

City-Level Climate Policy Uncertainty and Corporate ESG Report Issuance: A Bounded Null Association in Chinese Listed Firms

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Abstract. The direction of the impact of climate policy uncertainty on enterprise ESG disclosure is theoretically uncertain: real option logic predicts that enterprises postpone irreversible investment, and political legitimacy logic predicts that enterprises increase disclosure to hedge policy risks. This article uses the climate policy uncertainty index of the news text covering 293 prefecture-level cities. After matching, it obtained 40069 observations of 3,955 enterprises in 239 cities from 2011 to 2022. The dependent variable is whether the enterprise issued an independent ESG or social responsibility report in that year. After controlling the fixed effect of the enterprise and the year, for every 1 standard deviation increase in the index, the probability of the report release changes by 0.15 percentage points, and the 95% confidence interval [-0.27, 0.56] percentage points, and the benchmark release rate relative to 18.39% is [-1.5%, 3.0%]. The equivalence test can reject the real coefficient outside ± 0.75 percentage points at the 5% level. None of the 19 specifications in the specification curve is significant at the level of 10%. Provincial clustering, two-way clustering, wild cluster bootstrap and 1,000 permutation placebos cannot reject the zero effect. The significance of the scale interaction item changes according to the setting, which is exploratory evidence. Under the measurement and identification settings of this article, the average correlation between the uncertainty of urban climate policies and the release of enterprise ESG reports is limited to ± 0.75 percentage points, which is about 4.1% of the benchmark release rate.

Keywords: Climate policy uncertainty, ESG disclosure, Equivalence testing, Chinese listed firms

1. Introduction

In the process of China's promotion of carbon peaking and carbon neutrality goals, there are obvious fluctuations in the pace, strength and regional implementation of climate policies, and the resulting climate policy uncertainty has become an important external environment for enterprises. At the same time, ESG information disclosure has evolved from a voluntary behavior to a basic institutional arrangement in the capital market. The intersection of the two raises a question: when

the climate policy outlook of the enterprise's city is more unclear, will the enterprise release ESG reports more actively or more conservatively.

Theoretically, there are two predictions in opposite directions. The logic of real options believes that uncertainty increases the value of waiting options, and enterprises will postpone irreversible investment; the preparation and release of ESG reports requires continuous organizational resources and external assurance expenditure, which are difficult to interrupt once they start, and the inhibitory effect should be observed accordingly. The logic of political legitimacy believes that active disclosure when the policy outlook is unclear is a low-cost means of conveying the willingness to comply, according to which the promoting effect should be observed. The direction of the net effect is therefore an empirical problem.

There have been studies to measure the uncertainty of climate policies at the national level, focusing on green innovation, energy transformation and carbon emission efficiency, and the direct inspection of enterprise disclosure behavior is limited; while Chinese cities have significant differences in industrial structure, fiscal capacity and environmental law enforcement intensity, and national indicators alone will cover up this spatial heterogeneity.

This paper uses the urban sub-index of China's climate policy uncertainty index based on the news text and using the MacBERT model to match the ESG report release records of A-share listed companies from 2011 to 2022, contributing three points: examine the relationship at the urban rather than the national level; use an equivalence test when the significant coefficient is not obtained, and promote the conclusion that the significant correlation has never been found to be limited to a stateable interval; report a specification curve of 19 settings, four inference methods and 1,000 permutation placebos, so that the robustness of zero results can be directly tested.

2. Literature review

2.1. Measurement of climate policy uncertainty and economic consequences

The measure of climate policy uncertainty follows the news text method of Baker and others [1]. Gavriilidis [2] constructed the American index, and Ma et al. [3] extended the idea to China and gave a three-level index of country, province and city for the first time. Research based on these indicators found that climate policy uncertainty inhibits green innovation [4, 5], delays energy transformation [6], reduces carbon emission efficiency [7], and affects the employment adjustment of enterprises [8]; Deng et al. [9] pointed out that its impact is bidirectional.

2.2. Policy uncertainty and enterprise information disclosure

The classic channel of policy uncertainty affecting corporate behavior comes from the real option analysis of Bernanke [10] and Bloom [11]: irreversible investment is delayed when uncertainty rises. The ESG reporting system involves data governance, third-party assurance and long-term commitment, which is in line with this feature. On the other hand, disclosure is also a tool for managing policy risks: Xue et al. [12] found that when economic policy uncertainty rose, China's corporate social responsibility disclosure converged. Zhang et al. [13] emphasized its political attributes. Guenichi et al. [14] found that policy uncertainty would improve the level of ESG disclosure. Zhang and Sun [15] directly examined climate policy uncertainty and disclosure strategies. In the context of China, the intensity of environmental regulation significantly changes the level of enterprise environmental information disclosure [16], compulsory disclosure reduces the risk of default [17], and the improvement of disclosure helps to alleviate financing constraints [18].

2.3. Research hypothesis

The two documents point in opposite directions, and the net effect may be very small when the two work at the same time. Therefore, this article does not preset the direction, but tests whether the net correlation is significantly different from zero, and further tests whether it is limited to a stateable interval when it fails to reject the zero hypothesis. Considering that heavily polluting enterprises face stronger policy exposure and small enterprises face tighter resource constraints, this article makes an exploratory heterogeneity test on the intensity of industry pollution and enterprise scale.

3. Methodology

3.1. Data sources and samples

The uncertainty of climate policy is taken from the annual city-level index publicly released by Ma and others [3]. The original index covers 293 prefecture-level cities. Enterprise ESG report data is retrieved from the public disclosure search of CNINFO. It extracts the announcements with titles involving social responsibility reports, ESG reports and sustainable development reports from 2011 to 2023. After eliminating abstracts, corrections, English versions and semi-annual reports, they are attributed to the accounting year according to the title year, with a total of 11,782 records and 1978 enterprises. The financial data comes from the public financial statements of Eastmoney; the enterprise address is taken from the company profile of CNINFO and mapped to the prefecture-level city code through Chinese address analysis. After excluding the missing key variables, it is estimated that the sample is 40069 observations of 3,955 enterprises in 239 cities from 2011 to 2022, and the continuous variables are winsorized at the 1st and 99th percentiles.

3.2. Definition of variables

The dependent variable is a dummy variable issued by an independent ESG report. If the enterprise issues an independent ESG or social responsibility report in that year, take 1, otherwise take 0, the average value is 0.1839; this variable portrays the existence of the report, which does not reflect the length, quality and assurance level. The explanatory variable is the climate policy uncertainty index of the city where the enterprise is located in that year, and the standardized coefficient can be interpreted as the correlation magnitude of 1 standard deviation change. The control variables are the size of the enterprise, the asset-liability ratio, the rate of return on total assets, the listing period, the gross margin of sales and the growth rate of operating income. Heavy pollution industries are defined according to the 16 industries in the environmental protection verification industry classification catalog of the Ministry of Ecology and Environment, and the sample proportion accounts for 23.92%.

3.3. Estimation model and identification boundary

The benchmark model is a linear probability model, which controls the fixed effect of the enterprise and the fixed effect of the year at the same time. Standard errors are clustered at the city level. The fixed effect of enterprises absorbs the characteristics of enterprises and cities that do not change with time, and the fixed effect of years absorbs national shocks and common trends. The boundaries of identification need to be clear: there is no exogenous policy shock in this article. Local economic conditions, central environmental inspection, provincial regulations and media activity may affect the news text index and enterprise disclosure decision-making at the same time. Therefore, the

estimated results should be understood as conditional correlation rather than causal effects. The fixed effect of province-year interaction is used as a direct robustness test, not just one of the specifications in the specification curve.

3.4. Equivalence tests

When the coefficient is not significant, it is impossible to distinguish that the correlation is indeed small and the sample information is insufficient. This paper adopts two one-sided tests (TOST) [19] to test whether the estimated coefficient can be statistically limited to a given equivalent range. The equivalence bound is expressed with the reference of the benchmark release rate of 18.39%: ± 0.75 percentage points is about 4.1% of the benchmark release rate, and ± 0.5 percentage points is about 2.7%. These boundaries are selected by researchers to describe the magnitude of the association. They are not the critical values of policy relevance that have been argued by external standards; the equivalence bounds are not registered in advance. Therefore, this article reports a complete ladder from ± 2.0 to ± 0.25 percentage points, rather than just presenting a single boundary.

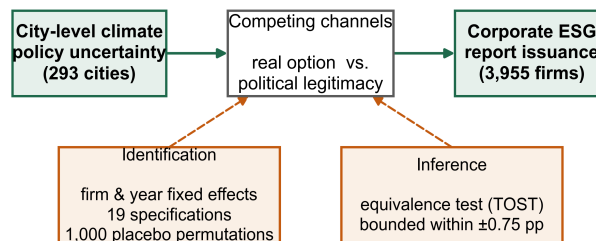


Figure 1. Research framework

4. Results

4.1. Descriptive statistics and trends

During the sample period, the average uncertainty of urban climate policy was 1.7596, with a standard deviation of 0.5574, which fell back after reaching its peak in 2016. The release rate of enterprise ESG reports rose from 16.27% in 2011 to 30.60% in 2022. Figure 1 gives a research framework, and Figure 2(a) shows that the two sequences do not show co-directional changes.

4.2. Benchmark regression

Table 1 reports the main results. The coefficient in pooled OLS is -0.0070, and after adding the control variable, it is -0.0021, which is not significant. After adding the fixed effect of the enterprise and the year, the coefficient is 0.0015, the standard error is 0.0021, and the p value is 0.487, that is, for every 1 standard deviation increase in the index, the probability of the report release changes by 0.15 percentage points, the 95% confidence interval $[-0.27, 0.56]$ percentage points, and the benchmark release rate of 18.39% is $[-1.5\%, 3.0\%]$. The direction of control variables is in line with expectations: the enterprise scale, the rate of return on total assets and the listing period significantly increase the probability of release, and the asset-liability ratio significantly reduces the probability of release.

4.3. Robustness, inference and placebo tests

Figure 2(b) summarizes 19 settings, including first-order lag, logarithm, taking the number of reports as the explained variable, eliminating four municipalities directly under the Central Government, replacing the fixed effect of the year with the interaction fixed effect between the province and the year, and re-measurement of uncertainty with the four moments of intra-year fluctuation, variation coefficient, intra-year peak and annual shock. All coefficients are between -0.70 and 0.75 percentage points, the median is 0.07 percentage points, and none of them are significant at the 10% level. Since the real option theory predicts the postponement of irreversible commitments, this paper also limits the sample to the enterprise year that has not yet released the report. The initial release rate of 33,304 observations is 3.95%, and the coefficient is also not significant.

In terms of inference, the scale of the sample cities is highly uneven. The top 10 cities account for 42.9% of the observations. The number of effective clusters calculated according to the Kish formula is 33.7, which is far lower than the nominal value of 239. Therefore, this article reports four inference methods: p value under urban clustering is 0.487, provincial clustering (27 clusters) is 0.302, urban and year two-way clustering is 0.465, and according to the wild cluster bootstrap clustered by city (Rademacher weight, 499 times) 0.471. The results of provincial clustering are only for diagnosis reference due to the small number of clusters. The placebo test randomly permutes index values across cities in each year, retaining the annual structure and annual value distribution of the city, but not the time series of a single city. Since cities may not be exchangeable within the year (there are continuous regional and structural differences), the test is treated as diagnostic evidence rather than formal inference: after repeating 1000 times, the real coefficient falls in the middle of the permutation distribution, and the two-sided proportion is 0.228.

4.4. Equivalence tests

The benchmark coefficient is 0.15 percentage points, and the 95% confidence interval is [-0.27, 0.56] percentage points. Under the equivalence bound of ± 0.75 percentage points, the two one-sided test p value is 0.002, that is, under the reference model and urban clustering inference, the real coefficient can be rejected at the 5% level to fall outside the interval. The tightest limit that can be rejected at the 5% level is ± 0.5 percentage points, and the p value is 0.046, which is close to the critical value; the equivalence is not valid under ± 0.25 percentage points, and the p value is 0.311. The equivalence statement is aimed at the coefficient of the measured index, not the latent construct itself.

4.5. Exploratory heterogeneity

The interaction coefficient between climate policy uncertainty and heavy pollution industry is 0.0036, and the p value is 0.584, which is not significant. The scale dimension adopts two inverse codings: the interaction coefficient with continuous scale variables (the larger the scale, the higher the value) -0.0043, and the p value is 0.020; the interaction coefficient with the small-firm dummy (small enterprises take 1) is 0.0146 (p value 0.000) when grouped by the annual median, and 0.0095 (p value 0.083) when grouped according to the scale of the first year of entering the sample. Because the two coding directions are opposite, the negative scale interaction term and the positive small enterprise interaction term lead to the same conclusion, that is, the response of large enterprises is more negative than that of small enterprises. However, the significance depends on the setting, and

the respective coefficients of large firms and small firms are not significant. Considering the multiple tests, this paper takes the heterogeneity of scale as exploratory evidence and does not put forward mechanism propositions based on it.

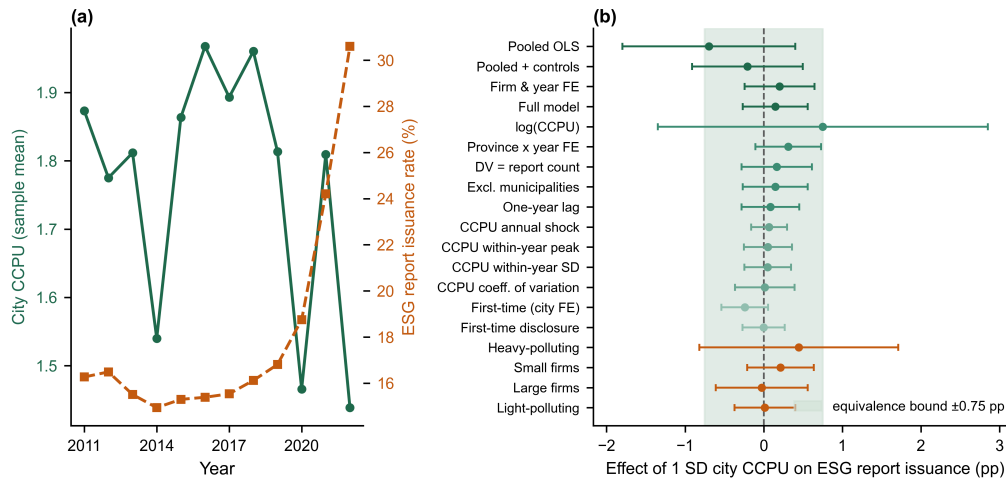


Figure 2. Trends and specification curve

Table 1. City climate policy uncertainty and ESG report issuance

Variable	(1)	(2)	(3)	(4)	(5)
CCPU	-0.0070 (0.0056)	-0.0021 (0.0036)	0.0020 (0.0023)	0.0015 (0.0021)	0.0005 (0.0021)
× Heavy	—	—	—	—	0.0036 (0.0065)
Firm FE	No	No	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes
Controls	No	Yes	No	Yes	Yes
N	40069	40069	40069	40069	40069
R2	0.0003	0.2571	0.0001	0.0189	0.0190

5. Discussion

The core finding of this article is that under the measurement and identification settings used, the average correlation between the uncertainty of urban climate policies and the release of enterprise ESG reports is limited to ± 0.75 percentage points (about 4.1% of the benchmark release rate), which contrasts with the existing evidence of its significant inhibition of green innovation [4] and energy transformation [6]. There are at least four observationally equivalent explanations. First, green innovation and capacity adjustment involve large irreversible capital expenditure and are sensitive to uncertainty. The preparation cost of ESG reports is relatively fixed and small, and the role of the real option mechanism is limited. Second, the ESG disclosure of Chinese enterprises is mainly driven by exchange rules, index component requirements and regulatory guidelines, and the weight of

institutional factors may exceed the marginal changes in the local policy environment. Third, the two theoretical mechanisms are in opposite directions and may cancel each other out. Fourth, both the news text index and the attribution of the enterprise city contain measurement errors, which will attenuate the coefficient toward zero.

The magnitude of the measurement error can be explained by a set of scenarios. If the measurement error of the index meets the classical hypothesis and is independent of the control variable, the real coefficient is equal to the estimated coefficient divided by the reliability; it is calculated by 0.56 percentage points above the 95% confidence interval on both sides, and reliability of 0.9, 0.7, 0.5 and 0.3 corresponds to 0.62, 0.80, 1.12 and 1.86 percentage points respectively. This set of values is an informal boundary of scenario deduction under a specific hypothesis: this article does not estimate the index reliability, and the error of urban attribution and the omission of the announcement are non-classical errors and are not covered by this calculation.

Another exploratory test uses the cross-section of the Huazheng ESG rating: among 3,907 enterprises, the average uncertainty of urban climate policy is 0.54 points higher for every 1 standard deviation higher, and the difference mainly comes from the governance dimension. The result has a different concept, belongs to the cross-section and does not control the level of urban development, which can neither verify nor deny the panel estimate.

There are three boundaries of this study: whether the virtual variable is portrayed in the report is not of quality, and there may be omissions and year attribution errors in the announcement retrieval; the city attribution of the enterprise is based on the current address, and the relocation within the sample period is not tracked, and the wrong enterprise year cannot be corrected by the fixed effect of the enterprise; the sample only contains enterprises that can match the company's profile, and the early delisting enterprises are incomplete.

6. Conclusion

This article examines the relationship between the uncertainty of urban climate policies and the release of enterprise ESG reports. On 40,069 firm-year observations, the estimated coefficient was 0.0015, which was not significant; the equivalence test showed that the coefficient could be rejected as falling outside ± 0.75 percentage points under the benchmark model. This lack of significance remains stable under 19 settings, four uncertainty measures, four inference methods, the first-time-issuance risk set and 1,000 permutation placebos. The direction of the scale interaction is consistent but the significance is unstable, which is only for exploratory evidence.

The direct meaning of the results is that this paper does not observe a conditional correlation beyond the reported equivalence bound between the urban climate policy uncertainty index and the release of enterprise ESG reports. This result cannot be used to judge the effect of interventions that change policy uncertainty, nor does it evaluate the relative effectiveness of any specific policy tools; comparing different disclosure systems requires targeted policy assessment designs. Subsequent research can expand the explanatory variables to the quality of disclosure and assurance level, track changes in the registered place of the enterprise, and examine its impact on substantive environmental input rather than disclosure behavior.

Declaration of interest

The author declares no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author contribution

The author confirms sole responsibility for the study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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