

# The Role of Environmental Management Capacity on Energy Efficiency: Evidence from China's Electricity Industry

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# Environmental Management Capacity in the U.S. Electricity Industry



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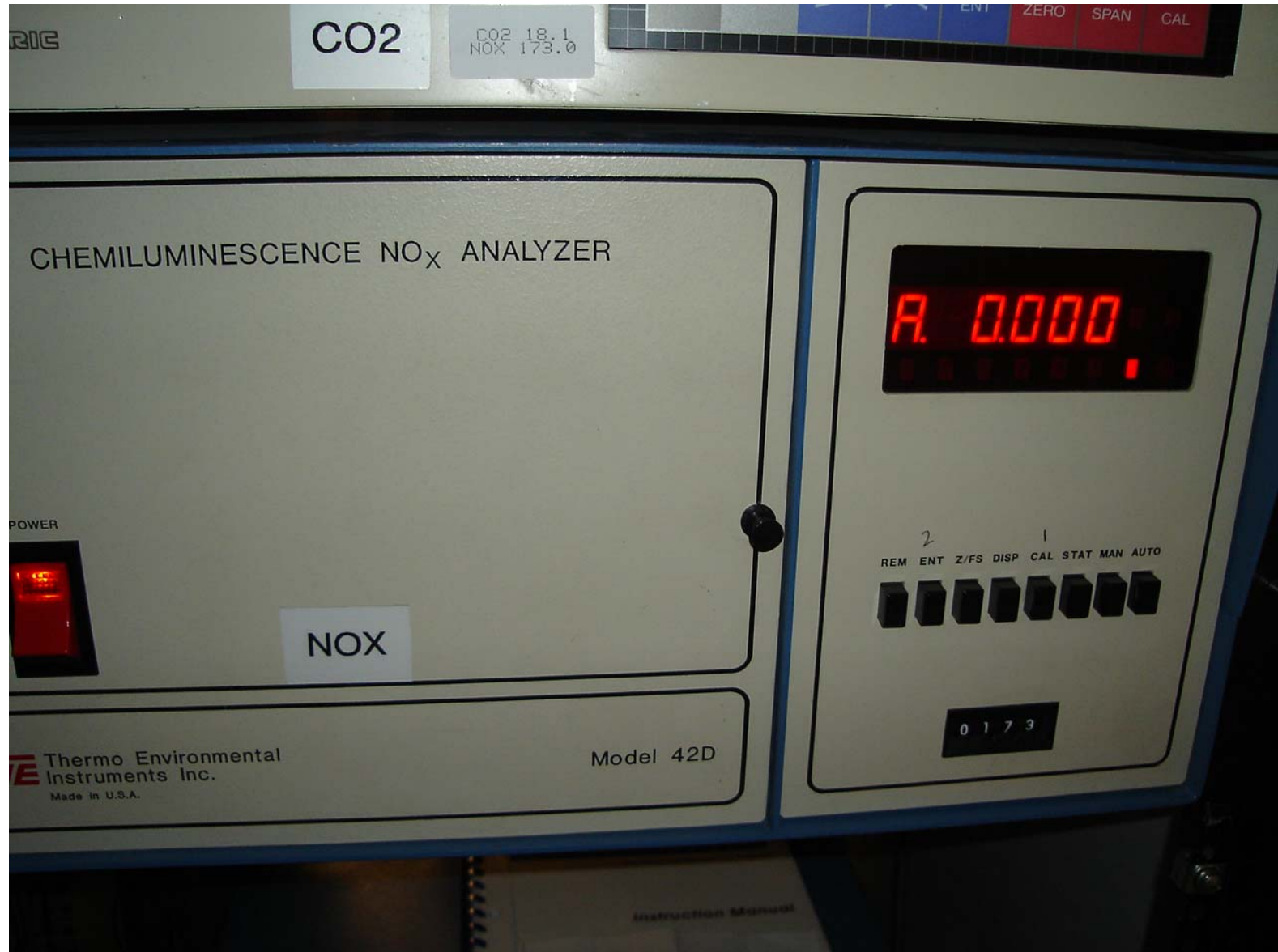




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# Environmental Management Capacity

**Efforts toward environmental protection through:**

- **Monitoring**
- **Administrative management**

**by the Government and Firms**

# Objective

- 1. Estimate energy efficiency in China's electricity industry**
- 2. Identify factors affecting energy efficiency**



# Outline

1. Introduction
2. Model
3. Results
4. Summary and Policy Implications

# 1. Introduction

# Energy Consumption in China

## **Heavy reliance on coal**

- 25% of the world total
- still in rapid increase

# China's Electricity Industry

## **The Biggest Coal Consumer**

- 54% of the total Nation's coal consumption (733 million tons)

## **Main Air Polluter**

- 30% of total SO<sub>2</sub> emission in the Nation

## **Coal Consumption Increasing Rapidly**

- 1,090 million tons in 2010
- 1,350-1,500 million tons in 2020

## **Inefficient Use of Coal**

**Energy Efficiency = Input Coal-Use Efficiency**

# Keys for Energy-Efficiency Improvement

- **Input (coal) price control**
- **R&D for efficient technology**
- **Developing Environmental Management Capacity**



## **2. Model**

# 2-Stage Empirical Model

## 1st Stage:

Estimate energy efficiency

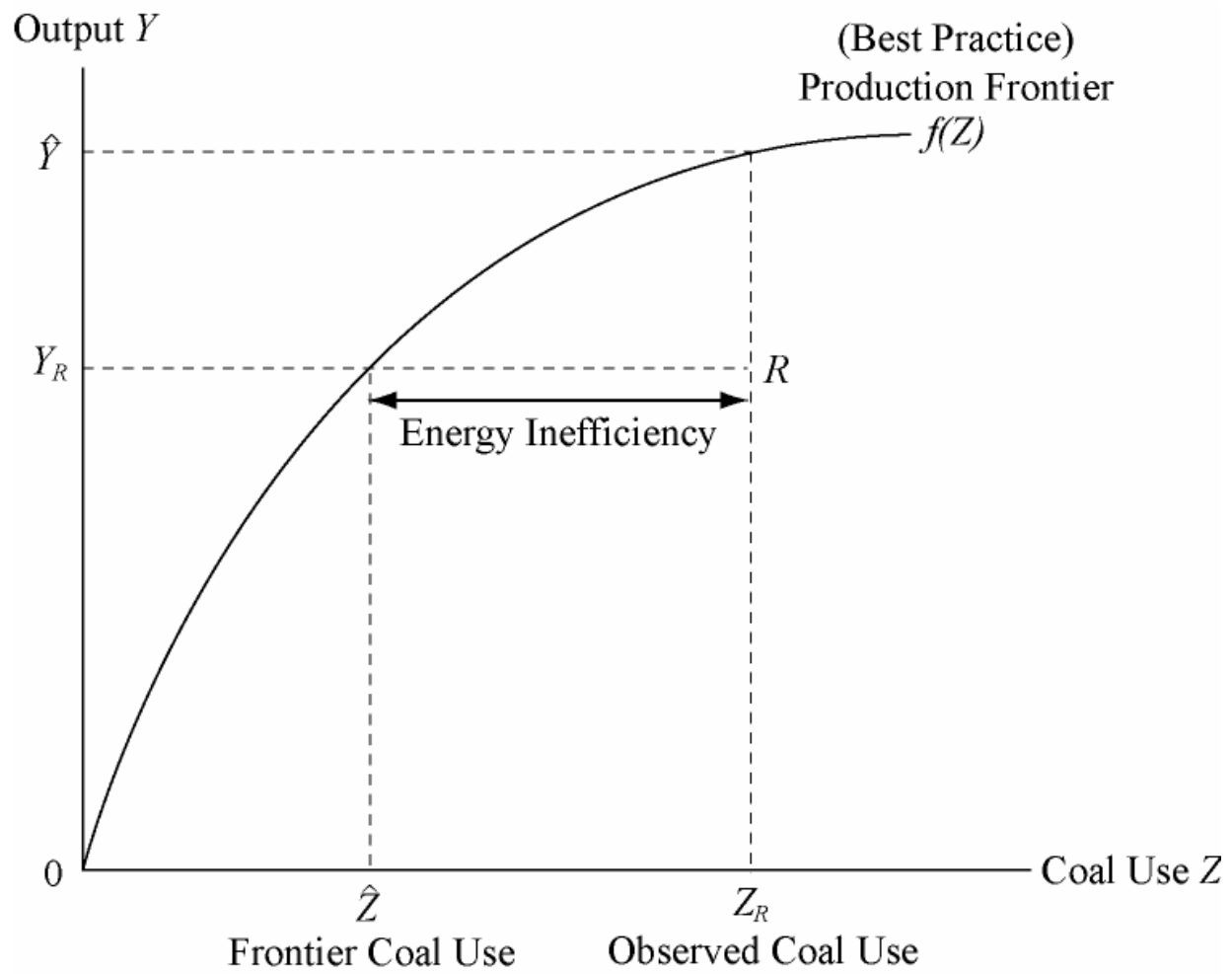
- Time-Varying Decay Stochastic Frontier Model

## 2nd Stage:

Identify factors affecting energy efficiency

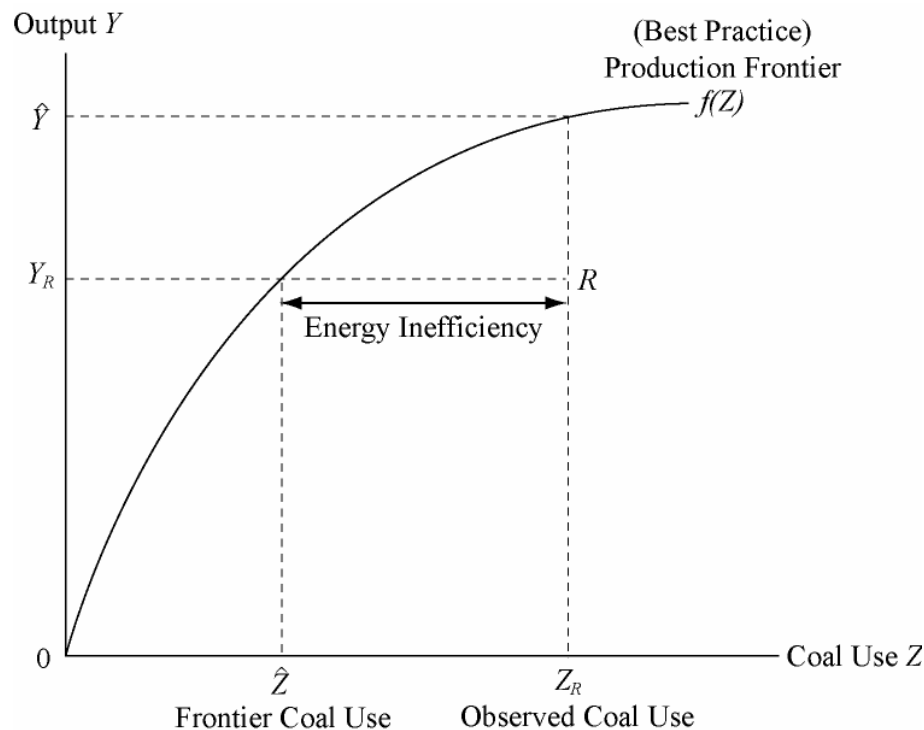
- Fixed-Effects Tobit Model

# Energy Efficiency



# Energy Efficiency

$$\text{Energy Efficiency} = \frac{\text{Best Practice Coal - Use}}{\text{Observed Coal - Use}} = \frac{\hat{Z}}{Z_R}$$



# Data

**Panel Data: 30 provinces from 1998 to 2002**

## **Firm-Level Data:**

- Output (in Yuan)
- Capital (annual value of fixed assets)
- Input coal use
- Environmental Management Capacity by firms
  - # of environmental management staff
  - # of environmental administrative staff

Source:

Survey data by former State Power Corporation of China  
(Compiled by Chinese Academy for Environmental Planning)



# Data

## Other Data for 2nd Stage Analysis

### Province-Level Background Characteristics

- Gross product per capita
- Electricity consumption
- Fuel price
- Environmental management capacity by government
  - # of monitoring and management stations

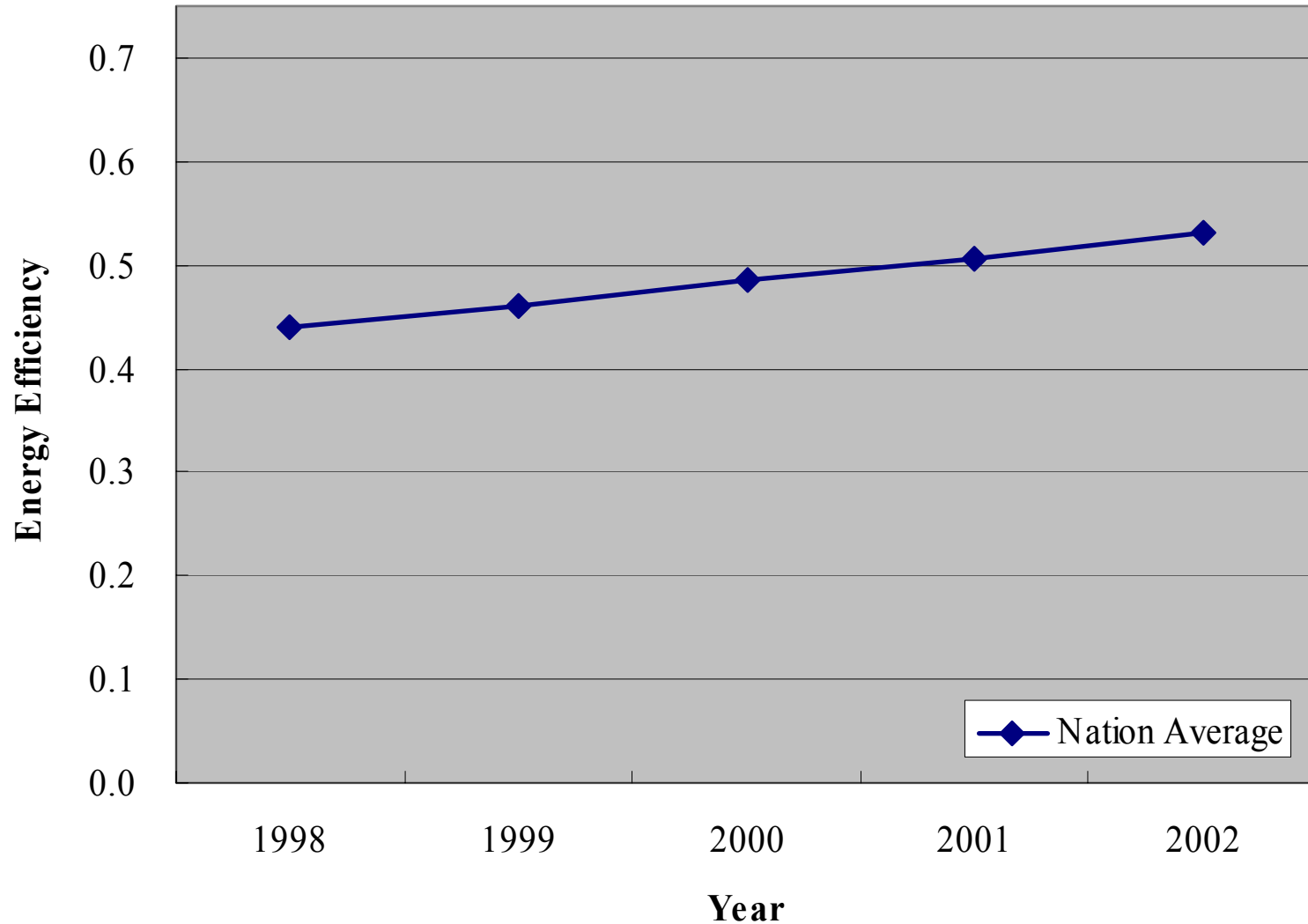
Source:

*Chinese Statistical Yearbook*

*Chinese Environmental Yearbook*

# 3. Results

# 1st Stage: The Estimated Energy Efficiency

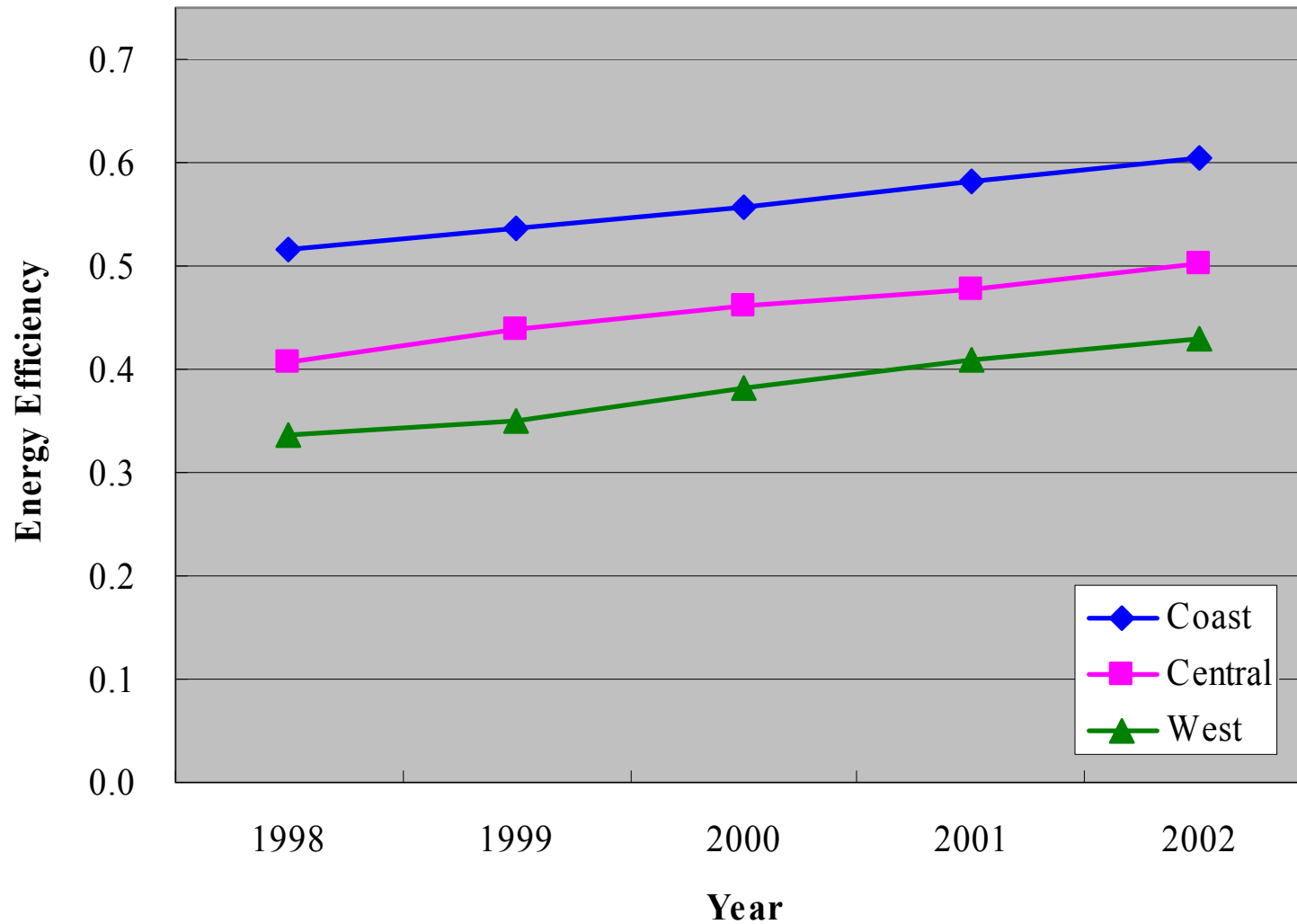


# 2nd Stage:

## Factors Affecting Energy Efficiency

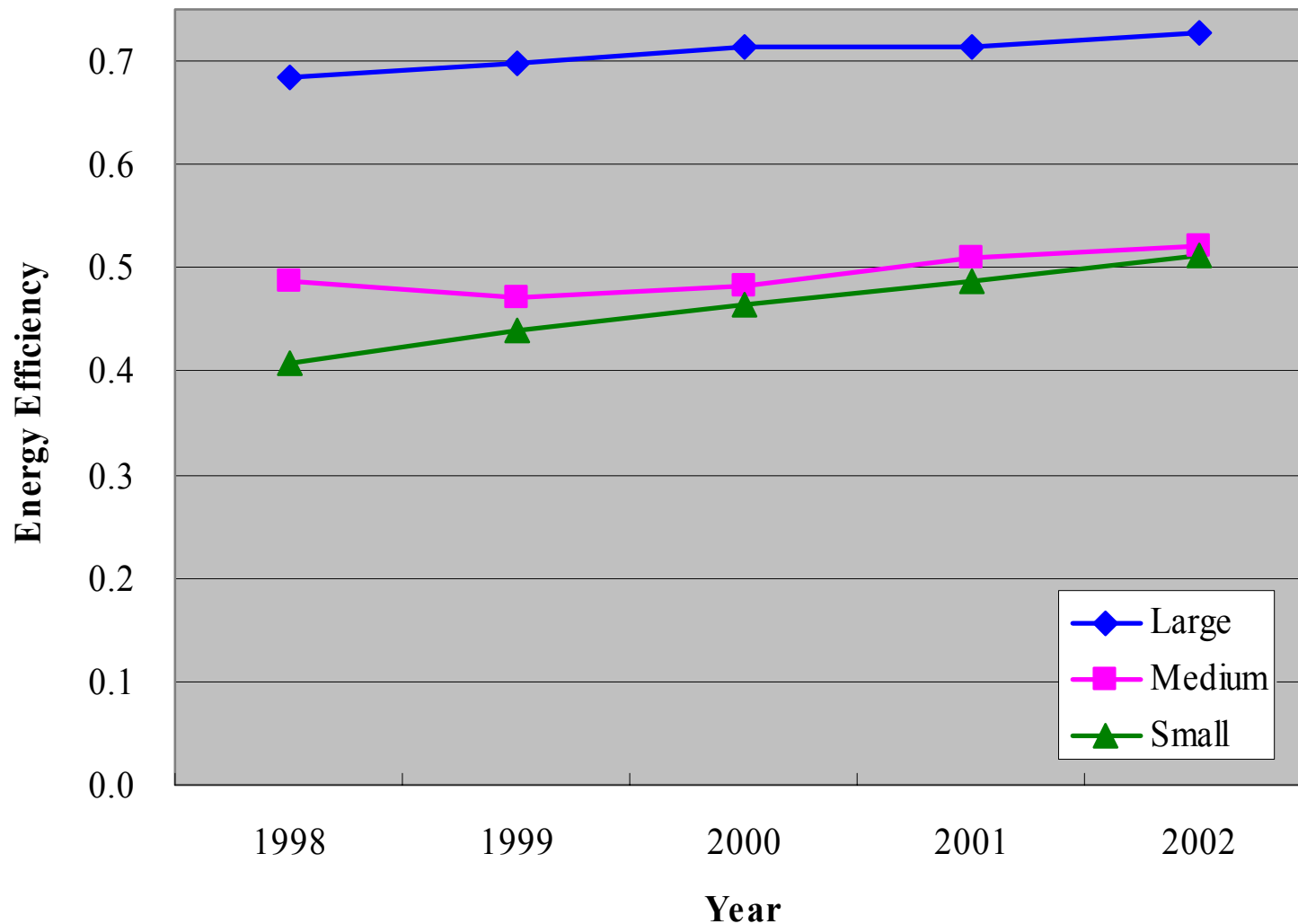
Variable	Coefficient	Standard Error	Elasticity	Standard Error
Constant	0.110 ***	0.015		
<i>Province-level Background Characteristics</i>				
Gross product per Capita	0.041 ***	0.003	0.076 ***	0.006
Electricity consumption	0.000 ***	0.000	0.077 ***	0.009
Fuel price	0.002 ***	0.000	0.506 ***	0.031
<i>Firm-specific Operational Characteristic</i>				
Dummy for large-scale firms	0.039 ***	0.004	0.008 ***	0.001
<i>Government Environmental Management Capacity</i>				
# of monitoring and management station	0.000 ***	0.000	<b>0.092</b> ***	0.010
<i>Firms' Environmental Management Capacity</i>				
# of monitoring staff	-0.001	0.001	-0.003	0.005
# of management staff	0.004 ***	0.001	<b>0.012</b> ***	0.003
$\rho$	0.905 ***	0.004		
$n$	1001			
$\chi^2$	1992.0			
Log-likelihood Ratio	0.790			

# The Estimated Energy Efficiency by Region

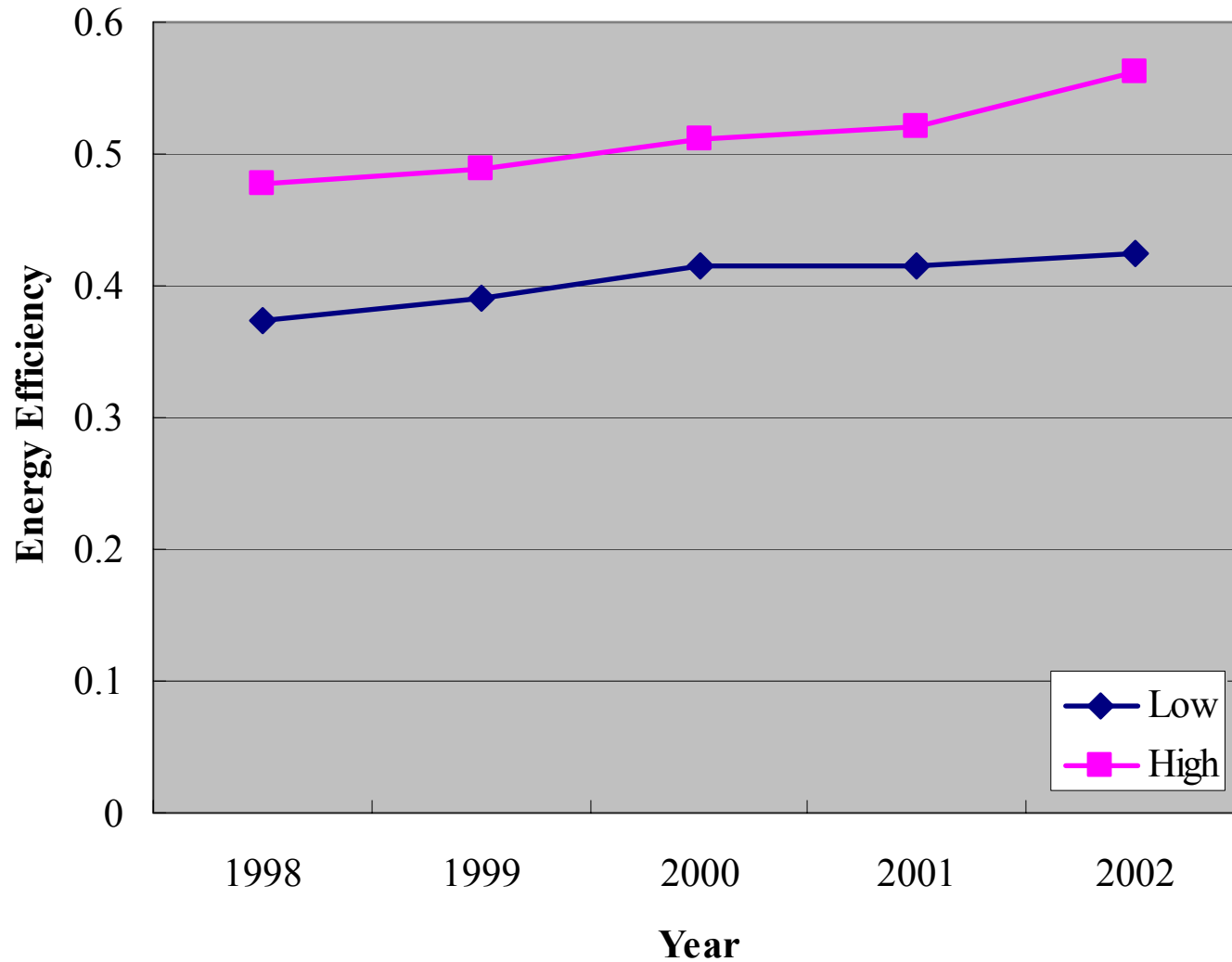




# The Estimated Energy Efficiency by Firm-Size



# The Estimated Energy Efficiency by Environmental Management Capacity by the Government



# The # of Firms by Region and Size

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		Region			Total
		Coast	Central	West	
Firm Size	Large	15	0	0	15
	Medium	38	20	6	64
	Small	40	47	44	131
	Total	93	67	50	210

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## **4. Summary and Policy Implications**

# Summary

- Significant increase in energy efficiency
- Significant variation in energy efficiency by:
  - Region
  - Firm-size
  - Environmental Management Capacity

# Policy Implication

- Target small and medium firms in Central and Western Regions
- Developing Environmental Management Capacity
  - Both government and firms
- Further technical assistance by foreign donor countries

# Next Steps

- Data Improvement
- International Comparison between U.S. and China  
(Joint Study with U of Texas at Austin)

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