Research Article

The Impact of Green Credit Guidelines on the Technological Innovation of Heavily Polluting Enterprises: A Quasi-Natural Experiment from China

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This study investigates the impact of China’s Green Credit Guidelines on the technological innovations of heavily polluting enterprises. This study uses data obtained from the CSMAR database (2007–2018) and China Marketization Index Report by Province 2018 and uses the Green Credit Guidelines as a quasi-natural experiment. The sample was divided into an experimental group and a control group; the experimental group disclosed environmental and sustainable development information, while the control group did not. This study’s primary finding is that the Green Credit Guidelines can improve the level of technological innovation of heavily polluting enterprises and have a greater impact in areas with high levels of marketization, indicating that the Green Credit Guidelines have a positive effect on the technological innovation of heavily polluting enterprises. This provides China with an experience constructing relevant policies and regulations and provides empirical evidence regarding the technological innovations of heavily polluting enterprises from the perspective of factor market distortions and the Porter hypothesis.

1. Introduction

Increasingly more ecological problems have emerged with the rapid development of urbanization; consequently, environmental problems have become a topic of common concern in both the practical and academic communities. The Chinese government also attaches a great importance to ecological and environmental issues; to strengthen environmental and resource protection, the government has formulated more policies and regulations to restrict the behavior of market players. The construction of an ecological civilization has become a strategic issue at the national level and a core task for governments and people [1, 2]. There is currently an urgent need to solve environmental problems at the institutional level and achieve a win-win situation between the public and the country.

Green credit refers to the concept of using environmental leverage to guide environmental protection and achieve coordinated development of the economy, society, and environment through control and coordination of resources, the environment, and pollution. Its original purposes were to control the expansion and development of the “three high” enterprises, guide funds to environmentally friendly enterprises, optimize the credit structure, serve the real economy, and ultimately reduce environmental pollution. First of all, green credit can promote the optimization and upgrading of the industrial structure through preferential loans to environmental protection companies and fines for polluting companies [3], and it plays a vital role in improving investment efficiency [3, 4] and reducing the pollution [5]. And green credit regulates the flow of social capital to strengthen environmental governance and promote social green production, which plays an increasingly important role in promoting environment friendly enterprises and limiting polluting enterprises [6]. This marks the beginning of a war in China on energy conservation and emission reduction to promote development of an ecological economy and a green economy. In the context of rapid
economic development, the task of energy conservation and emission reduction is even more urgent, and the government's environmental protection requirements for enterprises are also more stringent. Inadequate control methods and efforts have increased credit risk. Therefore, on February 24, 2012, the CBRC issued the Green Credit Guidelines to effectively prevent risks that may be encountered during the development of green credit and to play a greater restrictive role. In the context of rapid economic development, the industrial production model of "polluting first and then treating" is no longer consistent with the main mode of pollution control. Enterprise technological innovation has become an effective strategy for pollution control during the production process [7].

In terms of research on technological innovation, some researchers studied the factors that affected China's energy consumption from 1981 to 1987 and found that technological progress was the main force behind energy conservation [8]. Also, some research studies studied the changes in China's energy intensity from 1987 to 1992, and the results showed that technological progress was the main factor in reducing energy consumption [9]. The key reason is that technological innovation can reduce energy consumption by upgrading and adjusting the industrial structure. To a certain extent, traditional product and process innovation can stimulate the production activities of companies in heavily polluting industries (pharmaceutical and steel), thereby improving their energy consumption [10]. Technological innovation has become one of the main means of saving energy, reducing emissions, and decreasing pollution [11, 12]; it has effectively reduced unit energy consumption and changed its structure, thereby reducing energy waste and significantly impacting the sustainable development of enterprises. Therefore, technological innovation has become an important driving force for the high-quality development of the regional economy, which is the key to improving the regional technological innovation performance and production efficiency [13].

However, China's current green industry level is still relatively low, and effective implementation of green credit depends not only on banks' financial incentives but also on enterprises' technical upgrades [1]. In particular, heavily polluting companies have suffered high social pressure, investment risks, environmental litigation risks, and reputational risks. At the same time, when financial development has an important impact on financial constraints, green credit has a crucial impact on corporate financing [14], especially for the financing costs and maturity of heavily polluting companies [15, 16]; this will also indirectly affect the innovation and development of enterprises [17], which has an important impact on the development of green economy [3]. So credit policies and financial constraints have important impacts on the technology investments of enterprises [18]. Will they strengthen technology innovation to reduce emissions, obtain funds, and continue to qualify for credit? By contrast, after qualifying for financing, will they only focus on their interests and abandon the pursuit of environmental benefits? Thus, the study of the green credit guidelines has an important impact on and significant policy implications for core element technology innovation in the research and development of heavily polluting enterprises. Based on the above research, this study takes heavily polluting companies listed on Shanghai and Shenzhen A share markets from 2007 to 2018 as the research sample and classifies them according to whether they disclose environmental and sustainable development information. Using a difference in the differences method, empirical tests are performed to examine the effect of the green credit guidelines on corporate technological innovation, with further analysis of the impact under different environmental regulations and levels of marketization.

The innovations and contributions of this study are mainly as follows. First, the difference in the differences method is used to analyze the quasi-natural experiment of the green credit guidelines and examine the impact of macro policies and regulations on the innovation of micro enterprises, thereby enriching the literature on macro policies and corporate innovation and opening new research perspectives. Second, there is very little literature on the impact of green credit and corporate technological innovation in the context of microcosmic enterprises; this study helps fill this gap in the technological innovation research. Third, while testing the role of policies and regulations, the study also tests the operating conditions of the market mechanism and provides suggestions for adjusting macro policies and market mechanisms to better serve the development of the real economy. The results can be used as a reference for the relevant regulatory and policy-making departments and contribute to the economy's sustainable development. Fourth, the results of this paper provide experience for the country to formulate relevant policies and regulations in different regions and provide empirical evidence for technological innovation of heavily polluting companies from the perspective of factor market distortion and Porter's hypothesis.

The remainder of this article is organized as follows. The second section reviews the theory and develops the hypotheses. The third section describes the research design, and the fourth section discusses the empirical analysis. The fifth section presents the concluding remarks.

2. Theory and Hypotheses

The literature includes many studies on green credit policies and technical innovation; some scholars believe there is a positive relationship between the two [19]. Green credit policy plays an important role in resource allocation [15], especially the unconventional monetary policy and credit policy will affect the investment and financing behavior of enterprises [18]. When China implemented the green credit policy, its aim was to achieve sustainable economic development and achieve the dual goal of saving energy and reducing emissions and optimizing and upgrading the industrial structure [19]. The policy plays a restrictive role for heavily polluting enterprises through credit constraints, which are stricter for high-pollution companies with a poor environmental performance [20, 21]. Because the availability of green credit loans is closely related to a company's R&D...
investment and technical achievements, to qualify for green credit financing, companies must make technological progress in reducing environmental pollution, provide environmental protection through technological progress, and reduce policy ambiguity and the impact of the lack of information on corporate credit. Therefore, under environmental and public pressure, more enterprises have begun to be motivated to become green. They are actively responding to the ecology and adopting a series of energy saving and consumption reduction measures to promote sustainable economic development [22]. Environmental management capabilities are positively related to company performance, and the stronger the environmental management, the more significant the positive returns [23]; these in turn make the company more enthusiastic about engaging in technological innovation. Therefore, the green credit policy plays an important role in guiding green resources and improving resource utilization efficiency [24]. A company’s lean production may generate more public benefit spillovers, thereby playing a role in improving environmental benefits [25]; thus, the positive circular effect is obvious. At the same time, a company is also affected by its social responsibility for the environment. From the perspective of the environment and resources, the higher a company’s environmental and social responsibility, the better its stock price performance [26] and the more positive the impact on obtaining credit rights. When financial development has an important impact on financial constraints, green credit also has a vital impact on corporate financing [14], especially for the financing costs and maturity of heavily polluting companies [15, 16], plays an important role in the innovation and development of enterprises [17], and contributes to the green development of the economy [3]. And financial development will alleviate the financing constraints of enterprises and affect their financing behavior [3, 4, 27]. Liu et al. [15] used the double difference (DID) model to conduct a quasi-natural experiment on the “Green Credit Guidelines” issued by China and found that after the introduction of the green credit policy, the proportion and maturity of the debt financing of Chinese companies with serious pollution will drop significantly. In addition, environmental regulations have an important impact on the production efficiency of technological innovation [28], and the impact of green credit on financing is stable and continuous [15, 24]. It is believed that heavily polluting enterprises will definitely increase their emphasis on environmental pollution to qualify for financing and thus increase their investment in technologies that are closely related to pollution discharge. The Porter hypothesis proposes that proper environmental regulation will speed up technological innovation, and the productivity improvements brought about by these innovations will offset the costs incurred to respond to environmental protection, ultimately increasing enterprise profitability.

However, promulgation of the Green Credit Guidelines policy is an important factor that affects creditors’ risk perception. Environmental risks affect bank lending behaviors [29]. Financing is essential for companies to conduct production and operating activities, and this is closely related to technical decisions and the environmental performance [30]. Credit policies and financial constraints have a significant impact on corporate investment; more liquid assets will promote the company’s R&D investment, and more long-term debt and commercial bank credit may reduce its research and development investment [18]. Moreover, the debt financing capacity of heavily polluting companies has decreased significantly. Liu et al. [24] also indicate that the goal guidance in the green credit policy has greatly reduced the total financing of energy-intensive industries and had a significant inhibitory effect on investment [24]. Thus, the Green Credit Guidelines may limit financing for heavily polluting enterprises, which is not conducive to developing enterprise technological innovation. That is to say, although environmental laws and regulations can promote technological innovation and are one of the important means to achieve green transformation, due to the high cost of energy conservation and emission reduction, it is ultimately not conducive to the development of green innovation [31].

Signaling theory suggests that a company’s green credit financing announcement will affect the company by indicating that the company has obtained a loan, which will increase stock price expectations in the market [26]. At this time, on the one hand, the company has a fluke mentality, thinking that it is operating well, and it will not strengthen its technological innovation, leading to loan constraints in a later period. An improvement in technological innovation forms a positive cycle. However, the impact of the green credit policy on heavily polluting and energy-consuming enterprises is still unclear [20]. Figure 1 shows the impact mechanism of the green credit guidelines on technological innovation.

What is the mechanism through which it influences corporate technological innovation? This leads to competitive hypothesis 1:

H1a: green credit guidelines have a positive effect on the technological innovation of heavily polluting enterprises.

H1b: green credit guidelines have a negative effect on the technological innovation of heavily polluting enterprises.

The distortion in the factor market will cause the factor’s market price to deviate from its opportunity cost, leading to the problem of insufficient efficiency in the allocation of market resources. Prior to China’s reform and opening up, to support the development of the heavy industry, the low prices resulting from various factors in the planned economy created significant price distortions in the Chinese market. After the reform and opening up, the heavy industry’s development strategy has changed, and local governments have become champions of their local economy’s GDP. Under this driving mechanism, Chinese officials have been forced to intervene and control land, capital, labor, and other factors to control the market [20], which has an important impact on the level of resource allocation in the entire market. There is a close relationship between regional economic innovation and regional economic development.
so the invisible hand of the marketization level in different regions has an important effect on market innovation. As technological innovation is an important driving force for the high-quality development of the regional economy, improving factor endowment conditions and distribution efficiency is the key to regional technological innovation [13].

The factor endowment hypothesis suggests that when companies can benefit from factor inputs, that is, when the cost of factor inputs is lower than their benefit, they will comply with the corresponding environmental regulations. When the cost of obtaining green credit through technological innovation is lower than the cost of obtaining green credit without technological innovation, they will follow the rules to strengthen technical innovation; otherwise, they will abandon regulation. However, if the factor market is distorted, it will seriously inhibit improvement in China’s green economy production efficiency, which is not conducive to overall economic development [32]. The Porter hypothesis suggests that proper environmental regulation will accelerate technological innovation, and the productivity improvements brought about by these innovations will offset the costs of responding to environmental protection, ultimately increasing the profitability of enterprises in the market. Therefore, it is believed that the stronger the environmental regulations, the higher the technological innovation of enterprises. However, China has always had disproportionate development between the east, central, and west. There are great differences in the level of economic development and marketization among regions [33]. Environmental supervision has a significantly positive impact on the efficiency of regional capital allocation [34]. Omri [35] found that technological innovation can contribute to the three pillars of sustainable development at the same time only in rich countries, and it only affects the economic and environmental aspects of middle-income countries, whereas it has no effect on low-income countries. Xu and Li [6] further verified that the economically developed regions are more affected by green credit than the economically undeveloped regions. Where the degree of marketization is high, the level of technological development is high, the institutional environment is good, and the cost of technological innovation is relatively low. In contrast, where the degree of marketization is low, the market environment is relatively poor, and there are many government interventions. The problem is that local governments use their authority to deliberately increase the burden of enterprise approvals and licenses. As a result, an enterprise’s technical costs increase accordingly, making it more difficult for it to innovate.

Therefore, the following hypothesis is proposed:

**H2:** in areas with a high level of marketization, the stronger the environmental regulations, the more obvious the effect of green credit policies in guiding heavily polluting enterprises to increase their technological innovation capabilities; otherwise, the opposite is true.

### 3. Research Design

#### 3.1. Sample and Data Sources

This study selects heavily polluting listed companies in Shanghai and Shenzhen A share markets from 2007 to 2018 as the research object; 2007 was chosen as the starting year because it is the year the new accounting standard was implemented. Excluded from the sample were (1) current year companies marked ST or *ST and (2) companies with missing data. To eliminate the effects of extreme values, all continuous variables were winsorized at the 5% level, leaving a final sample of 2,337 observations. The financial data were obtained from the CSMAR database and the China Marketization Index Report by Province 2018 and were cross-checked manually.

#### 3.2. Model Setting and Variable Definitions

**3.2.1. Model Setting.** The Green Credit Guidelines implemented in 2012 present a natural experiment. This study uses a difference in the differences method to evaluate the impact of the green credit guidelines on the technological innovation of heavily polluting enterprises. Based on controlling...
other variables, the difference in the differences method can
test whether there is a significant difference in the processing
group’s technological innovation development status and
that of the control group before and after the green credit
guidelines were implemented. The model is set as in the
following equation [15, 36]:

\[ T_{i,t} = \beta_0 + \beta_1 \text{DID}_{i,t} + \beta_2 \text{treat}_{i,t} + \beta_3 \text{post}_{i,t} + \text{controls} + \text{year} + \text{indu} + \text{region} + \epsilon_{i,t}, \]  

(1)

where \( T_{i,t} \) is the dependent variable used to measure the listed
company’s degree of technological innovation. \( \text{DID}_{i,t} \) is the
core explanatory variable, and \( \text{DID}_{i,t} = \text{treat}_{i} \times \text{post}_{i} \). During
the sample period, if a listed company discloses environmental
and sustainable development information, \( \text{treat}_{i} = 1 \); otherwise, it equals 0. When \( t \geq 2012 \), \( \text{post}_{i} = 1 \); otherwise, it equals 0. Controls are the control variables, \( \text{year} \) represents the annual
effects, \( \text{treat}_{i} \) represents the industry effects, \( \text{region} \) represents the
regional effects, and \( \epsilon_{i,t} \) is the error term. At the same time,
the clustered file standard error reported in this study can solve
potential serial correlation and heteroscedasticity problems.
The processing group in this article includes listed companies
that disclose environmental and sustainable development
information, while the control group is composed of listed
companies that do not disclose environmental and sustainable
development. The estimated coefficient \( \beta_1 \) is the policy effect
that is the focus of this study. If the policy is effective, the
coefficient will be significantly positive.

3.2.2. Variables

(1) Technical innovation. Since the number of patents is
an important indicator of a company’s technological
level, technological innovation is measured in this study as the cumulative number of patents applied
for, obtained, authorized, or accepted as of the end of the
reporting period

(2) The difference in differences is the cross product of the experimental variable and the time variable

(3) Control variables. According to De Jonghe et al. [33],
it also controls for relevant company-level variables that
affect corporate technology innovation, including the sales ratio (SALES), asset-liability ratio (LEV), growth in sales (GROWTH), return on assets (ROA), ratio of independent directors (INDR),
shareholding ratio of the largest shareholder (TOPHLD), nature of listed company (SOE),
whether the company’s chairman and CEO are the
same individual (DUAL), asset size (SIZE), and
annual, industry, and regional effects. The definitions of the main variables are shown in Table 1 [33].

4. Empirical Analysis

4.1. Descriptive Statistics. According to the descriptive sta-
tistics in Table 2, the standard error of the technical inno-
vation of heavily polluting companies is 1,125.579, which
indicates technological innovation among heavily polluting
companies is heterogeneous, and the distribution of inno-
vation results is very uneven. The average value of the
disclosure of sustainable development information is 0.389. 
This indicates most companies still pay relatively little at-
tention to environmental governance, have poor environ-
mental awareness, and need improvement.

4.2. Trends of the Treatment and Control Groups before Policy
Implementation. Figures 2 and 3 show that whether the
dependent variable is a technological innovation or its re-
Residual mean, the treatment and control groups maintained
the same basic trend from 2007 to 2012. However, a sig-
nificant difference begins to appear after 2012, and the
condition of the treatment group is better than that of the
control group. The reason for the difference may be that,
after the 2012 Green Credit Guidelines policy was issued,
heavily polluting companies that focus on disclosing envi-
ronmental and sustainable development information will be
able to obtain credit from financing institutions because of
their good environmental management. With fewer fi-
nancing constraints, more funds can be used to develop the
enterprise itself, forming a positive economic cycle and
helping the enterprise upgrade, innovate, and develop

techology.

4.3. Empirical Analysis

4.3.1. Results for the Benchmark Model. To test hypothesis 1,
it uses equation (1) to estimate the impact of the green credit
policy on the technological innovation of heavily polluting
enterprises. The regression results are shown in Table 3.
Column (1) shows the regression that includes the core
variables treat and post and their interaction terms. Column
(2) through column (4) controls for annual effects, industry
effects, and regional effects, respectively, by adding control
variables. Column (5) controls for annual, industry, and
regional effects by adding control variables. The results show
that there is a positive relationship between the green credit
policy and technological innovation. The estimated value of
\( \text{DID} \) is positive and significant at the 10% level. That is,
implementation of the green credit policy significantly
promotes development of technological innovation, and the
effect of technological innovation is significant. The results
remain consistent regardless of the control variables in-
cluded or excluded. This may be because, to prepare to
qualify for credit financing, increasingly more heavily pol-
luting enterprises have begun to pay attention to their own
technical problems and improve environmental protection
standards under the guidance of the green credit policy. In
this process, the technological innovation ability of heavily
polluting enterprises is significantly improved. After
obtaining credit funds, they continue to strengthen their
technological development to improve their economic de-
velopment efficiency rate and environmental efficiency.
Therefore, the benchmark regression results show that
implementing the green credit policy has a significantly
Table 1: Variable definitions.

| Variable | Variable definition |
|----------|---------------------|
| TI       | Number of patents applied for, obtained, authorized, or accepted as of the end of the reporting period |
| Treat    | Equals 1 if the company discloses environmental and sustainable development information, otherwise 0 |
| Post     | Indicates whether the observation is before or after promulgation of the Green Credit Guidelines policy; equals 0 from 2007 to 2011 and 1 from 2012 to 2016 |
| DID      | Difference in differences term; the product of the experimental variables and time variables |
| SALES    | Sales ratio = sales revenue/total assets at the beginning of the year |
| LEV      | Liabilities to assets ratio = total liabilities at the end of the period/total assets at the end of the period |
| GROWTH   | Sales revenue of the current year-sales revenue of the prior year/sales revenue of the prior year |
| ROA      | Return on assets = EBIT/total assets at the end of the period |
| INDR     | Number of independent directors/total number of board members |
| TOPHLD   | Shareholding of the largest shareholder |
| SOE      | The nature of the listed company; equals 1 for a state-owned enterprise, otherwise 0 |
| DUAL     | Equals 1 if the chairman and CEO are the same individual, otherwise 0 |
| SIZE     | Asset size, measured as the natural logarithm of total assets at the end of the period |
| MKTIDX   | Fan Gang marketization index |
| Year     | Year dummy variable |
| Indu     | Industry dummy variable |
| Region   | Regional dummy variable |

Source: created by the author.

Table 2: Descriptive statistics.

| Variable | Mean   | Std. deviation | Minimum | Maximum |
|----------|--------|----------------|---------|---------|
| TI       | 202.697| 1125.579       | 0       | 34279   |
| Treat    | 0.389  | 0.488          | 0       | 1       |
| Post     | 0.655  | 0.475          | 0       | 1       |
| MKTIDX   | 2.55   | 3.692          | 0       | 9.85    |
| SIZE     | 21.915 | 1.332          | 20.07   | 24.492  |
| ROA      | 0.056  | 0.048          | -0.034  | 0.16    |
| INDR     | 0.37   | 0.044          | 0.333   | 0.455   |
| DUAL     | 0.256  | 0.437          | 0       | 1       |
| SOE      | 0.42   | 0.494          | 0       | 1       |
| SALES    | 0.615  | 0.356          | 0.142   | 1.497   |
| GROWTH   | 0.248  | 0.547          | -0.359  | 2.155   |

Source: all numbers are calculated based on the CSMAR database and China Marketization Index Report by Province (2018).

Figure 2: Pretreatment trends for the control and treatment groups based on TI. Source: author prepared using stata based on data from the CSMAR database and China Marketization Index Report by Province 2018.

Figure 3: Pretreatment trends for the control and treatment groups based on TI residuals. Source: author prepared using stata based on data from the CSMAR database and China Marketization Index Report by Province 2018.
positive impact on the technological innovation of heavily polluting enterprises. Hypothesis 1a is supported.

4.3.2. Heterogeneous Treatment Effects. Due to the existence of heterogeneous effects such as economic basis, environmental supervision, resource endowment, and geographical location, policy implementation effects will differ between regions. Therefore, it is necessary to analyze the heterogeneity of the benchmark regression results. This study examines the intensity of regional marketization and environmental regulation. Table 4 shows the results of the heterogeneity test; column (1) through column (4) reflects the group with a higher degree of marketization, while column (5) through column (8) reflects the group with a lower degree of marketization. The coefficient of DID is positive and significant at the 10% level for the group with a higher degree of marketization, while it is not significant for the group with a lower degree of marketization, indicating that the green credit guidance policy has no significant effect on the marketization process. The significant influence in the group with a higher degree of marketization supports hypothesis 2. This may be because environmental regulations are relatively strict when there is a high degree of marketization, and the market development environment is relatively good. For heavily polluting enterprises, the cost of technological innovation will be lower than the cost of responding to environmental protection. Therefore, enterprises will increase technological innovation and improve production performance to offset environmental regulations.

4.3.3. Identification Tests. These research results show that implementation of the green credit policy is conducive to strengthening the technological innovation capacity of heavily polluting enterprises. However, the conclusion may be affected by omitted variables bias. The following identification tests are performed to verify the reliability of applying DID to policy identification.

4.3.4. Pretreatment Trends Test for the Control and Treatment Groups. To further test the pretreatment trends and verify whether the policy has a time lag effect, it uses the event

| Table 3: Result for the benchmark model. |
|--------------------------------------|
|                                      |
| (1)       (2)       (3)       (4)       (5) |
| Treat     99.0021* (56.57) 41.0373* (24.6200) 41.8444* (24.8961) 31.9381* (18.86) 25.7140* (14.29) |
| Post      46.9430* (26.86) 31.2174* (17.71) 121.6668* (18.66) 33.2540* (18.86) 58.8774* (18.86) 58.8774* (18.86) |
| DID       380.2850*** (98.3472) 267.0631* (56.57) 271.8076* (26.86) 294.5685* (26.86) 309.9278* (26.86) 309.9278* (26.86) |
| SALES     219.6296 221.1714 217.1412 258.4925 264.2739 |
| LEV       −5.1e + 02 −5.0e + 02 −1.6e + 02 −1.5e + 02 −1.5e + 02 |
| GROWTH    15.6963 15.2347* 2.8583 7.3051 |
| ROA       −1.1e + 03 −1.1e + 03 −1.8e + 03*** −1.8e + 03*** |
| TOPHLD    509.9625* (750.0931) 515.7855 (791.8576) 296.2690 (851.6609) 313.4170 (896.4834) |
| SOE       −1.5e + 02 −1.5e + 02 −2.2e + 02 −2.2e + 02 |
| DUAL      64.1087 63.0375 58.6877 58.2025* |
| SIZE      152.8322*** (57.9052) 151.1647*** (56.9995) 105.0601* (60.9728) 101.0064* (57.7105) |
| MKTIDX    27.7000*** (97.7978) 27.7010*** (13.7642) 33.6743 30.5579 |
| INDR      −7.2e + 02 −7.2e + 02 −7.9e + 02 −7.8e + 02 |
| _cons     48.4940 54.1332 (54.1332) 1.1e + 03 (1.1e + 03) 1.2e + 03 |
| R²        0.0321 0.0717 0.0723 0.2758 0.2769 |
| N         2337 2168 2168 2168 2168 |

Source: all numbers are calculated based on equation (1). Note: The following brackets are standard errors below the coefficients, which represent significant values at the levels of 10%, 5%, and 1%, respectively.

Table 3: Result for the benchmark model.
| Table 4: Heterogeneous treatment effects test. |
|---------------------------------------------|
| MKTIDX > 2.55 | MKTIDX < 2.55 |
|   | (1)   | (2)   | (3)   | (4)   | (5)   | (6)   | (7)   | (8)   |
| Treat | 53.258** | 1.943** | 16.564* | 32.5401* | 36.5737 | 37.1431 | 5.157 | 6.0322 |
|       | (26.0430) | (9.00636) | (17.7815) | (35.2489) | (35.7226) | (45.0454) | (45.9561) |
| Post  | 27.9042* | 71.915* | 34.49341** | 87.1666* | 25.2016* | 20.6051 | 27.7566** | 4.9212 |
|       | (15.2482) | (38.9024) | (17.0817) | (42.6242) | (14.7689) | (31.5871) | (13.5758) | (34.239) |
| DID   | 485.7164* | 550.8624* | 373.8458* | 408.8617* | 10.3176 | 11.9261 | 4.9124 | 6.6593 |
|       | (265.3575) | (300.8521) | (204.2841) | (222.9501) | (56.1344) | (61.9884) | (56.4754) | (62.3552) |
| SALES | -643.1779 | -648.4518 | -501.6764 | -509.9591 | -37.9322 | -37.8976 | -29.0135 | -28.9422 |
|       | (-299.1107) | (-196.8959) | (-147.9471) | (-147.3456) | (-59.7938) | (-61.2012) | (-55.5566) | (-56.9065) |
| LEV   | -2.0 + 03** | -2.0 + 03** | -8.9e + 02* | -8.8e + 02* | 44.9515 | 47.2811 | 50.1226 | 52.901 |
|       | (-999.1107) | (-996.8959) | (-476.9471) | (-473.4563) | (-59.7938) | (-61.2012) | (-55.5566) | (-56.9065) |
| GROWTH | -3.8 + 03* | -3.6e + 03* | -5.6e + 03** | -5.8e + 03** | 236.287 | 262.305 | 244.3799 | 262.9136 |
| ROA   | (-104.0257) | (-82.1888) | (-90.356) | (-99.956) | (-10.5696) | (-10.0929) | (-10.6262) |
|       | (1.7 + 03*) | (1.7e + 03*) | (1.7 + 03*) | (1.7e + 03*) | (-13.0e + 03) | (-13.0e + 03) | (-37.9833) | (-52.9766) |
| TOLPHL | -867.9094 | -886.8309 | -850.0596 | -869.6945 | -109.2968 | (-107.472) | (-77.9857) | (-77.4566) |
| SOE   | 341.1923 | 342.0849 | 419.5122 | 422.7072 | 24.6236 | 24.5748 | 21.6326 | 21.3102 |
| DUAL  | 295.1416 | 302.5858 | 121.5137 | 133.4344 | 31.2318 | 31.5271 | 15.6764 | 15.2547 |
| SIZE  | (-252.0513) | (-261.6512) | (-232.8186) | (-242.1271) | (-23.9503) | (-23.6486) | (-21.0425) | (-21.0239) |
| MKTIDX | 396.5692** | 396.9989** | 340.8621* | 337.4935* | 37.7347** | 37.1001** | 25.6332** | 24.6832* |
|       | (158.9985) | (157.3843) | (191.2962) | (192.8438) | (20.559) | (20.4612) | (12.6146) | (12.6999) |
| INDR  | -89.1296 | 216.4785 | 92.6105 | 80.3357 | -86.5086** | -86.6099** | -5.7e + 02** | -5.7e + 02** |
| _cons | -3.60E + 03 | -3.60E + 03 | -2.60E + 03 | -2.60E + 03 | -110.7845 | 120.3381 | 108.0191 | 115.9929 |
| Year  | -5.0E + 03 | -5.0E + 03 | -5.9E + 03 | -5.9E + 03 | -213.747 | -216.6523 | -211.5991 | -214.5007 |
| Indu  | -8.5e + 03** | -8.8e + 03** | -7.5e + 03* | -7.6e + 03* | -5.1e + 02* | -5.1e + 02* | -9.4e + 02** | -9.4e + 02** |
| Region | -3.30E + 03** | -3.40E + 03** | -4.00E + 03* | -4.00E + 03* | -41.2372 | -41.3004 | -24.9753 | -24.6062 |
| R^2   | 0.1243 | 0.1276 | 0.31 | 0.3124 | 0.056 | 0.0594 | 0.1038 | 0.0969 |
| N     | 764 | 764 | 764 | 764 | 1404 | 1404 | 1404 | 1404 |

Source: all numbers are calculated based on equation (1). Note: The following brackets are standard errors below the coefficients, which represent significant values at the levels of 10%, 5%, and 1%, respectively.
study method to study the dynamic effect of the green credit guidance policy [37, 38]. Specifically, it replaces DID in formula (1) with a dummy variable indicating several years before and after the green credit policy implementation; the dependent variable remains unchanged, as shown in the following equation:

\[ T_{i,t} = \beta_0 + \sum_{s=1}^{4} \beta_s D_s + \beta_{-4} \text{control}_{i,t} + \delta_i + \gamma_t + \epsilon_{i,t}, \]  

(2)

where \( D_s \) is the dummy variable for the year the green credit policy was implemented. A negative number \( S \) indicates \( S \) years before implementation of the green credit policy, while a positive number indicates \( S \) years after green credit policy implementation. Figure 4 shows the parameter estimates for \( \{\beta_5, \beta_{-4}, \beta_{-3}, \ldots, \beta_1, \beta_4\} \). The figure illustrates that the coefficients before policy implementation are generally not significant, while the coefficients after policy implementation are generally significant at the lowest confidence interval level. The test results further verify the parallel trend hypothesis and show that the policy effect shows a gradual upward trend and has continuity after implementation occurs.

Figure 4 provides further evidence on the parallel trend hypothesis. The coefficient curves and maximum confidence intervals are all above 0; some coefficients of the minimum confidence interval are also greater than 0, which satisfies the pretreatment trends assumption of the DID model.

5. Placebo Test

To eliminate interference of other factors or unobserved missing variables in the study’s basic conclusions, it performs a placebo test [30, 39]. It draws 1,500 random samples; 10 samples are randomly selected each time from the whole sample as the treatment group for the indirect test. According to equation (1), using the regression results of column (5) in Table 3 as the benchmark results, the coefficient estimate for DID_{t1} is as follows:

\[ \hat{\beta}_1 = \beta_1 + \mu \frac{\text{cov}(\text{DID}_{t1}, \epsilon_{i,t}\mid \text{control})}{\text{var}(\text{DID}_{t1}\mid \text{control})} \]  

(3)

In equation (3), the control variables reflect all variables that cannot be observed. If the estimate of \( \beta_1 \) is unbiased, then \( \mu \) must be 0. However, it is not known whether \( \mu \) is 0 or whether the unobserved factors affect the test results. According to the relevant economic theory, DID_{t1} does not impact the interpreted variables in random samples. If \( \beta_1 = 0 \), then, it can also be deduced that \( \mu \) is 0. Figure 5 reports the kernel density estimate of the estimated coefficient. Because the estimates are concentrated around 0, it can deduce that \( \mu \) is 0, which proves that our basic conclusion is not affected by other random factors. That is, the randomly established green credit policy has no effect on the technological innovation of heavily polluting enterprises. The test results are shown in Table 5; columns (1) and (2) are the regression results of replacing the policy implementation point with 2013, and columns (3) and (4) are the results of replacing the policy implementation point with 2015. The item (treat \( \times \) post) DID2 and DID3 are no longer significant.
reinforcing that it is an exogenous shock, and the conclusion is reliable.

6. Robustness Test

The PSM-DID method is used as a robustness test to further analyze the policy effect of the green credit guidance.

First, to facilitate comparison, the control variables in the previous tests are used in a logit regression to predict the probability of each enterprise’s disclosure of environmental and sustainable development information. The nearest neighbor, radius, and kernel matching methods are then used to match the control group to the sample (treatment group) that actively discloses environmental and sustainable development information, so the processing group and control group are in the green credit guidance as far as possible. There is no significant difference before the policy impact, reducing the endogeneity problems caused by the self-selection bias of the choice to disclose environmental and sustainable development information.

Second, the DID method is used to identify the net impact of the green credit guidance on the technology innovation of heavily polluting enterprises. Because the tendency score can best solve the deviation problem of observable covariates and the double difference method can eliminate the influence of unobservable variables such as time-varying variables, the combination of these two methods can better identify the policy effect. No matter which matching method is used, the \( t \)-test of the observations before and after matching is not significant, and the difference is small as given in Appendix.

The regression results are shown in Table 6. The estimated results of radius, kernel, and nearest neighbor matching are shown, respectively, in columns (1)–(3). In principle, the estimation results of any matching method will not be very different [40]. From the estimation results of the

| Table 5: Transformation of policy implementation points. |
|-----------------------------------------------|
| (1)  | (2)  | (3)  | (4)  |
| Treat  | 60.5914 | 101.4942 | 104.5407 | 109.8326** |
| Post2 | (73.6671) | (68.8888) | (65.4154) | (53.5740) |
| DID2  | 69.6015 | 91.2790 | (59.6959) | (163.3056) | 279.0212 | 165.8258 | (215.5341) | (140.2437) |
| Post3 | 25.7314 | 46.2126 | (57.2225) | (129.1283) |
| DID3  | 32.4159 | 11.8972 | (32.8058) | (243.2950) |
| SALES | 315.5692 | 322.0162 | (297.4583) | (299.5797) |
| LEV | −3.7e + 02 | −3.7e + 02 | (246.6655) | (215.5341) |
| GROWTH | 8.9980 | 11.8972 | (32.4159) | (32.8058) |
| ROA | −1.5e + 03 | −1.5e + 03 | (1.1e + 03) | (1.1e + 03) |
| TOPHLD | 388.7778 | 392.9291 | (294.4725) | (295.9822) |
| SOE | −2.5e + 02 | −2.5e + 02 | (134.0068) | (133.1534) |
| DUAL | 52.6587 | 51.1028 | (51.5991) | (50.1108) |
| SIZE | 174.7900** | 175.1140*** | (61.1703) | (61.0578) |
| MKTIDX | 225.0020 | 198.7667 | (137.9179) | (123.3613) |
| INDR | −7.3e + 02 | −7.4e + 02 | (747.6475) | (750.0367) |
| _cons | 88.8955* | 116.1809*** | (47.9528) | (41.1425) |
| Year | Yes | Yes | Yes | Yes |
| Indu | Yes | Yes | Yes | Yes |
| Region | Yes | Yes | Yes | Yes |
| R² | 0.1047 | 0.1497 | 0.1039 | 0.1497 |
| N | 2337 | 2168 | 2337 | 2168 |

Source: all numbers are calculated based on equation (1). Note: The following brackets are standard errors below the coefficients, which represent significant values at the levels of 10%, 5%, and 1%, respectively.
three matching methods in Table 6, the estimation coefficients, signs, and significance levels of the matching methods are basically consistent with the results of the benchmark regression in Table 3. Therefore, the estimate of the impact of the green credit guidance on technology innovation of heavily polluting enterprises is stable.

### 7. Concluding Remarks

The purpose of this study was to investigate the influence of the green credit guidelines on technological innovation of heavily polluting enterprises. After estimating several specifications of the DID model using samples obtained from the CSMAR database (2007–2018) and China Marketization Index Report by Province (2018), the research results show that the green credit guidance can improve the technological innovation level of heavily polluting enterprises. Further analysis shows that due to differences in the factor endowment structure, economic basis, environmental supervision intensity, and geographical factors, which lead to heterogeneous policy effects between different regions, the impact is greater in areas with high levels of market orientation. The conclusion is consistent throughout several recognition and robustness tests and shows that the green credit guidance has a positive effect on the technological innovation of enterprises. It not only plays an important role in developing market environment mechanisms but also provides an experience constructing relevant policies and regulations in China. Furthermore, the study provides empirical evidence by analyzing the technological innovation of heavily polluting enterprises from the perspective of factor market distortion and the Porter hypothesis.

In view of the availability of data and the limitations of research methods, this research still has some shortcomings, which are not enough to fully control the operation of the entire macroeconomic and microeconomics; so, it is necessary to pay attention to the universality and particularity of contradictions. In the future, we need to focus on introducing more complex models to measure the degree of technological innovation of heavily polluting companies, so as to put forward more meaningful solutions for different types of polluting companies, and put forward

| Table 6: Robustness test results. |
|------------------|------------------|------------------|
|                  | Radius matching | Kernel matching  | Nearest neighbor matching |
|                  | (1)             | (2)             | (3)             |
| Treat            | 19.6033*        | 19.6030*        | 19.6032*        |
| Post             | 38.5234*        | 38.5236*        | 38.5233*        |
| DID              | 289.5674*       | 289.5674*       | 289.5674*       |
| SALES            | (172.6691)      | (172.669)       | (172.6691)      |
| Post             | (317.0722)      | (317.0722)      | (317.0722)      |
| LEV              | (−300.8824)     | (−300.8822)     | (−300.8824)     |
| GROWTH           | (−33.4457)      | (−33.4457)      | (−33.4457)      |
| ROA              | (−1.50E + 03)  | (−1.50E + 03)  | (−1.50E + 03)  |
| INDIC            | (−7.40E + 02)  | (−7.40E + 02)  | (−7.40E + 02)  |
| TOPHLD           | 398.3817        | 398.3817        | 398.3817        |
| POST             | (−300.6895)     | (−300.6895)     | (−300.6895)     |
| SOE              | (−2.5e + 02)   | (−2.5e + 02)   | (−2.5e + 02)   |
| DUAL             | (−134.2982)     | (−134.2982)     | (−134.2982)     |
| SIZE             | 173.3524***     | 173.3524***     | 173.3524***     |
| MKTIDX           | (−60.6272)      | (−60.6272)      | (−60.6272)      |
| _cons            | (−136.6827)     | (−136.6827)     | (−136.6827)     |
| Year             | YES             | YES             | YES             |
| Indu             | YES             | YES             | YES             |
| Region           | YES             | YES             | YES             |
| R²               | 0.1501          | 0.1501          | 0.1501          |
| N                | 2168            | 2168            | 2168            |

Source: all numbers are calculated based on equation (1). Note. The following brackets are standard errors below the coefficients, which represent significant values at the levels of 10%, 5%, and 1%, respectively.
substantive suggestions for the development of China’s economy.

Based on this study’s conclusion and the current state of domestic and international development, it offers the following suggestions. First, it should strengthen the willingness of heavily polluting enterprises to disclose environmental information, improve their environmental awareness, and tap their endogenous development power from inside to outside. At the same time, the government should further strengthen the relevant laws and regulations, strengthen supervision, and guide heavily polluting enterprises. Second, it should focus on the differences in the enterprise development under different marketization levels and conduct targeted environmental management for heavily polluting enterprises. It should give full play to the three-dimensional coordination mechanism of a “government-market society” in constructing an ecological civilization and provide support for the innovation and development of heavily polluting enterprises.

7.1. Notes

(1) This study takes listed companies that actively disclose environmental and sustainable development information as the treatment group affected by the green credit guidance policy. To implement macrocontrol policies such as the comprehensive work plan for energy conservation and emission reduction of the 12th Five Year Plan of the State Council (GF (2011) No. 26), the opinions of the State Council on strengthening the keywork of environmental protection (GF (2011) No. 35), and the requirements of the combination of regulatory policies and industrial policies, banking financial institutions should be encouraged to take green credit as the starting point and actively adjust the credit structure. The CBRC has formulated the green credit guidelines to effectively prevent environmental and social risks, better serve the real economy, and promote the transformation of the economic development mode and economic restructuring.

(2) This study uses the industry codes of the industry classification guidelines for listed companies as revised by the China Securities Regulatory Commission in 2012 and selects companies in the heavily polluting industries listed in Shanghai and Shenzhen. A share markets from 2007 to 2018 as the research sample for analysis. The sorted heavily polluting industry codes are B01, B03, B05, B07, C01, C03, C05, C11, C14, C31, C35, C41, C43, C61, C65, C67, C81, D01, H01, and H03.

Data Availability

The data used to support this study are included within this article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Supplementary Materials

Table 1: t-test for radius matching; Table 2: t-test for kernel matching; Table 3: t-test for nearest neighbor matching; Table 4: sample comparison; Figure 1: difference between unmatched sample and matched sample; and Figure 2: propensity score for unmatched sample and matched sample. (Supplementary Materials)

References

[1] M. Aizawa and Y. Chaofei Yang, "Green credit, green stimulus, green revolution? China’s mobilization of banks for environmental cleanup," *The Journal of Environment & Development*, vol. 19, no. 2, pp. 119–144, 2010.
[2] Z. Dan, D. Zeng, and Q. Zhou, "Regional technical innovation suitability and economic growth in China," *Procedia Engineering*, vol. 15, pp. 5343–5349, 2011.
[3] L. He, L. Zhang, Z. Zhong, D. Wang, and F. Wang, "Green credit, renewable energy investment and green economy development: empirical analysis based on 150 listed companies of China," *Journal of Cleaner Production*, vol. 208, pp. 363–372, 2019.
[4] L. He, R. Liu, Z. Zhong, D. Wang, and Y. Xia, "Can green financial development promote renewable energy investment efficiency? a consideration of bank credit," *Renewable Energy*, vol. 143, pp. 974–984, 2019.
[5] H. Kang, S. Jung, and H. Lee, "The impact of green credit Policy on manufacturers’ efforts to reduce suppliers’ pollution," *Journal of Cleaner Production*, vol. 248, 2020.
[6] X. Xu and J. Li, "Asymmetric impacts of the policy and development of green credit on the debt financing cost and maturity of different types of enterprises in China," *Journal of Cleaner Production*, vol. 264, 2020.
[7] D. S. Siegel, "Green management matters only if it yields more green: an economic/strategic perspective," *Academy of Management Perspectives*, vol. 23, pp. 5–16, 2009.
[8] X. Lin and K. R. Polenske, "Input-output anatomy of China’s energy use changes in the 1980s," *Economic Systems Research*, vol. 7, no. 1, pp. 67–84, 1995.
[9] R. F. Garbaccio and M. S. H. A. Jorgenson, "Why has the energy-output ratio fallen in China?" *Energy Journal*, vol. 20, pp. 63–91, 1999.
[10] J. Yin, S. Wang, and L. Gong, "The effects of factor market distortion and technical innovation on China’s electricity consumption," *Journal of Cleaner Production*, vol. 188, pp. 195–202, 2018.
[11] M. Jánícik, "Dynamic governance of clean-energy markets: how technical innovation could accelerate climate policies," *Journal of Cleaner Production*, vol. 22, no. 1, pp. 50–59, 2012.
[12] Y.-J. Zhang, Y.-L. Peng, C.-Q. Ma, and B. Shen, "Can environmental innovation facilitate carbon emissions reduction? evidence from China," *Energy Policy*, vol. 100, pp. 18–28, 2017.
[13] J. Wang and L. Yang, “Does factor endowment allocation improve technological innovation performance? An empirical study on the Yangtze river delta region,” Science of The Total Environment, vol. 716, 2020.

[14] Y. Hao, B. Ye, M. Gao et al., “How does ecology of finance affect financial constraints? empirical evidence from Chinese listed energy- and pollution-intensive companies,” Journal of Cleaner Production, vol. 246, 2020.

[15] X. Liu, E. Wang, and D. Cai, “Green credit policy, property rights and debt financing: quasi-natural experimental evidence from China,” Finance Research Letters, vol. 29, pp. 129–135, 2019.

[16] D. Su and L. Lian, “Does green credit affect the investment and financing behavior of heavily polluting enterprises?” Journal of Finance Research, vol. 462, no. 12, pp. 127–141, 2018.

[17] Z. Li, G. Liao, Z. Wang, and Z. Huang, “Green loan and subsidy for promoting clean production innovation,” Journal of Cleaner Production, vol. 187, pp. 421–431, 2018.

[18] K. Chang, Y. Zeng, W. Wang, and X. Wu, “The effects of credit policy and financial constraints on tangible and research & development investment: firm-level evidence from China’s renewable energy industry,” Energy Policy, vol. 130, pp. 438–447, 2019.

[19] D. Jin and N. Menggi, “The paradox of green credit in China,” Energy Procedia, vol. 5, pp. 1979–1986, 2011.

[20] B. Zhang, Y. Yang, and J. Bi, “Tracking the implementation of green credit policy in China: top-down perspective and bottom-up reform,” Journal of Environmental Management, vol. 92, no. 4, pp. 1321–1327, 2011.

[21] J. Zhang, X. Zhou, and Y. Li, “Does factor market distortion bar Chinese firms’ R&D?” Economic Research Journal, vol. 8, pp. 78–91, 2011.

[22] P. Bansal and K. Roth, “Why companies go green: a model of ecological responsiveness,” Academy of Management Journal, vol. 43, no. 4, pp. 717–736, 2000.

[23] R. D. Klassen and C. P. McLaughlin, “The impact of environmental management on firm performance,” Management Science, vol. 42, no. 8, pp. 1199–1214, 1996.

[24] J.-Y. Liu, Y. Xia, Y. Fan, S.-M. Lin, and J. Wu, “Assessment of a green credit policy aimed at energy-intensive industries in China based on a financial CGE model,” Journal of Cleaner Production, vol. 163, pp. 293–302, 2017.

[25] A. A. King and M. J. Lenox, “Lean and green? an empirical examination of the relationship between lean production and environmental performance,” Production & Operations Management, vol. 10, pp. 244–256, 2001.

[26] C. Flammer, “Corporate social responsibility and shareholder reaction: the environmental awareness of investors,” Academy of Management Journal, vol. 56, no. 3, pp. 758–781, 2013.

[27] Q. Ji and D. Zhang, “How much does financial development contribute to renewable energy growth and upgrading of energy structure in China? financial development contribute to renewable energy growth and upgrading of energy structure in China?” Energy Policy, vol. 128, pp. 114–124, 2019.

[28] H. Yasmeen, Q. Tan, H. Zameer, J. Tan, and K. Nawaz, “Exploring the impact of technological innovation, environmental regulations and urbanization on ecological efficiency of China in the context of COP21,” Journal of Environmental Management, vol. 274, 2020.

[29] D. S. Banking, “Sustainable banking: the greening of finance,” Greener Management International, vol. 1999, pp. 5-6, 2001.

[30] D. C. Andersen, “Credit constraints, technology upgrading, and the environment,” Journal of the Association of Environmental and Resource Economists, vol. 3, no. 2, pp. 283–319, 2016.

[31] X. Ouyang, Q. Li, and K. Du, “How does environmental regulation promote technological innovations in the industrial sector? evidence from Chinese provincial panel data,” Energy Policy, vol. 139, 2020.

[32] B. Lin and Z. Chen, “Does factor market distortion inhibit the green total factor productivity in China?” Journal of Cleaner Production, vol. 197, pp. 25–33, 2018.

[33] O. De Jonghe, D. Dewachter, and S. Oncken, “Bank capital (requirements) and credit supply: evidence from pillar II decisions,” Journal of Corporate Finance, vol. 60, Article ID 101518, 2020.

[34] C. Geng and Z. Cui, “Analysis of spatial heterogeneity and driving factors of capital allocation efficiency in energy conservation and environmental protection industry under environmental regulation,” Energy Policy, vol. 137, Article ID 111081, 2019.

[35] A. Omri, “Technological innovation and sustainable development: does the stage of development matter?” Environmental Impact Assessment Review, vol. 83, 2020.

[36] M. Bertrand, E. Duflo, and S. Mullainathan, “How much should we trust differences-in-differences estimates?” The Quarterly Journal of Economics, vol. 119, no. 1, pp. 249–275, 2004.

[37] L. S. Jacobson, R. J. Lalonde, and D. G. Sullivan, “Earnings losses of displaced workers,” American Economic Review, vol. 83, pp. 685–709, 1993.

[38] P. Li, Y. Lu, and J. Wang, “Does flattening government improve economic performance? evidence from China,” Journal of Development Economics, vol. 123, pp. 18–37, 2016.

[39] E. L. Ferrara, A. Chong, and S. Duryea, “Soap operas and fertility: evidence from Brazil,” American Economic Journal: Applied Economics, vol. 4, no. 4, pp. 1–31, 2012.

[40] V. Vandenbergh and S. Robin, “Evaluating the effectiveness of private education across countries: a comparison of methods,” Labour Economics, vol. 11, no. 4, pp. 487–506, 2004.