv]). Thus, the crucial question we must answer is: What is the exact impact of environmental regulations on employment in a populous developing country like China?

Based on this, this paper utilizes financial data of enterprises from the Guotai Junan (CSMAR) database and the data on the number of employees and the composition of employees of enterprises from the Wanderlust (Wind) database, and uses the implementation of the NEPL as a quasi-experiment to identify the causality between environmental regulations and enterprise employment using difference-in-differences (DID) methodology. We find that the NEPL reduces the labor demand of heavily polluting enterprises by approximately 16.3%, which is line with the findings of Walker (2011). In addition, regarding employment structure and heterogeneity analysis, the reduction in employment primarily affects low-skilled labor, and the reduction is particularly significant in new enterprises, non-state-owned enterprises, and enterprises in regions with stricter environmental regulations.

Compared to existing literature, this paper offers two crucial contributions. Firstly, from a literary perspective, unlike discussions of regional regulatory policies or market-based regulatory policies, this paper uses the implementation of China's nationwide government-led environmental regulation policy (the NEPL) as a quasi-experiment to discuss the balance between environmental regulation and employment and conduct a further analysis of this issue from both a quantitative and structural perspective. This provides a basis for a comprehensive understanding of the effects of government-led environmental regulation policies on employment, complementing the existing literature.

Secondly, this study provides novel empirical evidence on the effects of pollution regulation on employment in the largest developing country. Specifically, it utilizes Chinese enterprise data to examine this issue, and conducts heterogeneity analysis based on three distinct perspectives. Such examination is intrinsic to comprehending the determinants of labor employment decisions under environmental regulation policies. Additionally, these insights may assist developing countries in formulating advanced environmental regulation policies to alleviate the negative employment impacts and establish a strong foundation for policy-making.

The remainder of this paper is organized as follows. The next section offers background on China's environmental regulation policy and a summary of the pertinent literature. Section 3 outlines our study's methodology, including model creation, data collection, and variable selection. Section 4 concentrates on conveying the empirical findings, including baseline regressions, robustness tests, and heterogeneity analysis. In section

5 we set forth our conclusions and policy recommendations.

2 Background and Literature Review

2.1 Policy Background

The development and enhancement of China's legal framework for ecological environmental protection has evolved significantly over time. The "Provisions on the Protection and Improvement of the Environment" issued in 1973 marked the initiation of China's formal environmental protection regulations. Subsequently, the "Environmental Protection Law (for trial implementation)" promulgated in 1979 further defined the scope, objectives, principles, and applicability of environmental protection. These developments laid the foundation for China's environmental protection efforts to transition onto a legal track. Subsequently, as environmental challenges escalated, the need for a more comprehensive and structured legal approach became evident. This led to the formulation of landmark laws such as the Environmental Protection Law of 1989, which marked the formal establishment of a legal framework for environmental protection in China. Despite these developments, several pivotal challenges impeded the effective implementation of the Environmental Protection Law. These challenges included implementation gaps causing regional inconsistencies, weak enforcement mechanisms due to resource constraints, and inadequate penalties failing to deter non-compliance effectively. Limited public participation hindered comprehensive decision-making, while administrative complexities led to coordination challenges among different governmental bodies. Moreover, insufficient transparency of environmental information restricted accountability, and difficulties in attributing pollution to specific corporations hampered corporate responsibility. In response to these challenges, China embarked on a journey to revamp its environmental legal framework. From the Third Session of the Eighth National People's Congress in 1995 to the Fifth Session of the Eleventh National People's Congress in 2011, a total of 2,474 representatives of the National People's Congress and delegations from Taiwan and Hainan put forth a combined total of 78 proposals for amending the Environmental Protection Law. This reflects that the current Environmental Protection Law, formulated during the initial stages of economic reform, is no longer in line with the requirements of economic and social development. The amendment of the Environmental Protection Law in 2011 was included in the legislative agenda of the 11th National People's Congress. Over the following three years, after undergoing four rounds of deliberation and two rounds of public consultation, the new Environment Protection Law was finally settled on April 24th, 2014 and formally implemented on January 1^{st}, 2015.

The new Environmental Protection Law (NEPL) of 2015 is considered the strictest environmental protection law in China to date. Its implementation means that China addresses environmental concerns in a more comprehensive and robust manner. Specifically, compared to its predecessor, the NEPL introduces significant reforms in at least the following areas: 1) The law bolsters enforcement by granting regulatory bodies broader authority, enabling swift actions against violators. 2) A focus on enhanced stakeholder participation and information transparency empowers affected communities, NGOs, and the public. 3) Governments in heavily polluted areas are held accountable. This engenders a culture of responsibility and performance-driven environmental management. 4) Severe penalties for environmental offences have been strengthened, such as the establishment of a system of consecutive daily penalties, seizure and detention, and referral for administrative detention. Data from China's Ministry of Environmental Protection show that, since the implementation of the NEPL in 2015, there have been over 170000 key cases investigated and prosecuted. During the "Thirteenth Five-Year Plan" period (2016-2020), China has witnessed a substantial increase in environmental administrative penalty cases, totaling 833000 cases, marking a 1.4-fold growth compared to the "Twelfth Five-Year Plan" period (2011-2015). Increased case registrations and penalties reflect heightened enforcement commitment. The law's transformative elements foster a cultural shift towards environmental preservation and sustainability.

2.2 Literature Review

Currently, in response to global climate change and environmental degradation, countries globally have formulated various environmental regulation policies. These policies have greatly influenced economies and societies, attracting a significant attention from the academic community. Among these, the impact of environmental regulation policies on employment remains uncertain.

Some studies have shown that environmental regulations can have negative effects on energy-intensive and polluting industries or enterprises, possibly leading to job losses. Yip (2018)[v] investigates the consequences of the UK's carbon tax policy on the labor market and determined that its adoption resulted in a 1.3% decline in total employment across the country. Greenstone (2002)[vi] estimates the effects of the Clean Air Act during its initial 15 years of implementation (1972-1987) and found that nonattainment counties, compared to attainment counties, experienced a loss of about 590,000 jobs in pollution-intensive industries. Walker (2011) assesses the influence of the 1990 Clean Air Act Amendments (CAAAs) on plant and sector employment levels, suggesting that changes in county-level regulatory status, caused by the CAAAs, led to a decrease in the size of employment by up to 15 percent during the 10 years subsequent to the changes. Sheriff (2019) concentrates on the effects of updated nitrogen oxides (NOx) regulations on employment in fossil-fueled power plants according to the CAAAs and suggests that they may have encouraged labor-saving technological advancements in impacted facilities, leading to negative consequences for workforce numbers. Under the context of China specifically, Liu (2017)[vii] estimates that a stricter wastewater discharge standard led to a reduction of approximately 7% decrease in the labor demand for textile printing and dyeing enterprises in Lake Tai region. Liu (2021)[viii] finds that China's Key Cities for Air Pollution Control (KCAPC) reduced SO2 emissions by around 26% and caused a decline of approximately 3% in manufacturing labor demand in affected cities.

Additionally, some research has shown that environmental regulation can lead to job creation and its impact on enterprises' labor demand is due to a combination of job creation and job destruction. Berman and Bui (2001)[ix] decomposes the effect of enterprises' environmental regulations on enterprises' labor demand into an output effect and a factor substitution effect, and find that a sharp increase in the number of air quality regulations in the Los Angeles Basin did not reduce labor demand of refineries. Morgenstern (2002) combines a unique plant-level data set with industry-level demand information to examine four polluting industries, finding that increased environmental spending generally does not cause a significant change in employment. Yamazaki (2017)[x] examines the employment impact of British Columbia's revenue-neutral carbon tax implemented in 2008, indicating that it generated a small but statistically significant 0.74% annual increases in employment from 2017 to 2013 on average. Hafstead (2018)[xi] analyzes the effects of environmental policy on employment (and unemployment), which found that imposing a pollution tax causes substantial reductions in employment in polluting industry, but this is offset by increased employment in non-polluting industry. Specifically, under the context of China, Ren (2020) finds that driven by the expansion of enterprise's production scale, the emissions trading program significantly increases the high-skilled labor demand of regulated enterprises. Zhong (2021)[xii] differentiates the variance between high-and-low-skilled labor and finds that implementing environmental regulation will generate "compliance cost effect" and "innovation offset effect", with the former effect promotes the employment of high-skilled labor while suppressing that of low-skilled labor and the latter effect facilitates the employment for both types of labor.

Based on varying environmental regulation policies in different countries, the aforementioned literature has conducted detailed discussions on the relationship between environmental regulation and employment but has not reached a unanimous conclusion. In general, the lack of consensus in the academic community regarding the impact of environmental regulation policies on employment may stem from three factors:

(1) Variations in the categorization of regulation policies. Environmental regulation policy is categorized as government-led and market-based, which have different mechanisms and impacts on employment. The former type involves the enforcement of effective environmental pollution management administrative regulatory systems, commands, and penalties for polluting activities. This could have adverse effects on business productivity and operations, which could harm employment prospects (Greenstone, 2002[xiii]; Walker, 2011; Sheriff, 2019). On the other hand, market-based environmental regulation policy primarily uses market mechanisms to automatically adjust environmental resources. This offers enterprises the liberty to select the most cost-effective production processes, encourages pollution reduction and technological innovation, and facilitates employment (Ren, 2020; Zhong, 2021).

(2) Differences in the extent of coverage of these policies. Some research merely focuses on regional environmental regulation policies. That is, the implementation of the policy is targeted only at specific regions (Morgenstern, 2002). However, pertinent research has unearthed that the enhancement of environmental regulations may prompt highly-polluting enterprises relocate to areas with relatively less intense environmental enforcement, creating a "Pollution Heaven" (Wu et al, 2017[xiv]) and culminating in a "Pollution Shelter Effect" (Chichilnisky, 2017[xv]). In addition, the decrease in employment can be attributed to heavily polluting enterprises relocating to areas with less stringent environmental regulations. This practice worsens pollution levels in the destination areas while simultaneously boosting employment rates there (Levinson & Taylor, 2008[xvi]).

(3) Differences in labor employment. Some studies focus more on the change of the overall employment at a country (Yip, 2018; Morgenstern, 2002), ignoring variations in the labor structure. However, changes in employment levels may vary between different types of labor (Zhong, 2021). Most studies do not delve deeper into this issue from the perspective of employment structure.

In contrast to the above, our research focuses on the government-led nationwide environmental regulation policy, the new Environmental Protection Law (the NEPL) in China, and discusses both the general and specific labor structure, confirming the policy effect on labor employment negative. In addition, since the NEPL is a nationwide environmental regulation policy, the "Pollution Shelter Effect" can be prevented.

3 Research Design

3.1 Sample and Data

Intending to examine the impact of the NEPL on labor employment in heavily polluting enterprises, this paper selects A-share manufacturing enterprises listed on China's Shanghai and Shenzhen stock markets from 2011 to 2019 as the initial research sample. Drawing on Wen et al., (2022)[xvii] the initial sample was treated as follows: 1) excluding companies with abnormal statuses such as ST or PT; 2) excluding companies that have changed in the industry category during the research period; 3) removing observations with missing or abnormal values for key variables; and 4) winsorizing continuous variables at the 1% level to control for extreme values. Based on the above principles, a total of 13065 annual sample observations are finally obtained for 1738 enterprises, of which 765 were heavy polluters and 973 are non-heavy polluters. The financial data of enterprises used in this paper are from the Guotai Junan (CSMAR) database, and the data on the number of employees and the composition of employees of enterprises are mainly from the Wanderlust (Wind) database.

3.2 Model Setting

For the purpose of examining the impact of the NEPL on labor employment in heavily polluting enterprises, basic regression model is constructed as follows:

$$Labor_{it} = a + \beta_1 Treat_i \times Post_t + \rho X_{it} + \gamma_t + \mu_i + \varepsilon_{it} (1)$$

where i represents the enterprise, and t represents the year. Therefore, the dependent variable $Labor_{it}$ represents the labor demand of enterprise i in year t. $\beta_1 Treat_i \times Post_t$ is the independent variable, which is the interaction term between a group dummy variable ($Treat_i$) and a time dummy variable ($Post_t$), which represents whether an enterprise i is influenced after the NEPL in year t. The estimated coefficient β_1 of $Treat_i \times Post_t$ in this paper is the core coefficient that reflects the impact of the NEPL on the employment of the enterprise. X_{it} includes a series of control variables. γ_t represents year fixed effects, μ_i represent Enterprise fixed effects, and ε_{it} is the random error term. To mitigate the effects of sample correlation, the standard errors are clustered at the enterprise level in the model.

3.3 Variable Definition and Description

3.3.1 Dependent Variable

The dependent variable in this paper is the labor employed by enterprise i in year t, which is expressed as the natural logarithm of the total number of employees in the enterprise. In addition, this paper examines the impact of the implementation of the new environmental protection law on the hiring of high-skilled and low-skilled labor in enterprise. This paper measures the employment of high-skilled workers using the natural logarithm of the number of employees with bachelor's degree and above, and uses the natural logarithm of the number of employees with less than bachelor's degree to measure the employment of low-skilled workers.

3.3.2 Independent Variable

The independent variable is $Treat_i_Post_t$is the interaction of the NEPL policy dummy variables and time dummy variables, representing the policy variable of the NEPL. $Treat_i$ is a group dummy variable, where listed companies in heavy polluters are assigned as the treatment group ($Treat_i$=1) and listed companies in non-heavily polluting industries are assigned as the controlled group ($Treat_i$=0). Specifically, our study refers to "Industry Classification Catalogue for Environmental Inspection of Listed Companies (Draft for Solicitation of Comments)" released in 2010 and the "Industry Classification Guidelines for Listed Companies" revised by the China Securities Regulatory Commission (CSRC) in 2012 to clarify the sample enterprises into treatment groups and control groups. We select 18 specific industries such as mining, textile manufacturing, and pharmaceutical manufacturing as heavy polluters, and 23 other specific industries as non-heavy polluters. $Post_t$ is a time dummy variable, and since the NEPL was implemented from January 1st, 2015, the years from 2015 onwards are considered as the years when the policy is in effect ($Post_t$=1), while other years are considered as pre-policy years ($Post_t$=0).

3.3.3 Control Variables

According to previous research (Tang et al., 2020[xviii]), the model incorporates a range of control variables, including the wage level of the labor (Lnwage), the scale of enterprise (Size), the asset-liability ratio of enterprise (Lev), the profitability of enterprise (Profit), the cash holdings of enterprise (Cash), the profit rate of asset (Roa), the growth ability of enterprise (Tobinq), the capital intensity of enterprise (KI), equity structure of enterprise (Top1), the selling expense rate of enterprise (Ser) as controlled variables. The definitions and descriptions of these variables are provided in Table 1.

Table 1 Summary

	Obs.	mean	sd	min	max	Definition
	Dependent Variable					
TLabor	12922	7.760	1.080	5.390	11.060	ln (total labor)
Hlabor	12177	5.910	1.260	2.300	9.520	ln (total labor with bachelor degree and above)
Llabor	12883	7.500	1.140	4.540	10.790	ln (total labor with less than bachelor's degree)
	Independent Variable					
Treat_Post	13065	0.330	0.470	0	1	time dummy* group dummy
	Control Variables					
Lnwage	13065	11.57	0.420	10.560	12.840	ln (labor's average wage)
Size	13065	22.010	1.150	19.980	25.940	ln (total assets)
Lev	13065	0.390	0.190	0.0500	0.910	total liabilities/total assets
Tobinq	13065	1.920	0.960	0.880	7.250	Tobin's Q
Roa	13065	0.040	0.050	-0.200	0.200	net revenue/total revenue
Ser	13065	0.0800	0.0800	0.000	0.480	selling expenses/total revenue
Top1	13065	35.000	13.740	9.230	74.570	the shareholding proportion of the controlling shareholder

In addition, Figure 1 illustrates alterations in employment levels between heavily polluting and non-heavily polluting companies prior to and following the NEPL. Prior to 2015, no notable changes occurred in the patterns of labor employment for either type of enterprise, indicating a largely parallel trend. However, since the NEPL in 2015, there has been a decrease in the overall employment of both non-heavily and heavily polluting enterprises alike. Nevertheless, in comparison to non-heavily polluting enterprises, the reduction in employment figures for heavily polluting businesses is more apparent and quicker. This suggests a substantial reduction in the workforce of heavily polluting companies due to the NEPL. This validates that the shift in labor employment within heavily polluting enterprises is a result of the NEPL instead of other policies, which is a necessary condition for implementing differences-in-differences method.

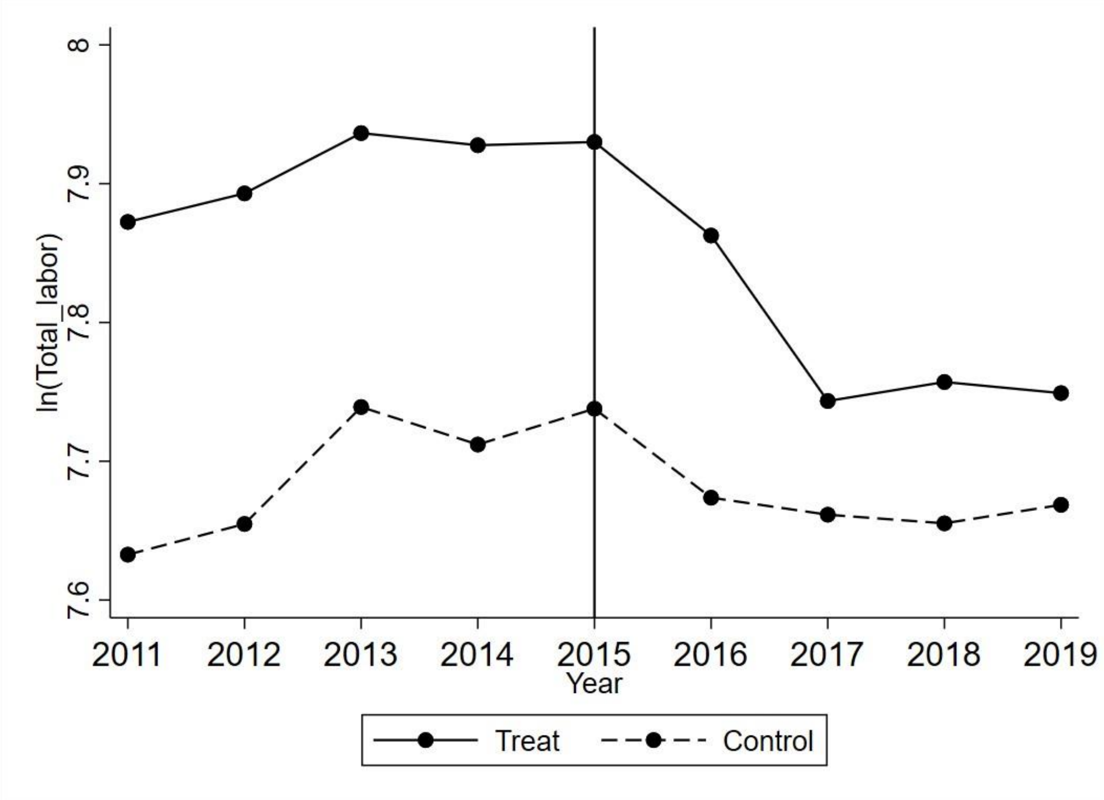

Figure 1 Trend of the labor employment in heavily polluting and non-heavily polluting enterprises from 2011 to 2019

4 Empirical Results

4.1 Based Results

Table 2 reports the baseline regression results. Column (1) and (2) report the estimates results before and after integrating the control variables. The coefficient estimates for $Treat_i \times Post_t$ are statistically significant at the 1% level in both cases, with values of -0.147 and -0.163, respectively. This indicates that the enforcement of the NEPL has resulted in a 16.3% decrease in labor employment by heavily polluting enterprises, which goes against the government's employment goals. In addition, the coefficients of labor wage level (Lnwage) and enterprise profitability (Profit) demonstrate negativity, and the coefficients for enterprise size (Size), enterprise gearing (Lev), enterprise growth (Tobinq), asset profitability (Roa), sales expense ratio (Ser), and enterprise equity structure (Top1) are positive, all in line with expectations.

Further, we discuss the impact of the NEPL on labor structure. Specifically, the labor is divided into two groups based on their education level: "high-skilled labor" and "low-skilled labor". Then, we conduct regressions respectively. Column (3) reports the regression results of high-skilled labor, with a non-significant coefficient of -0.006. Column (4) reports the regression results of low-skilled labor, with a significant coefficient of -0.045 at 5% level. It is evident that there is a significant decrease in the employment of labor in heavily polluting enterprises following the NEPL. The effect is more pronounced for labor categorized as low-skilled labor, but not significant for those categorized as high-skilled labor.

Table 2: Baseline estimated effects of the NEPL on enterprise employment

	(1) Tlabor	(2) Tlabor	(3) Hlabor	(4) Llabor
Treat_Post	-0.147***	-0.163***	-0.006	-0.045**
	(0.027)	(0.043)	(0.027)	(0.020)
Lnwage		-0.768***	-0.328***	-0.744***
		(0.040)	(0.040)	(0.030)
Size		0.852***	0.762***	0.680***
		(0.010)	(0.025)	(0.021)
Lev		0.412***	0.098	0.355***
		(0.075)	(0.069)	(0.061)
Profit		-1.003***	-0.131**	-0.239***
		(0.313)	(0.060)	(0.067)
Tobinq		0.039***	0.031***	0.023***
		(0.012)	(0.008)	(0.005)
Roa		3.517***	0.767***	0.834***
		(0.649)	(0.210)	(0.174)
Ser		1.224***	1.528***	0.574***
		(0.141)	(0.234)	(0.185)
Top1		0.004***	0.004**	0.000
		(0.001)	(0.002)	(0.001)
Constant	7.813***	-2.592***	-7.414***	0.906
	(0.009)	(0.476)	(0.705)	(0.593)
Enterprise fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	12922	12922	12007	12727
R-squared	0.013	0.755	0.299	0.509

Note: ***, ** and * indicate significant levels at 1%, 5%, and 10% respectively, robust standard errors are clustered at the enterprise level and reported in parentheses.

4.2 Robust Test

4.2.1 Parallel Trend Test

One of the key assumptions for using the difference-in-differences (DID) method is that the changes in the control and treatment group follow parallel trends. To test this assumption, we have augmented Equation (1) based on Liu et al., (2021), we modified Equation (1) by including the interaction term between the relative year dummy variable ($Year_{2015+k}$) and the group dummy variable ($Treat$) to test the parallel trend. This approach enabled us to construct a model with the following structure:

$$Labor_{it} = a + \alpha_k \sum_{k=-4\ (k\neq-1)}^{4} Treat\_Year_{2015+k} + \rho X_{it} + \gamma_t + \mu_i + \varepsilon_{it} (2)$$

where $Year_{2015+k}$ are year dummy variables. If it is the current year, the year dummy variable takes the value of 1; otherwise, it takes the value of 0. Figure 3 presents coefficients of $Treat\_Year_{2015+k}$ and its 95% confidence intervals from 2011 to 2019. Before the NEPL, the coefficients of $Treat\_Year$ interactions do not significantly differ from 0, indicating that heavily polluting and non-heavily polluting enterprises have similar trends of total labor employment. After the NEPL, the coefficients of $Treat\_Year$ interactions are significantly less than 0, which indicates a decrease in total labor employment in heavily polluting enterprises.

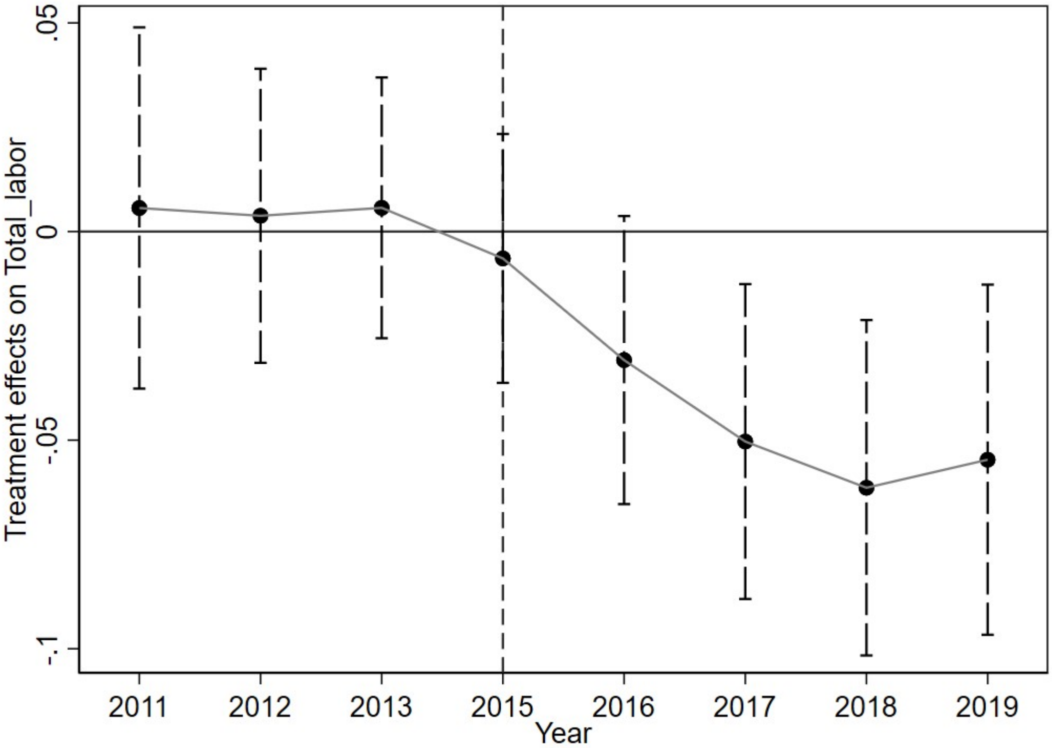

Figure 2 Treat_Post interaction coefficients for total labor employment from 2011 to 2019

Notes: Figure presents coefficients and 95% confidence intervals on $Treat\_Year$ interactions from the regression of ln(total labor employment) on $Treat\_Year$ interactions, enterprise fixed effects and year fixed effects.

4.2.2 No Anticipation Effect

Another key assumption for using the difference-in-differences (DID) method is no anticipatory effect, which means that the treatment group ought not have advance knowledge of reactions before the NEPL. To test this assumption, we follow the approach of Beck (2010)[xix] by inserting an interaction term between the year prior to the implementation of the policy (2014) and the group dummy variable ($Treat$) in Equation 1 to test this assumption. If the coefficient of DID_pre1 is not significant, it would confirm the absence of the anticipatory effect. Then, retaining the samples from the years before the policy was implemented (2012-2014) and constructed fictional policy implementation years (Policy_2014, Policy_2013, Policy_2012), we re-estimated the regressions. According to Table 3, the estimated coefficient of DID_pre1 in column (1) is -0.018 being not significant. Estimated coefficients of DID_2014, DID_2013 and DID_2012, presented in columns (1) ~ (3) are -0.014, -0.006 and 0.005 respectively. However, these coefficients are insignificant, which indicates the absence of anticipatory effects. Therefore, it is safe to conclude that heavily polluting enterprises didn't anticipate the NEPL and reduce labor employment. As such, our empirical analysis supports the assumption of no anticipatory effects.

Table 3 Anticipatory Effects Test Results

	(1)	(2)	(3)	(4)
Treat_Post	-0.116***			
	(0.022)			
DID_pre1	-0.018			
	(0.012)			
DID_2014		-0.014		
		(0.011)		
DID_2013			0.006	
			(0.007)	
DID_2012				0.005
				(0.007)
Lnwage	-0.724***	-0.682***	-0.682***	-0.682***
	(0.030)	(0.024)	(0.024)	(0.024)
Size	0.611***	0.701***	0.701***	0.701***
	(0.040)	(0.018)	(0.018)	(0.018)
Lev	0.378***	0.286***	0.286***	0.286***
	(0.076)	(0.050)	(0.050)	(0.050)
Profit	-0.112	-0.205***	-0.205***	-0.205***
	(0.070)	(0.068)	(0.068)	(0.068)
Tobinq	0.033***	0.030***	0.030***	0.030***
	(0.007)	(0.004)	(0.004)	(0.004)
Roa	0.622***	0.639***	0.639***	0.639***
	(0.198)	(0.161)	(0.161)	(0.161)
Ser	0.538*	0.652***	0.652***	0.652***
	(0.304)	(0.152)	(0.152)	(0.152)
Top1	-0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Constant	2.416**	7.819***	-0.007	-0.150
	(0.956)	(0.011)	(0.491)	(0.479)
Enterprise fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	4528	12922	12922	12922
R-squared	0.989	0.934	0.975	0.678

Note: ***, ** and * indicate significant levels at 1%, 5%, and 10% respectively, robust standard errors are clustered at the enterprise level and reported in parentheses.

4.2.3 Impact of Other Policy Effects

It is necessary to consider the influence of other policy impacts. To begin with, we focused on the listing effect. Upon going public, businesses may experience growth and restructuring in their production processes, affecting workforce employment levels. Specifically, we retain the sample of enterprises which became publicly traded before 2011 and 2015, and re-estimate the regression. The results are presented in columns (1) and (2) of Table 4. The results indicate that the estimated coefficient of $Treat_i \times Post_t$ remains statistically significant, indicating that the NEPL reduces labor employment in enterprises.

Next, we examined the effects of the "Address Overcapacity" policy. It is worth noting that there is a considerable overlap between the industries and policy timeline that were influenced by the "Address Overcapacity," which has been in place since 2016. Based on "The Guiding Opinions on Addressing the Issue of Severe Excess Capacity" released by the State Council in 2013, we identified and separated five industries, namely steel, cement, electrolytic aluminum, flat glass, and shipbuilding, as industries experiencing excess capacity. Subsequently, we re-evaluated these industries independent of the entire sample, with the results presented in column (3) of Table 4. The estimated coefficient of $Treat_i\_Post_t$ is -0.035 and statistically significant at the 5% level, which indicates that after the NEPL, the employment of enterprises was reduced by 3.5%. Thus, the results are still valid when considering the isolated impact of the "Address Overcapacity" policy.

Table 4 Robust Test Result: Other policy effects

	(1)	(2)	(3)
Treat_Post	-0.042***	-0.036**	-0.035**
	(0.016)	(0.017)	(0.016)
Lnwage	-0.683***	-0.691***	-0.696***
	(0.024)	(0.026)	(0.024)
Size	0.703***	0.707***	0.696***
	(0.019)	(0.020)	(0.019)
Lev	0.299***	0.259***	0.322***
	(0.052)	(0.057)	(0.050)
Profit	-0.195***	-0.177***	-0.202***
	(0.064)	(0.057)	(0.067)
Roa	0.031***	0.033***	0.027***
	(0.005)	(0.005)	(0.004)
Tobinq	0.588***	0.537***	0.639***
	(0.159)	(0.154)	(0.166)
Top1	0.625***	0.559***	0.671***
	(0.161)	(0.175)	(0.156)
Ser	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)
Constant	-0.063	-0.003	0.222
	(0.505)	(0.543)	(0.519)
Enterprise fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	11194	9427	12194
R-squared	0.971	0.970	0.973

Note: ***, ** and * indicate significant levels at 1%, 5%, and 10% respectively, robust standard errors are clustered at the enterprise level and reported in parentheses.

4.3 The Heterogeneity Analysis

4.3.1 Enterprise Ownership

The impact of the NEPL on labor hiring may differ depending on the ownership of enterprises. In order to investigate this, this paper categorizes the sample into two categories, state-owned enterprises and non-state-owned enterprises, and conducts sub-sample regression. The results are presented in columns (1) and (2) of Table 5. The estimated coefficient of $Treat_i\_Post_t$ is -0.032, but this result is non-significant in column (1). The estimated coefficient of $Treat_i\_Post_t$ is -0.047 in non-state-owned enterprises, which is significant at the 5% level in column (2). This indicates that state-owned enterprises did not reduce their labor employment after the NEPL, while non-state-owned enterprises, conversely, carried out more extensive layoffs. The possible reasons for this are as follows: firstly, this may be attributed to the resource advantage of state-owned enterprises. Compared to non-state-owned enterprises, state-owned enterprises have advantages when it comes to acquiring resources. They have easier access to bank credit and policy support, which allows them to make relatively minor adjustments in response to external changes in the environment. This helps them avoid extensive layoffs. Secondly, there are higher entry barriers to being employed by state-owned businesses than privately owned businesses, resulting in labor with higher qualifications and skills. In contrast, the labor in non-state-owned enterprises is more likely to consist of individuals with lower education and skills. As a result, high-skilled labor in state-owned enterprises possesses advanced skill levels and are less affected by the NEPL, whereas low-skilled labor in non-state-owned enterprises may not meet the developmental needs of the enterprises and therefore experience greater impacts from the new law consequently.

Furthermore, column (3) and (4) report the regression results for the estimated coefficient of $Treat_i\_Post_t$ of high-skilled labor. The estimated coefficient of $Treat_i\_Post_t$ is 0.024 in state-owned enterprises, being non-significant in column (3). The estimated coefficient of $Treat_i\_Post_t$ is -0.026 in non-state-owned enterprises, being non-significant in column (4). Column (5) and (6) report the regression results of the estimated coefficient of $Treat_i\_Post_t$ of low-skilled labor. The estimated coefficient of $Treat_i\_Post_t$ is -0.034 in state-owned enterprises, and is not statistically significant. While in non-state-owned enterprises, the estimated coefficient of $Treat_i\_Post_t$ is -0.042 at the 10% significance level. This indicates that the NEPL did not result in any reduction of employment for highly-skilled workers by either state-owned or non-state-owned enterprises, but non-state-owned enterprises did see a decrease in employment for low-skilled workers. This may be due to the reason that state-owned enterprises have a social responsibility to fulfill, which includes providing social employment. Consequently, layoffs in state-owned enterprises tend to be more stringent than in non-state-owned enterprises and the employment of low-skilled labor is guaranteed.

Table 5 Heterogeneity analysis: Enterprise ownership

	(1)	(2)	(3)	(4)	(5)	(6)
	Tlabor	Tlabor	Hlabor	Hlabor	Llabor	Llabor
	SOEs	Non-SOEs	SOEs	Non-SOEs	SOEs	Non-SOEs
Treat_Post	-0.032	-0.047**	0.024	-0.026	-0.034	-0.042*
	(0.023)	(0.021)	(0.045)	(0.034)	(0.031)	(0.024)
Lnwage	-0.679***	-0.699***	-0.372***	-0.316***	-0.764***	-0.750***
	(0.036)	(0.030)	(0.060)	(0.051)	(0.053)	(0.036)
Size	0.739***	0.670***	0.738***	0.772***	0.707***	0.657***
	(0.033)	(0.022)	(0.040)	(0.030)	(0.037)	(0.025)
Lev	-0.002	0.333***	0.085	0.080	0.157	0.342***
	(0.089)	(0.058)	(0.127)	(0.085)	(0.115)	(0.070)
Profit	-0.124***	-0.463***	-0.078*	-0.308***	-0.137***	-0.517***
	(0.032)	(0.120)	(0.044)	(0.093)	(0.033)	(0.138)
Tobinq	0.021***	0.024***	0.024	0.037***	0.009	0.017***

	(0.007)	(0.005)	(0.017)	(0.009)	(0.010)	(0.006)
Roa	0.416***	1.342***	0.763***	1.211***	0.648***	1.520***
	(0.128)	(0.252)	(0.270)	(0.310)	(0.165)	(0.295)
Ser	0.447	0.785***	0.965**	1.746***	0.497	0.686***
	(0.271)	(0.169)	(0.427)	(0.276)	(0.371)	(0.192)
Top1	0.003*	0.001	0.009***	0.000	0.003	0.001
	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)	(0.001)
Constant	-0.655	0.762	-6.282***	-7.803***	0.695	1.389**
	(0.862)	(0.587)	(1.119)	(0.906)	(1.066)	(0.695)
Enterprise fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4233	8689	3944	8233	4213	8670
R-squared	0.978	0.969	0.926	0.928	0.960	0.962

Note: ***, ** and * indicate significant levels at 1%, 5%, and 10% respectively, robust standard errors are clustered at the enterprise level and reported in parentheses.

4.3.2 New Enterprises and Old Enterprises

Differences in the difficulty of production adjustments between old and new enterprises may lead to differences in the impact of the NEPL on labor employment in enterprises. In this paper, we categorize the sample enterprises into two distinct subgroups - old and new - using the median age of the sample, and study them by regression separately. The results are presented in columns (1) and (2) of Table 6. The estimated coefficient of $Treat_i\_Post_t$ is -0.015 in old enterprises, being non-significant in column (1). Conversely, the estimated coefficient of $Treat_i\_Post_t$ is -0.057 in new enterprises, being significant at 5% level in column (2). The results indicate that the NEPL had a noteworthy impact in decreasing the employment levels of new enterprises during their growth phase. It is important to note, however, that there was no significant effect found on the employment scale of mature established enterprises. This discrepancy is primarily attributed to the fact that old enterprises in their stable phase are more resistant to shocks, but their production adjustment ability is relatively constrained. Thus, the impact of the NEPL on old enterprises is comparatively minor. Conversely, new enterprises are more sensitive in responding to external environmental changes in their production and operational decisions. Therefore, they are more adept at adapting to the NEPL in a swifter manner.

Furthermore, we focus on labor with varying skills. Columns (3) and (4) report the regression results of high-skilled labor in old and new enterprises. The estimated coefficient of $Treat_i\_Post_t$ is -0.020 and is not statistically significant in column (3). The estimated coefficient of $Treat_i\_Post_t$ is -0.022 and non-significant in column (4). Columns (5) and (6) report the regression results of low-skilled labor in enterprises. The estimated coefficient of $Treat_i \times Post_t$ is -0.009, which is not statistically significant in column (5). The estimated coefficient of $Treat_i\_Post_t$ is -0.063 and significant at 5% level in column (6). This indicates that the NEPL reduces the employment of newly-formed companies during their development stage, predominantly through the reduction of low-skilled workers. This is because highly-skilled labor is a vital resource for enterprises that are undergoing production transformations as a response to environmental regulations. Furthermore, both new and old enterprises do not decrease their employment of highly-skilled workers due to external impact. In contrast, low-skilled labor has less advanced skills and is more vulnerable to being replaced by new technologies and equipment. Therefore, under stricter regulations, new enterprises choose to decrease their employment of low-skilled labor in response to these pressures.

Table 6 Heterogeneity analysis: New and old enterprises

	(1) Tlabor Old	(2) Tlabor New	(3) Hlabor Old	(4) Hlabor New	(5) Llabor Old	(6) Llabor New
Treat_Post	-0.015	-0.057**	-0.020	-0.022	-0.009	-0.063**
	(0.024)	(0.025)	(0.038)	(0.041)	(0.029)	(0.030)
Lnwage	-0.633***	-0.724***	-0.309***	-0.299***	-0.746***	-0.755***
	(0.037)	(0.028)	(0.052)	(0.050)	(0.048)	(0.037)
Size	0.647***	0.688***	0.731***	0.748***	0.651***	0.665***
	(0.027)	(0.027)	(0.034)	(0.040)	(0.031)	(0.030)
Lev	0.213***	0.316***	0.112	0.030	0.304***	0.377***
	(0.070)	(0.068)	(0.091)	(0.115)	(0.089)	(0.080)
Profit	-0.124***	-0.494***	-0.111*	-0.166	-0.163***	-0.568***
	(0.043)	(0.130)	(0.059)	(0.115)	(0.047)	(0.151)
Tobinq	0.019***	0.026***	0.028***	0.039***	0.009	0.022***
	(0.005)	(0.007)	(0.009)	(0.011)	(0.006)	(0.008)
Roa	0.276**	1.761***	0.725***	0.875*	0.453***	1.989***
	(0.132)	(0.295)	(0.209)	(0.458)	(0.159)	(0.343)
Ser	0.481**	1.010***	1.157***	2.303***	0.371	0.769**
	(0.210)	(0.281)	(0.332)	(0.405)	(0.256)	(0.332)
Top1	0.002	0.001	0.004*	0.001	0.002	-0.000
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.696	0.628	-6.872***	-7.462***	1.600	1.273
Enterprise fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
	(0.784)	(0.674)	(0.948)	(1.068)	(0.980)	(0.800)
Observations	7277	5645	6871	5306	7265	5618
R-squared	0.982	0.980	0.960	0.934	0.972	0.972

Note: ***, ** and * indicate significant levels at 1%, 5%, and 10% respectively, robust standard errors are clustered at the enterprise level and reported in parentheses.

4.3.3 External Enforcement Environment

Effective implementation of the NEPL also relies on the importance that local governments place on environmental enforcement. We divided the sample enterprises into areas with high and low intensity of environmental enforcement based on the median number of environmental legislations and regulations implemented in each province before the NEPL's initiation in 2015. Columns (1) and (2) of Table 7 report the regression results of total labor in regions with high and low intensity of environmental enforcement. In regions with high intensity of environmental enforcement, the estimated coefficient of $Treat_i\_Post_t$ is -0.043 and is significant at 5% level. The estimated coefficient of $Treat_i\_Post_t$ is -0.037 in regions with low intensity of environmental enforcement, and is non-significant. This indicates that the

NEPL affects employment differently depending on the degree of environmental enforcement across regions. Specifically, the NEPL significantly reduced the scale of labor employment in regions with higher intensity of environmental enforcement, whereas it did not have a significant effect on labor employment in regions with less strict enforcement. This is because in regions with stricter environmental enforcement, the NEPL imposes more pronounced cost pressures on enterprises. Consequently, enterprises are prompted to make more substantial adjustments, thereby reducing labor employment.

Furthermore, we examine various forms of labor. Columns (3) and (4) of Table 7 report the regression results of high-skilled labor in regions with high and low intensity of environmental enforcement level. The estimated coefficient of $Treat_i\_Post_t$ is -0.035 and non-significant in column (3). Similarly, the estimated coefficient of $Treat_i\_Post_t$ is -0.036 and non-significant in column (4). Columns (5) and (6) of Table 7 report the regression results of low-skilled labor in regions with high and low intensity of environmental enforcement. The estimated coefficient of $Treat_i\_Post_t$ is -0.059 and significant at 5% level in column (5). The estimated coefficient of $Treat_i\_Post_t$ is -0.022 and non-significant in column (6). This indicates that the NEPL will not reduce the scale of the employment of high-skilled labor in regions with either high or low environmental enforcement, whereas it will significantly lower the employment of low-skilled labor.

Table 7 Heterogeneity analysis: External enforcement environment

	(1)	(2)	(3)	(4)	(5)	(6)
	Tlabor	Tlabor	Hlabor	Llabor	Hlabor	Llabor
	High	Low	High	Low	High	Low
Treat_Post	-0.043**	-0.037	-0.035	0.036	-0.059**	-0.022
	(0.021)	(0.023)	(0.039)	(0.036)	(0.027)	(0.028)
Lnwage	-0.713***	-0.643***	-0.321***	-0.343***	-0.758***	-0.719***
	(0.031)	(0.035)	(0.058)	(0.051)	(0.042)	(0.043)
Size	0.675***	0.729***	0.798***	0.710***	0.642***	0.713***
	(0.023)	(0.029)	(0.035)	(0.033)	(0.028)	(0.032)
Lev1	0.345***	0.209***	0.042	0.174*	0.433***	0.264***
	(0.066)	(0.074)	(0.100)	(0.094)	(0.086)	(0.084)
Profit	-0.608***	-0.136***	-0.314	-0.081*	-0.393***	-0.194***
	(0.159)	(0.041)	(0.206)	(0.045)	(0.152)	(0.061)
Tobinq	0.029***	0.026***	0.037***	0.024**	0.024***	0.019**
	(0.006)	(0.006)	(0.010)	(0.012)	(0.007)	(0.008)
Roa	1.500***	0.359**	1.202**	0.581**	1.212***	0.610***
	(0.311)	(0.149)	(0.466)	(0.246)	(0.327)	(0.201)
Ser	0.917***	0.479**	1.968***	1.145***	0.863***	0.407
	(0.239)	(0.204)	(0.444)	(0.242)	(0.277)	(0.261)
Top1	0.001	0.001	0.003	0.004**	0.001	0.000
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.879	-1.040	-8.337***	-6.041***	1.875**	-0.102

	(0.608)	(0.814)	(1.015)	(0.937)	(0.773)	(0.934)
Enterprise fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7194	5728	6761	5416	7190	5693
R-squared	0.974	0.976	0.931	0.939	0.961	0.965

Note: ***, ** and * indicate significant levels at 1%, 5%, and 10% respectively, robust standard errors are clustered at the enterprise level and reported in parentheses.

5 Conclusion and Policy Implications

The balance between environmental protection and employment promotion is one of the focal issues when formulating environmental policies. However, studies have not reached a consistent conclusion regarding the relationship between the two. In recent years, China has developed green transformation policies to achieve economic growth with environmentally friendly aims, which has led to concurrent issues of unemployment. This study offers insight into maintaining a balance between environmental regulation and employment promotion from the perspective of developing countries. Specifically, utilizing the NEPL as a quasi-natural experiment, this research aims to determine the effects of stronger environmental enforcement on the labor demand of heavily polluting enterprises. The results are as follows: Firstly, the NEPL reduces the labor demand of heavily polluting enterprises by approximately 16.3%, and this conclusion still holds after a series of robustness tests. Secondly, from the perspective of labor of different skill levels, the decreasing effect of the NEPL on labor demand of heavily polluting enterprises is mostly attributed to the decrease of low-skilled labor. At last heterogeneity analysis shows that the negative effect of environment regulation on labor demand is more pronounced in non-state-owned enterprises, new enterprises and provinces with low environmental enforcement intensity. This is mainly attributed to the decrease of low-skilled labor. The policy implementations based on the findings of this study are as follows:

First, when implementing the environmental enforcement, it is essential to provide supportive measures to stabilize employment rate. In particular, environmental enforcement can be integrated with employment and investment policies, encouraging non-employees to engage in eco-culture and ecotourism, among other industries. This ensures a positive and sustainable future for both the environment and the employment can be ensured.

Additionally, it is necessary to offer employment support measures for low-skilled workers who are more affected by environmental regulatory policies is necessary. The government should continue to increase investments to improve employment standards. In particular, employee training programs should be substantially supported to assist with skill development and job changes. Furthermore, it is necessary to enhance the public employment service system, increase the flexibility of labor market information flow, reduce barriers to labor mobility, and promote employment opportunities.

Lastly, it is crucial for the government to consider the varying impact that environmental policies have on employment across different enterprise types and implement tailored support measures. To mitigate social costs and unemployment risks, the government should provide subsidies for non-state-owned enterprises and aid new enterprise transformation. Furthermore, the government should provide differentiated, precise assistance to enhance resource efficiency, encourage environmentally-friendly methods, and foster sustainable growth.

Reference

[i] Walker, W. R. (2011). Environmental regulation and labor reallocation: Evidence from the Clean Air Act. American Economic Review, 101(3), 442-447.

[ii] Sheriff, G., Ferris, A. E., & Shadbegian, R. J. (2019). How did air quality standards affect employment at US power plants? The importance of timing, geography, and stringency. Journal of the Association of Environmental and Resource Economists, 6(1), 111-149.

[iii] Morgenstern, R. D., Pizer, W. A., & Shih, J. S. (2002). Jobs versus the environment: an industry-level perspective. Journal of environmental economics and management, 43(3), 412-436.

[iv] Ren, S., Liu, D., Li, B., Wang, Y., & Chen, X. (2020). Does emissions trading affect labor demand? Evidence from the mining and manufacturing industries in China. Journal of environmental management, 254, 109789.

[v] Yip, C. M. (2018). On the labor market consequences of environmental taxes. Journal of Environmental Economics and Management, 89, 136-152.

[vi] Greenstone, M. (2002). The impacts of environmental regulations on industrial activity: Evidence from the 1970 and 1977 clean air act amendments and the census of manufactures. Journal of political economy, 110(6), 1175-1219.

[vii] Liu, M., Shadbegian, R., & Zhang, B. (2017). Does environmental regulation affect labor demand in China? Evidence from the textile printing and dyeing industry. Journal of Environmental Economics and Management, 86, 277-294.

[viii] Liu, M., Tan, R., & Zhang, B. (2021). The costs of "blue sky": Environmental regulation, technology upgrading, and labor demand in China. Journal of Development Economics, 150, 102610.

[ix] Berman, E., & Bui, L. T. (2001). Environmental regulation and labor demand: Evidence from the south coast air basin. Journal of Public Economics, 79(2), 265-295.

[x] Yamazaki, A. (2017). Jobs and climate policy: Evidence from British Columbia's revenue-neutral carbon tax. Journal of Environmental Economics and Management, 83, 197-216.

[xi] Hafstead, M. A., & Williams III, R. C. (2018). Unemployment and environmental regulation in general equilibrium. Journal of Public Economics, 160, 50-65.

[xii] Zhong, S., Xiong, Y., & Xiang, G. (2021). Environmental regulation benefits for whom? Heterogeneous effects of the intensity of the environmental regulation on employment in China. Journal of Environmental Management, 281, 111877.

[xiii] Greenstone, M. (2002). The impacts of environmental regulations on industrial activity: Evidence from the 1970 and 1977 clean air act amendments and the census of manufactures. Journal of political economy, 110(6), 1175-1219.

[xiv] Wu, H., Guo, H., Zhang, B., & Bu, M. (2017). Westward movement of new polluting firms in China: Pollution reduction mandates and location choice. *Journal of Comparative Economics*, *45*(1), 119-138.

[xv] Chichilnisky, G. (2017). North–South trade and the global environment. In *International Trade and the Environment* (pp. 261-284). Routledge.

[xvi] Levinson, A., & Taylor, M. S. (2008). Unmasking the pollution haven effect. *International economic review*, *49*(1), 223-254.

[xvii] Wen, H., Zhong, Q., & Lee, C. C. (2022). Digitalization, competition strategy and corporate innovation: Evidence from Chinese manufacturing listed companies. *International Review of Financial Analysis*, *82*, 102166.

[xviii] Tang, H. L., Liu, J. M., & Wu, J. G. (2020). The impact of command-and-control environmental regulation on enterprise total factor productivity: A quasi-natural experiment based on China's "Two Control Zone" policy. Journal of Cleaner Production, 254, 120011.

[xix] Beck, T., Levine, R., & Levkov, A. (2010). Big bad banks? The winners and losers from bank deregulation in the United States. *The journal of finance*, *65*(5), 1637-1667.

Acknowledgement

1 Topic Origin

I was born in Guizhou, but I am currently studying in Shenzhen. These two places have left me with distinctly different impressions. Guizhou boasts breathtaking natural landscapes, but it has also faced issues of environmental pollution and excessive resource exploitation. In stark contrast, Shenzhen is a city teeming with vitality and opportunities, steadily rising as a global hub of innovation and technology. However, both these places share a common concern: the environment and employment.

In its early years, Shenzhen primarily served as an export-driven city with a focus on heavy-polluting industries like leather and electronics manufacturing. However, through successful economic transformation, it has evolved into an innovation-driven city. Today, Shenzhen is characterized by a diverse and highly educated labor, largely composed of immigrants. On the other hand, Guizhou, located in the central-western region of China, has faced developmental challenges. It is now actively absorbing polluting manufacturing industries transferred from the eastern regions, resulting in relatively higher pollution levels. The labor in Guizhou predominantly consists of local residents with lower levels of human capital.

When I am studying in Shenzhen, I participated in several environmental volunteer activities organized by the school, advocating for pollution reduction. However, after several visits to Guizhou, I noticed that Guizhou doesn't seem to prioritize environmental protection. This contrasted with Shenzhen's environmental governance philosophy, which left me perplexed. While reading news and articles on unemployment issues, I began to realize that environmental regulation and employment constitute a complex balance and environmental regulation is not free but with serious cost. I wanted to delve deeper into this issue, and understand the true relationship between environmental policies and employment, starting from the most representative environmental regulation in China, the NEPL. This contemplative journey sparked the inspiration for me to write this paper. I hope that by researching the effects of the NEPL on enterprise employment, I can provide greater insights into this seemingly contradictory relationship and offer valuable recommendations for future policy-making and economic development. This paper will be my contribution to both my hometown and my second home, Shenzhen, as well as to the global discourse on the interplay between the environment and employment.

2 Research Background

In recent years, China has faced a dual challenge which is maintaining stable employment for its vast population while combating severe environmental issues. This delicate balance has been at the forefront of the country's policy agenda. The context for my research into the impact of the NEPL on enterprise employment is deeply rooted in this dynamic policy landscape.

“Keep employment” has been widely discussed in recent years in the context of China's economic downturn. With a population of over 1.4 billion, China faces immense pressure to provide employment for its citizens. This imperative has guided the government's approach to economic development and policymaking. Stable employment is not only an economic necessity but also a social and political imperative to maintain social stability and prevent unrest.

However, against the backdrop of “Keep Employment,” China has been grappling with the detrimental effects of rapid industrialization and urbanization. These processes have resulted in alarming levels of pollution, resource depletion, and ecological degradation. Recognizing the urgency of these environmental challenges, China has embarked on a mission to transform its development model from “growth at all costs” to one that prioritizes environmental sustainability.

In response to this environmental crisis, China has gradually tightened its environmental regulations. These regulations encompass a range of areas, from air and water quality to industrial emissions and land use. They have culminated in the implementation of the NEPL in 2015. This comprehensive legislation marked a significant shift towards more rigorous environmental protection and a departure from earlier, more lenient regulations.

The enactment of the NEPL signaled China's commitment to environmental preservation and sustainable development. This commitment raised an important question: how would this intensified environmental regulation impact employment in the country, particularly in industries that had previously been major contributors to economic growth?

As China strives to find a balance between environmental sustainability and stable employment, my research into the effects of the NEPL on enterprise employment seeks to shed light on this intricate relationship. It aims to provide valuable insights into how

China can navigate the uncharted waters of environmental regulation while ensuring that "Keep Employment" remains a top priority. My study not only examines the policy's outcomes but also contributes to the ongoing discourse on achieving harmonious coexistence between economic growth, environmental protection, and social well-being in one of the world's most populous nations.

3 Research Process

The journey of conducting this research on the impact of the NEPL on enterprise employment in China has been a fascinating and educational one. It began with a personal interest in environmental issues, which was nurtured over time by reading numerous papers on the impact of environmental regulations on employment. My academic development took a crucial step forward under the free guidance of teacher Wang Yijun at Shenzhen Middle School. Wang not only imparted valuable knowledge in econometrics but also provided hands-on training in using statistical software Stata. These skills were indispensable for the empirical research that followed. The next phase of the research involved data acquisition and processing. I, along with teacher Wang Yijun, accessed relevant databases from Wanderlust (Wind) and Guotai Junan. The empirical research phase was both challenging and rewarding. Armed with the knowledge acquired and the data in hand, I conducted extensive analysis to understand the nuanced relationship between environmental regulations and enterprise employment. This stage allowed me to apply the theories and techniques I had learned under Wang's mentorship.

Completing this research would not have been possible without the invaluable support and guidance I received along the way. I extend my heartfelt gratitude to teacher Wang Yijun for being an exceptional mentor. Her unwavering dedication to my academic growth, tireless efforts in answering my questions, and willingness to sacrifice her own time without any return, even during rest periods, were instrumental in enabling me to successfully complete this thesis.

I would also like to express my appreciation to the other economics teachers at Shenzhen Middle School who, in times of confusion, readily clarified my doubts and provided valuable insights voluntarily.

Lastly, I am deeply grateful to my family for their constant encouragement and unwavering belief in my abilities. Their support has been a source of strength throughout this research journey.

This paper is not just a product of my individual efforts but a culmination of the collective support and guidance I received. Thank you all for making this research a reality.