The Impact of Environmental Information Disclosure on Pollution Reduction in China

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Motivation

- 80 percent of Chinese population are exposed to pollution levels far exceeding the safety standards of the U.S. environmental protection bureau. Over 300 million Chinese people are using polluted water; one third of the water system across the nation is below the safety standard, and one fifth of the farmland is contaminated by heavy metals (the Ministry of Environmental Protection of China and Chinese Academy of Engineering, 2011).
- In the eleventh "Five-year Plan" (2006-2010), Chinese state planned to decrease the emission of COD and by 10 percent per year; during the 5-year period, the ratio of energy consumption to the GDP was targeted to decline by 20 percent compared to the 2005 level.

- *Strategies:*
  - *Top-down arrangements*;
    - Specifying sub-targets of energy and environment conservation for local governments;
    - The revised Environmental Protection Law, 2015 (the strictest by now).
  - *Bottom-up strategy: environmental information disclosure*;
    - The GreenWatch program (1998);
    - *The Measures on Open Environmental Information (for trial)(2007).*

- *Questions:*
  - *What determines different extent of disclosure performance for local governments?*
    - Several papers are about this, but not thorough.
  - *Is environmental disclosure effective in combating pollution in China?*
    - *To my knowledge, nobody did this, though it is important.*

Purposes

- *Determinants of environmental disclosure;*
- *Effect of disclosure on pollution reduction in China.*

Literature review

- Environmental regulation approaches:
  - Command-and-control and market oriented tools;
  - Environmental information disclosure (third wave).
    - Advantages: (1) To regulate pollutants not covered by traditional regulations, such as U.S. TRI;

      (2) Effective in some developing countries with few environmental regulatory arrangements or weak enforcement capacity;

      (3) Implement cost is low.

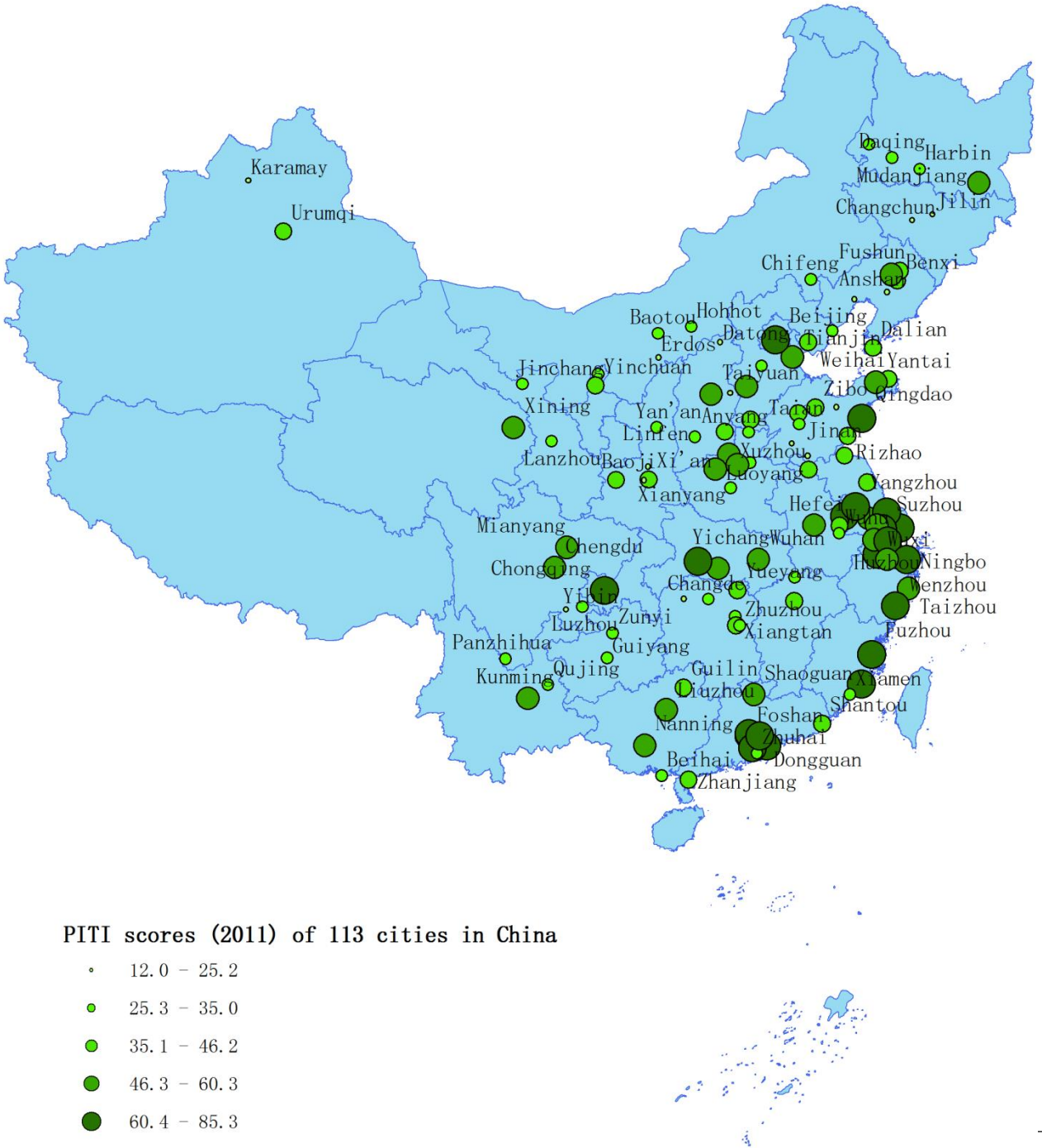
- Lots of research on environmental disclosure in the U.S., Indonesia, India, Philippines, Vietnam among others;
- *Research on China's environmental disclosure is limited possibly due to the lack of data;*
  - *For the GreenWatch, Dasgupta et al. (2004) and Wang et al. (2004).*
  - *The GreenWatch only covers two cities; results are not representative.*
  - *Their research is qualitative while this study is rigorously quantitative.*

PITI index

- *The Institute of Public and Environmental Affairs* together with *the Natural Resources Defense Council* has compiled the PITI index for 113 Chinese cities since 2008.
- The PITI during 2008-2011 is used in the study.
- *To construct the PITI index, each city is first evaluated from eight aspects of environmental disclosure, each of which is assigned a full score with the total of 100.*

Table 1: Eight Aspects of Regional Environmental Disclosure

Aspects of disclosure	Full score	Average score (2011)	Aspects of disclosure	Full score	Average score (2011)
a. Disclosure of enterprise violations	28	10.2	e. Disposition of verified petitions and complaints	18	10.2
b. Results of "enforcement campaigns"	8	4.3	f. Environmental impact assessment (EIA) reports	8	2.6
c. Clean production audit information	8	3.1	g. Discharge fee data	4	1.3
d. Enterprise environmental performance ratings	8	0.9	h. Response to public information requests	18	10.1


Karamay
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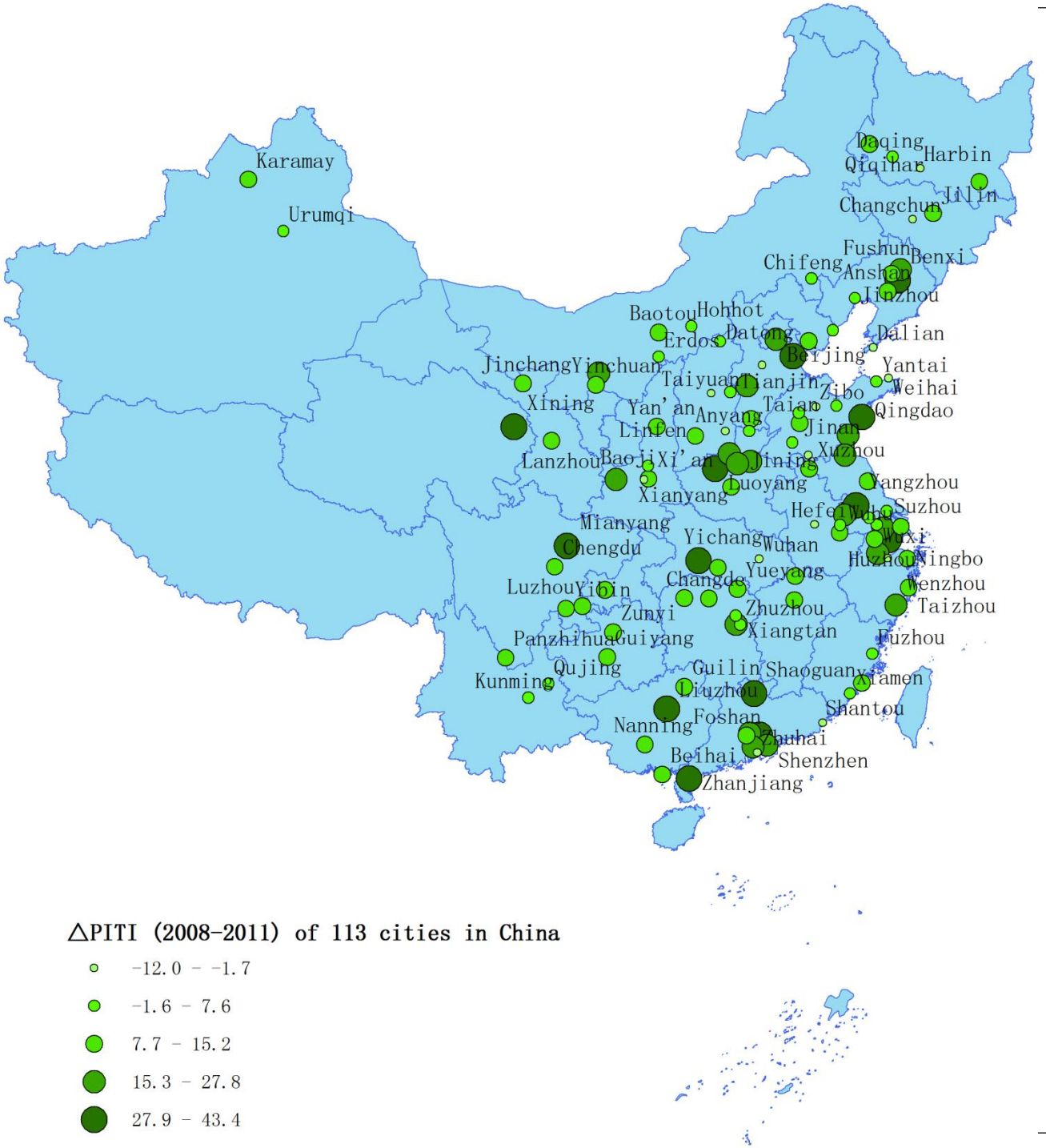
Daqing
Harbin
Mudanjiang
Changchun
Jilin
Fushun
Benxi
Chifeng
Anshan
Baotou
Hohhot
Beijing
Datong
Tianjin
Dalian
Erdos
Weihai
Yantai
Jinchang
Yinchuan
Taiyuan
Zibo
Qingdao
Xining
Yan'an
Anyang
Taian
Jinan
Linfen
Rizhao
Lanzhou
Baoji
Xi'an
Luoyang
Yangzhou
Xianyang
Hefei
Suzhou
Mianyang
Yichang
Wuhan
Chengdu
Huzhou
Ningbo
Chongqing
Yueyang
Changde
Wenzhou
Yibin
Zhuzhou
Taizhou
Luzhou
Zunyi
Xiangtan
Fuzhou
Panzhihua
Guiyang
Kunming
Qujing
Guilin
Shaoguan
Xiamen
Liuzhou
Shantou
Nanning
Foshan
Zhuhai
Beihai
Dongguan
Zhanjiang
PITI scores (2011) of 113 cities in China
12.0 - 25.2
25.3 - 35.0
35.1 - 46.2
46.3 - 60.3
60.4 - 85.3


Karamay
Urumqi
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Harbin
Qiqihar
Jilin
Changchun
Fushun
Benxi
Chifeng
Anshan
Jinzhou
Baotou
Hohhot
Datong
Dalian
Erdos
Beijing
Jinchang
Yinchuan
Yantai
Taiyuan
Tianjin
Zibo
Weihai
Xining
Yan'an
Anyang
Taian
Qingdao
Linfen
Jinan
Lanzhou
Baoji
Xi'an
Xuzhou
Jining
Luoyang
Yangzhou
Xianyang
Suzhou
Hefei
Wuhu
Mianyang
Yichang
Wuxi
Chengdu
Wuhan
Huzhou
Ningbo
Yueyang
Changde
Wenzhou
Luzhou
Yibin
Zhuzhou
Taizhou
Zunyi
Xiangtan
Panzhihua
Guiyang
Fuzhou
Qujing
Guilin
Shaoguan
Xiamen
Kunming
Liuzhou
Shantou
Foshan
Nanning
Zhuhai
Beihai
Shenzhen
Zhanjiang
△PITI (2008-2011) of 113 cities in China
-12.0 - -1.7
-1.6 - 7.6
7.7 - 15.2
15.3 - 27.8
27.9 - 43.4

Empirical model – determinants of PITI

- ***Hypothesis 1***: *Mayors' tenure is positively correlated with cities' PITI scores; non- native mayors or Party Committee Secretaries with a PhD degree come along with better environmental disclosure.*
- ***Hypothesis 2***: *Cities with high unemployment rates have lower PITI scores; tourist cities would have higher PITI.*
- ***Hypothesis 3***: *Cities with more internet users, higher GDP per capita and closer to the Hong Kong would have higher PITI scores.*
- ***Hypothesis 4***: *Cities with better legal system are associated with higher PITI index.*

Specification:

$$PITI_{it} = \beta_0 + \beta_1 O_{it} + \beta_2 E_{it} + \beta_3 P_{it} + \beta_4 Legal_{it} + \beta_5 X_{it}$$

$$+ prov.\ fixed\ effects + year\ fixed\ effects + \varepsilon_{it}, \qquad (1)$$

Table 4: The Determinants of Cities' PITI Scores

Method	OLS	OLS	OLS	OLS	OLS	OLS	QMLE
Model number	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tenure	0.969					0.738	0.738
	(0.38)**					(0.35)**	(0.35)**
Native	-0.77					-1.07	-1.29
	(1.31)					(1.26)	(1.27)
Native_s	-1.14					-1.37	-1.71
	(1.26)					(1.18)	(1.18)
PhD	3.37					2.45	2.5
	(1.33)**					(1.14)**	(1.15)**
PhD_s	-0.44					-0.25	-0.17
	(1.34)					(1.29)	(1.33)
Unemploy		-2.43				-2.39	-2.5
		(1.1)**				(1.19)**	(1.18)**
Tourism		7.54				3.99	4.94
		(2.5)***				(2.83)	(2.8)*
log(Internet)			5.16			3.89	4.17
			(0.72)***			(0.84)***	(0.86)***
log(Dist)			-4.68			-5.64	-5.12
			(2.48)*			(2.6)**	(2.5)**
log(GDP_p)	9.52	10.93	6.87	12.53	15.53	10.39	11.1
	(1.53)***	(1.49)***	(1.23)***	(1.59)***	(1.48)***	(1.61)***	(1.63)***
Legal				3.11			
				(1.25)**			
log(firm size)					-9.52	-5.68	-6.35
					(1.49)***	(1.54)***	(1.61)***
$log(SO2)_{t-1}$	1.57	2.05	0.43	1.45	1.96	0.91	1.02
	(0.94)*	(0.93)**	(0.88)	(1.2)	(0.93)**	(0.9)	(0.98)

Table 5: The Determinants of Cities' Sub-PITI Scores

Dependent variable	PITI_a	PITI_b	PITI_c	PITI_d	PITI_e	PITI_f	PITI_g	PITI_h
Model number	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tenure	0.15	-0.002	0.09	0.06	0.15	0.18	0.006	0.2
	(0.17)	(0.05)	(0.04)**	(0.03)**	(0.15)	(0.04)***	(0.043)	(0.17)
Native	-0.44	-0.32	-0.08	0.04	0.53	0.26	-0.16	-0.8
	(0.58)	(0.2)	(0.16)	(0.11)	(0.59)	(0.19)	(0.14)	(0.7)
Native_s	-1.24	-0.57	-0.06	0.001	-0.02	0.11	0.1	0.3
	(0.54)**	(0.2)***	(0.17)	(0.13)	(0.59)	(0.17)	(0.15)	(0.6)
PhD	2.17	0.09	-0.012	0.11	0.64	-0.04	0.13	-0.65
	(0.6)***	(0.19)	(0.17)	(0.1)	(0.67)	(0.16)	(0.15)	(0.6)
PhD_s	0.41	-0.21	-0.26	-0.05	0.21	-0.19	0.005	-0.15
	(0.6)	(0.24)	(0.18)	(0.09)	(0.57)	(0.18)	(0.15)	(0.6)
Unemploy	-0.36	0.22	-0.06	-0.07	-2.32	0.33	0.26	-0.4
	(0.55)	(0.17)	(0.15)	(0.09)	(0.5)***	(0.29)	(0.23)	(0.5)
Tourism	-0.08	-0.28	0.55	-0.1	3.09	0.07	0.01	0.7
	(1.22)	(0.49)	(0.32)*	(0.2)	(1.1)***	(0.3)	(0.3)	(1.08)
log(Internet)	1.26	0.34	-0.18	0.09	1.04	-0.01	0.38	0.97
	(0.3)***	(0.13)**	(0.12)	(0.08)	(0.4)***	(0.11)	(0.1)***	(0.4)**
log(Dist)	-3.86	-0.003	-1.08	-0.98	1.05	-0.48	0.58	-0.8
	(0.9)***	(0.43)	(0.46)**	(0.3)***	(1.26)	(0.37)	(0.36)	(1.2)
log(GDP_p)	1.78	0.71	0.26	0.14	3.75	0.44	0.27	3.02
	(0.7)**	(0.29)**	(0.26)	(0.14)	(0.8)***	(0.26)*	(0.21)	(0.8)***
log(firm size)	-1.7	-0.47	0.01	-0.08	-1.3	-0.05	0.08	-2.17
	(0.67)**	(0.3)	(0.24)	(0.14)	(0.8)	(0.22)	(0.2)	(0.8)**
$log(SO2)_{t-1}$	-0.97	0.23	-0.04	0.12	1.07	-0.18	-0.34	1.02
	(0.4)**	(0.17)	(0.12)	(0.08)	(0.4)**	(0.12)	(0.1)***	(0.44)**

Empirical model – effects of PITI

- ***Hypothesis 5:*** *Cities with higher PITI scores have more pollution-combating expenditures and better environmental performance; greater community pressure will reinforce the impact of environmental disclosure on cities' pollution reduction.*
- ***Hypothesis 6:*** *Environmental disclosure complements traditional regulation in that it reinforces the effects of traditional environmental regulation.*

Specification:

$$Y_{it} = \alpha_0 + \alpha_1 PITI_{it-1} + \alpha_2 \mathrm{Re}gu_{it-1} + \alpha_3 PITI_{it-1} * Char\_\mathrm{int}_{it-1} + \alpha_4 PITI_{it-1} * Inter_{it-1}$$

$$+ \alpha_5 X_{it} + v_i + \varepsilon_{it}, \qquad (2)$$

- Estimation method: fixed/random effect?
- Fixed effect model is equivalent to adding 113 city dummies and the lost degrees of freedom amount to over 35 percent of usable observations.
- So random effect + Hausman test.

Table 6: Correlation Coefficients between Variables (2)

	1	2	3	4	5	6	7	8
1 $PITI_{t-1}$	1							
2 $\log(Charge_{t-1})$	0.13*	1						
3 $\log(Punish_{t-1})$	0.34*	0.44*	1					
4 $PITI_{t-1} \times Char\_int_{t-1}$	0.02	0.52*	0.12*	1				
5 $PITI_{t-1} \times Inter_{t-1}$	0.5*	-0.03	0.17*	-0.12*	1			
6 $\log(Elec\_int_t)$	-0.03	-0.07	-0.12*	0.2*	0.04	1		
7 $Second_t$	-0.09	0.13*	0.03	0.12*	-0.13*	0.24*	1	
8 $Growth_t$	-0.21*	-0.18*	-0.26*	-0.12*	-0.22*	-0.06	0.02	1

Notes: * denotes 5% significance level.

Table 7: Effects of environmental disclosure on pollutants and pollution-control investment (1)

Dependent variable	COD_den	COD_int	NH_den	NH_int	$SO2\_den$	$\log(Invest)$
Model number	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$PITI_{t-1}$	**-0.19**	**-0.12**	-0.06	**-0.66**	**-0.31**	**0.015**
	(0.09)**	**(0.07)***	(0.05)	**(0.3)****	**(0.1)*****	**(0.007)****
$\log(Charge_{t-1})$	-11.5	-9.66	-2.59	-18.9	-6.05	0.16
	(5.68)**	(4.5)**	(2.27)	(13.4)	(3.7)	(0.16)
$\log(Punish_{t-1})$	-5.35	-2.5	-1.95	-6.49	1.7	-0.04
	(1.9)***	(1.6)	(1)**	(6.6)	(1.7)	(0.09)
$PITI_{t-1}$	0.12	0.07	0.08	0.5	0.13	
$\times Char\_int_{t-1}$	(0.1)	(0.08)	(0.59)	(0.4)	(0.1)	
$PITI_{t-1}$	**-0.11**	**-0.08**	**-0.05**	-0.15	-0.02	
$\times Inter_{t-1}$	**(0.04)****	**(0.03)****	**(0.02)****	(0.1)	(0.04)	
$\log(Elec\_int_t)$	3.7	4.7	0.8	7.1	-10.1	0.14
	(4.2)	(3.2)	(1.9)	(10.1)	(2.6)***	(0.18)
$Second_t$	-0.07	0.05	0.14	-0.1	0.09	0.013
	(0.18)	(0.16)	(0.08)*	(0.7)	(0.2)	(0.01)
$Growth_t$	-0.9	-0.59	-0.48	-3.01	0.46	-0.02
	(0.8)	(0.7)	(0.46)	(3.5)	(0.6)	(0.03)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
χ^2	5.33	6.2	6.4	5.31	6.8	7.42
$Prob > \chi^2$	0.72	0.62	0.6	0.72	0.54	0.19

Table 8: Effects of environmental disclosure on pollutants and pollution-control investment (2)

Dependent variable	*COD_int*	*SO2_den*	*SO2_den*	*COD_den*	*SO2_den*	*COD_den*	*COD_int*	*SO2_den*	*NH_den*	log(*Invest*)
Sub- PITI	**PITI_c**	**PITI_c**	**PITI_f**	**PITI_g**	**PITI_g**	**PITI_h**	**PITI_h**	**PITI_h**	**PITI_h**	**PITI_h**
Model number	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
sub_PITI_{t-1}	**-1.7**	**-1.4**	**-1.6**	**-1.95**	**-1.8**	**-0.81**	**-0.43**	**-0.57**	**-0.18**	**0.029**
	(1)*	**(0.8)***	**(0.8)****	**(1)***	**(0.9)***	**(0.2)*****	**(0.16)*****	**(0.2)*****	**(0.1)***	**(0.016)***
$\log(Charge_{t-1})$	-8.39	-4.6	-5.8	-11.3	-5.5	-11.7	-9.7	-5.87	-2.5	0.2
	(4.3)**	(3.9)	(3.9)	(5.7)**	(3.9)	(5.4)**	(4.4)**	(3.7)	(2.3)	(0.17)
$\log(Punish_{t-1})$	-3.3	0.5	1.4	-6.2	0.52	-5.1	-2.5	1.1	-2	-0.02
	(1.8)*	(1.6)	(1.8)	(2.1)***	(1.6)	(1.9)***	(1.6)	(1.6)	(1)**	(0.08)
sub_PITI_{t-1}	0.05	0.08	0.09	0.12	0.1	0.1	0.05	0.1	0.07	
$\times Char\_int_{t-1}$	(0.07)	(0.11)	(0.11)	(0.1)	(0.11)	(0.1)	(0.07)	(0.1)	(0.05)	
sub_PITI_{t-1}	**-0.1**	-0.08	-0.07	**-0.16**	-0.08	**-0.1**	**-0.09**	-0.06	**-0.05**	
$\times Inter_{t-1}$	**(0.03)*****	(0.06)	(0.05)	**(0.04)*****	(0.06)	**(0.04)****	**(0.03)*****	(0.05)	**(0.02)*****	
$\log(Elec\_int_t)$	4.77	-9.6	-9.7	3.9	-9.5	3.75	4.78	-9.83	0.8	0.14
	(3.2)	(2.7)***	(2.7)***	(4.2)	(2.6)***	(4.1)	(3.2)	(2.5)***	(1.8)	(0.18)
$Second_t$	0.07	0.12	0.07	-0.1	0.07	-0.05	0.06	0.11	0.14	0.012
	(0.17)	(0.21)	(0.2)	(0.18)	(0.2)	(0.17)	(0.16)	(0.2)	(0.08)*	(0.01)
$Growth_t$	-0.48	0.55	0.46	-1.03	0.45	-0.9	-0.56	0.48	-0.48	-0.024
	(0.69)	(0.64)	(0.6)	(0.8)	(0.6)	(0.8)	(0.7)	(0.6)	(0.46)	(0.035)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
χ^2	10.2	6.9	7.1	7.43	6.9	5.9	5.4	7.8	7.4	6.9
$Prob > \chi^2$	0.25	0.54	0.52	0.49	0.55	0.65	0.71	0.45	0.49	0.22

Main results

- *Environmental disclosure is generally effective in pollution reduction;*
- *The effect is greater when public pressure for better environment is higher;*
- *No interaction between disclosure and traditional regulation;*
- *Among the eight aspects of disclosure, "Response to public information requests" is most important in pollution reduction.*

Thank you and enjoy!!!