

# **Can Voluntary Programs Resolve China's Environmental Crisis?**

*An Analysis of ISO 14001 Certification in a Sample of Chinese Firms*

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*Poster prepared for presentation at the Agricultural & Applied Economics Association's 2011  
AAEA & NAREA Joint Annual Meeting, Pittsburgh, Pennsylvania, July 24-26, 2011*

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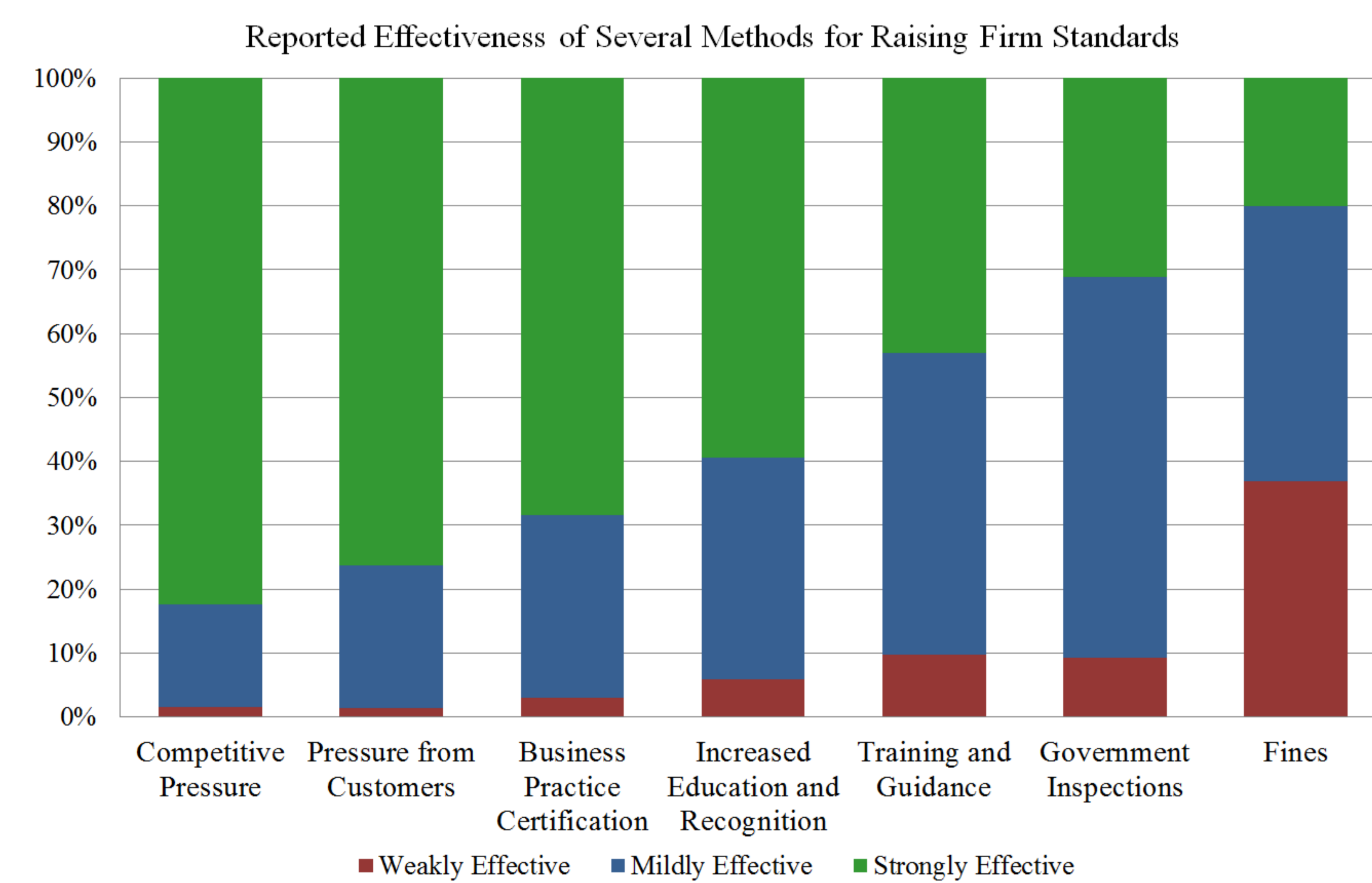
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## Introduction



- China's rapid economic growth has been accompanied by rapid environmental degradation.
- China is currently the largest producer of greenhouse gasses in the world.
- China is also home to 20 of the 30 most polluted cities in the world. (World Bank, 2011)

- Weak federal oversight leads to poor enforcement of environmental regulations at the local level (Beyer, 2006). Firms report that regulatory enforcement actions rank among the least effective methods for raising production standards.



- Voluntary environmental programs such as the ISO 14001 environmental management system (EMS) standard present firms with market-based incentives to improve environmental performance. ISO 14001 is particularly popular in China, which now ranks as the world's single largest adopter of the standard (ISO, 2008).

## Objectives

- Estimate the determinants of ISO 14001 certification in a sample of Chinese firms.
- Estimate the effect of ISO 14001 certification on environmental performance, accounting for potential endogeneity between certification and performance (Potoski and Prakash, 2005).

## Data

- Data come from the Industrial Enterprise Survey conducted in 2006 in China with the cooperation of the International Finance Corporation (IFC) and China's National Bureau of Statistics (NBS). Approximately 100 firms were surveyed in each of 12 cities (1,268 total).



- The sample only includes manufacturing firms with annual revenue greater than 5 million yuan. The sample was stratified according to ownership type (state-owned, foreign invested, private domestic) and then firm size within each city. A cross-section of 666 firms remains after eliminating firms for missing data.

## Methods

- Estimate the determinants of ISO 14001 certification
  - Estimate a probit model of ISO 14001 certification (Nishitani, 2009)
  - Estimate a bivariate probit with selection for EMS adoption and EMS certification (King et al., 2005).
- Estimate a two-stage probit model of environmental performance instrumenting ISO 14001 certification with variables from (1).
  - Measure performance with self-reported data on compliance with environmental standards and citations for violating environmental regulations

## Results

- ISO 14001 Certification

	Probit			Bivariate Probit	
	(1)	(2)	(3)	ISO 14001	Env Prot Dept
<b>Regulatory Environment</b>					
Few Gov't Environmental Inspections (0-10)	-0.35 (-1.36)	-0.30 (-1.17)	-0.28 (-1.06)	0.14 (0.51)	-0.77 <sup>a</sup> (-3.93)
No Applicable Environmental Standards	-0.98 <sup>c</sup> (-1.89)	-0.98 <sup>c</sup> (-1.83)	-0.97 <sup>c</sup> (-1.80)	-0.60 (-0.88)	-0.82 <sup>a</sup> (-4.53)
<b>Customer Characteristics</b>					
Largest Customer: Foreign	0.37 (1.46)	0.15 (0.70)	0.15 (0.72)	0.34 <sup>c</sup> (1.85)	-0.17 (-1.31)
Environmentally Conscious Customers		0.66 <sup>a</sup> (2.99)	0.64 <sup>a</sup> (2.97)	0.33 (1.44)	0.38 <sup>a</sup> (3.25)
Customer Quality Inspections			-0.25 (-1.11)	-0.46 <sup>b</sup> (-2.45)	0.40 <sup>a</sup> (3.08)
Environmental Customers x Quality Inspections			0.91 <sup>c</sup> (1.83)	0.91 <sup>b</sup> (2.13)	0.15 (0.57)
<b>Firm Characteristics</b>					
Environmental Protection Department	0.91 <sup>a</sup> (4.03)	0.81 <sup>a</sup> (3.43)	0.82 <sup>a</sup> (3.49)		
log(Total Employment)	0.35 <sup>a</sup> (4.05)	0.37 <sup>a</sup> (4.11)	0.38 <sup>a</sup> (4.24)		0.38 <sup>a</sup> (7.53)
Trademark	0.34 (1.55)	0.32 (1.49)	0.32 (1.43)	0.28 (1.44)	-0.03 (-0.27)
Eco-Label	1.24 <sup>a</sup> (4.68)	1.17 <sup>a</sup> (4.35)	1.23 <sup>a</sup> (4.54)	0.48 <sup>b</sup> (2.04)	0.64 <sup>a</sup> (3.36)
ISO 9001 Certification	1.31 <sup>a</sup> (4.55)	1.28 <sup>a</sup> (4.56)	1.29 <sup>a</sup> (4.46)	1.07 <sup>a</sup> (4.22)	
Foreign Joint Venture	0.44 <sup>b</sup> (1.92)	0.43 <sup>c</sup> (1.81)	0.42 <sup>c</sup> (1.77)	0.20 (1.00)	0.06 (0.42)
College Educated Management (60%+)	-0.20 (-1.10)	-0.16 (-0.86)	-0.12 (-0.66)	-0.03 (-0.16)	0.39 <sup>a</sup> (3.06)
Low Market Share (0% to 1%)	-0.06 (-0.29)	-0.02 (-0.11)	-0.02 (-0.09)	0.23 (1.20)	-0.12 (-1.00)
City FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
N	589	589	589	357	666
Pr > Chi <sup>2</sup>	0.00	0.00	0.00		0.00
Pr > Chi <sup>2</sup> (p=0)					0.01

- ISO 14001 certification is positively associated with size, foreign ownership, superior EMS, and serving environmentally conscious customers. There appears to be complementarity between ISO 14001 and other environmental/ISO certifications.
- Certification is more likely when environmentally conscious customers invest in ex-post monitoring.
- Bivariate probit results show that size and human capital are significant in determining the EMS adoption decision, but not the certification decision.

- Environmental Performance

	Env. Citation	Environmental Standards Met					
		All	Waste Gas	Waste Water	Solid Waste	Noise	Bio-diversity
ISO 14001 (IV)	-1.92 <sup>b</sup> (-2.05)	1.53 <sup>b</sup> (2.20)	0.06 (0.05)	2.39 <sup>b</sup> (2.07)	1.49 (0.83)	2.52 <sup>a</sup> (2.83)	1.53 (1.02)
N	514	514	241	300	142	365	164
Pr > Chi <sup>2</sup>	0.00	0.00	0.96	0.00	0.00	0.02	0.00
Wald Exogeneity	0.04	0.06	0.97	0.06	0.05	0.01	0.11
Overidentification	0.14	0.58	0.21	0.32	0.32	0.45	0.66
Prob > F (Joint significance of instr.)	0.00	0.00	0.00	0.00	0.00	0.00	0.01

a, b and c represent significance at the 1%, 5% and 10% level

- Certification lowered the probability of observing a citation and raised the probability a firm reported compliance with relevant environmental standards.
- Results are robust to controls for endogeneity using valid instruments.

## Conclusions

- Firms use ISO 14001 to signal superior EMS technology to environmentally conscious customers.
- A separating equilibrium with ISO 14001 may require ex-post monitoring since it does not signal a firm's environmental performance.
- ISO 14001 certified firms exhibit superior environmental performance, even after controlling for endogeneity.

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