AN EMPIRICAL STUDY OF GLOBAL CORPORATE SOCIAL RESPONSIBILITY REPORTING REGULATION AND PRACTICE OVER 2000-2015 PERIOD

BY

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DISSERTATION

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Abstract

This dissertation is motivated by an observation of a global steep increasing trend in corporate social responsibility (CSR) reporting regulation since year 2000. By 2015, world top 63 economies have instituted 345 CSR reporting regulation policies. Among them, 64.2% are mandatory (Carrots&Sticks, 2016). Most previous studies on CSR were conducted when it was practiced voluntarily without regulation. By far, a complete history and full scope quantitative study of recent CSR reporting regulation has not been done yet. Particularly, rare attention has been given to the financial incentives for firms to full CSR under the regulation.

In chapter 1, I analyze the drivers of CSR reporting regulation using long differences by looking back at the entire history of CSR regulation and including most countries which have instituted CSR reporting instruments. I find that the most significant and robust driver of global CSR reporting regulation is the size of an economy measured by GDP level of a country. Besides, the deterioration of $PM_{2.5}$ air pollution level might be a driver to the development of voluntary CSR policies. Both the international trade spillover effect and the international organization promotion effort might be drivers to the development of general sustainability CSR policies. However, during the past 15 years, the regional differences in the development of CSR regulation policies among bordering countries has increased. Additional likely associations with the development of CSR reporting regulation are the extent that a country removes financial bubbles in its stock market and the democratic institution as well as political environment of a country.

In chapter 2, I explore financial incentives for firms to fulfill CSR under CSR reporting regulations. The two key questions I addressed are: Is there a link between firms' CSR performance and financial performance? (Q1) Particularly, can publishing CSR reports motivate firms to fulfill their CSR obligation? (Q2) I answer these two questions by empirically analyzing a large panel data set from China after CSR reporting regulation. The data set includes 120 top firms from China spanning from year 2007 to 2013. The total revenue of sampled firms constitutes around half of China's non-agriculture GDP. Particularly, we introduce the factor of firms' CSR reports and reporting behaviors into our

study, which has not been considered by most studies of CSR since these studies were done when CSR reporting was practiced voluntarily (Orlitzky, Schmidt, Rynes, 2003; Margolis, Elfenbein, and Walsh, 2007). The results show that the short-run links and long-run links between firms' CSR performance and financial performance are different. In the short run, publishing CSR reports generates higher net profit compared with not publishing CSR reports. However, the marginal impact of lagged CSR performance on net profit is negative. In the long run, the marginal impact of lagged CSR performance on net profit is positive. However, better CSR performance also results in higher total operating cost. Leaders and Followers receive positive marginal impact of lagged CSR performance on net profit in the long run, while the positive marginal impact on Leaders is greater than the marginal impact on Followers. Leaders and Followers' CSR performance need to exceed a certain level to receive a positive net profit from CSR performance. The Uncommitted firms receive negative marginal impact of lagged CSR performance on net profit. Among four CSR performance sub-indices, social CSR performance has the most consistent positive impacts on profitability. Lagged market CSR performance and CSR management performance also have positive effects on profitability. The link between environmental CSR performance and financial performance is very limited and in general negative.

In chapter 3, I evaluate the impacts of global CSR reporting regulation on sustainable development since 73% of global CSR reporting policies are related with firms' environmental CSR performance and 38% of global CSR reporting policies are related with general sustainability (Carrots&Sticks, 2016). I select three indicators for sustainable development: energy intensity, CO_2 emissions and $PM_{2.5}$ pollution level.

For energy intensity, I followed Fisher-Vanden, Jefferson, Liu and Tao (2004) and used a reduced form model to investigate whether CSR regulation may urge firms to use energy more efficiently or prudently and further reduce a nation's energy intensity. Since I use macro level time series data, panel unit root test and panel cointegration analysis are used to explore the relations.

For CO_2 emissions, I started from Kaya identity (Yamaji, Matsuhashi, Nagata & Kaya, 1991), which gives an exact decomposition of CO_2 emissions into four factors, and then focused on examining the impact of CSR regulation on the key factor of carbon intensity of energy by using panel cointegration analysis.

For $PM_{2.5}$ pollution level, I used a dynamic panel model and adopted a recently developed econometric method, panel fully aggregated estimator (PFAE) by using X-differencing procedure proposed by Han, Phillips, and Sul (2014) which has strong asymptotic and finite sample performance characteristics that dominate other procedures such as bias corrected least squares (LSDVC), generalized method of moments (GMM), and system GMM methods.

Overall, I find that there is a positive long-run Granger causality from 3-year lag of environmental CSR policies to energy intensity. This might be due to the reason that all CSR reporting policies on pollution control are classified into environmental CSR policies. And more CSR policies on pollution control may increase the cost to producers to meet the environmental requirements in the short run. No significant result is found for CSR policies on CO_2 emissions. However, both current year general sustainability CSR policies and 3-year lag of environmental CSR policies have significant negative impacts on $PM_{2.5}$. And 3-year lag of environmental CSR policies also has a significant negative impact on $PM_{2.5}$. Besides, I also identify some other important factors related with energy efficiency, CO_2 emissions and $PM_{2.5}$ pollution.

At the end of each chapter, policy implications and suggestions are provided.

To the Lord, my heavenly father;

And to my parents, for their love without any reservation.

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Chapter 1
Drivers of Global Corporate Social Responsibility (CSR) Reporting Regulation

1.1 Introduction

It was around the year 2000 that a remarkable shift of the global consensus in the scope of corporate sustainability reporting emerged. In June 2000, the Global Reporting Initiative (GRI) launched the first global framework for comprehensive sustainability reporting *Sustainability Reporting Guidelines on Economic, Environmental, and Social Performance*, which enlarged the coverage scope of sustainability reporting from environmental issues to a triple-bottom-line of economic, environmental and social performance. (GRI's History, GRI website; *Sustainability Reporting Guidelines*, GRI, June 2000). Soon after, this triple-bottom-line has been accepted as modern standards of corporate social responsibility (CSR) (*What is CSR?*, UNIDO, website), which is defined as "the responsibility of enterprises for their impacts on society" (European Commission, 2011).

Since then, the number of the reporting regulation instruments that require firms to fulfill their CSR and report their CSR performance information has grown fast. By 2015, 98.4% of the world top 64 economies have instituted 345 reporting regulation instruments in total. Moreover, 64.2% of these instruments are mandatory (www.carrotsandsticks.net). It is worth to ask why does CSR reporting regulation grow so fast globally? What are drivers behind this growth? What role does each driver play?

Most previous studies on CSR were conducted when CSR was practiced voluntarily (Orlitzky, Schmidt, and Rynes, 2003; Margolis, Elfenbein, and Walsh, 2007; Kitzmueller & Shimshack, 2012). However, a complete history and full scope study of CSR reporting regulation has not been done yet. It would be valuable to review the development of global CSR reporting regulation to better understand the role of each driver in the fast growth and globalization of CSR reporting regulations. Such a study would also help us to better understand the divergence of CSR reporting regulation among different countries.

In this chapter, I analyze the drivers of CSR reporting regulation using long differences by looking back at the entire history of CSR regulation and including most countries which have instituted CSR reporting instruments.

I find that the most significant and robust driver of global CSR reporting regulation is the size of an economy measured by GDP level of a country. Besides, the deterioration of $PM_{2.5}$ air pollution level might be a driver to the development of voluntary CSR policies. Both the international trade spillover effect and the international organization promotion effort might be drivers to the development of general sustainability CSR policies. However, during the past 15 years, the regional differences in the development of CSR regulation policies among bordering countries has increased. Additional likely associations with the development of CSR reporting regulation are the extent that a country removes financial bubbles in its stock market and the democratic institution as well as political environment of a country.

The rest of this chapter is organized as follows. In section 1.2, I take a short review on the history of global CSR reporting regulation and identify five drivers of global CSR reporting regulation. In section 1.3, I first select proxy variables for drivers and then empirically test the impacts of drivers in shaping the development of global CSR reporting regulation. In section 1.4, limitations and future studies are discussed.

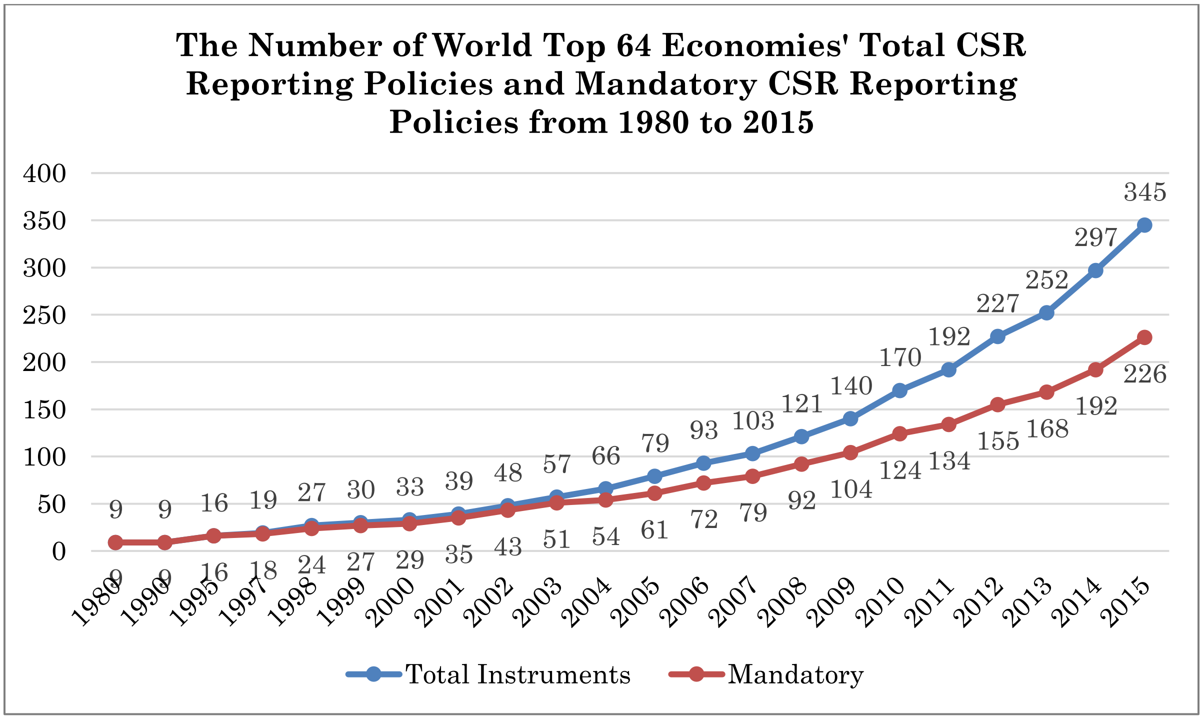
1.2 A Short History of Global CSR Reporting Regulation

In April 2016, the most comprehensive database of world corporate social responsibility reporting instruments was established, covering the period since 2000. The website of the database named www.carrotsandsticks.net (Carrots&Sticks) contains information on various forms of sustainability reporting instruments. An overwhelming majority of all instruments are issued by governments or industry regulators on CSR reporting regulation, in the forms of legislation, regulation, guidance, guidelines, frameworks and standards. Only a very small portion of instruments are issued by private standards initiatives or voluntary initiative, or on sustainable reporting regulation on organizations in public sectors. This database is based on a report and associated research conducted jointly by KPMG International, GRI, United Nations Environment Programme (UNEP) and The Centre for Corporate Governance in Africa at the University of Stellenbosch Business School (About Carrots & Sticks, www.carrotsandsticks.net). In total, around 345 CSR reporting regulation policies from world top 64 economies have been documented in this database.

According to Carrots&Sticks, every reporting instrument is classified as either mandatory or voluntary. Usually, mandatory policies are more specific and have clear requirements on what information firms are required to report. For example, U.S.A. EPA issued the Mandatory Reporting of Greenhouse Gases Rule (74 FR 56260) in year 2009 which requires reporting of greenhouse gas (GHG) data and other relevant information from large sources and suppliers in the United States. For another example, in year 2015, India the board of the Securities and Exchange Board (SEBI) mandated listed companies, especially top 500 companies, to submit Business Responsibility Reports, describing measures taken along the key principles enunciated in the 'National Voluntary Guidelines on Social, Environmental and Economic Responsibilities of Business' framed by the Ministry of Corporate Affairs (MCA). On the other side, voluntary policies are more general and mainly provide some guidelines or suggest some standards on firms' CSR behaviors or governance. For example, in year 2012, the China Banking Regulatory Commission updated the Green Credit Guidelines that regulate the environmental performance of Chinese banks. In clause 3 and 4, it first clarifies environmental and social (E&S) responsibilities of banks by requiring Chinese banks to promote green credit and effectively identify, assess, monitor, control or mitigate environmental & social (E&S) risks in business operations, develop E&S risk management systems, strengthen credit policies and processes that are related. Correspondingly, in clause 24, it further clarifies banks' E&S disclosure responsibility by requiring Chinese banks to disclose green credit strategy and policies, and green credit implementation status.

Also, each CSR reporting regulation instrument is classified into one or more categories based on its regulation scope. There are four categories: general sustainability, governance, environmental and social. It is common to have multiple instruments under the same category for one country. This is because there are multiple types of instruments issuers, including national/federal government, local government, industry regulators, financial regulators, stock exchange, etc. Also, each instrument may only focus on one or several specific issues under a category. Carrots&Sticks doesn't provide the detailed information on the content included in each category. Sometimes, an instrument belongs to multiple categories. Other times, an instrument may be very specific and only be classified into one category. We just followed the classification results done by Carrots&Sticks. The statistics are presented in Figure 1.1 to Figure 1.4.

Figure 1.1



(Source: data is collected from www.carrotsandsticks.net, statistics is done by author)

Figure 1.2

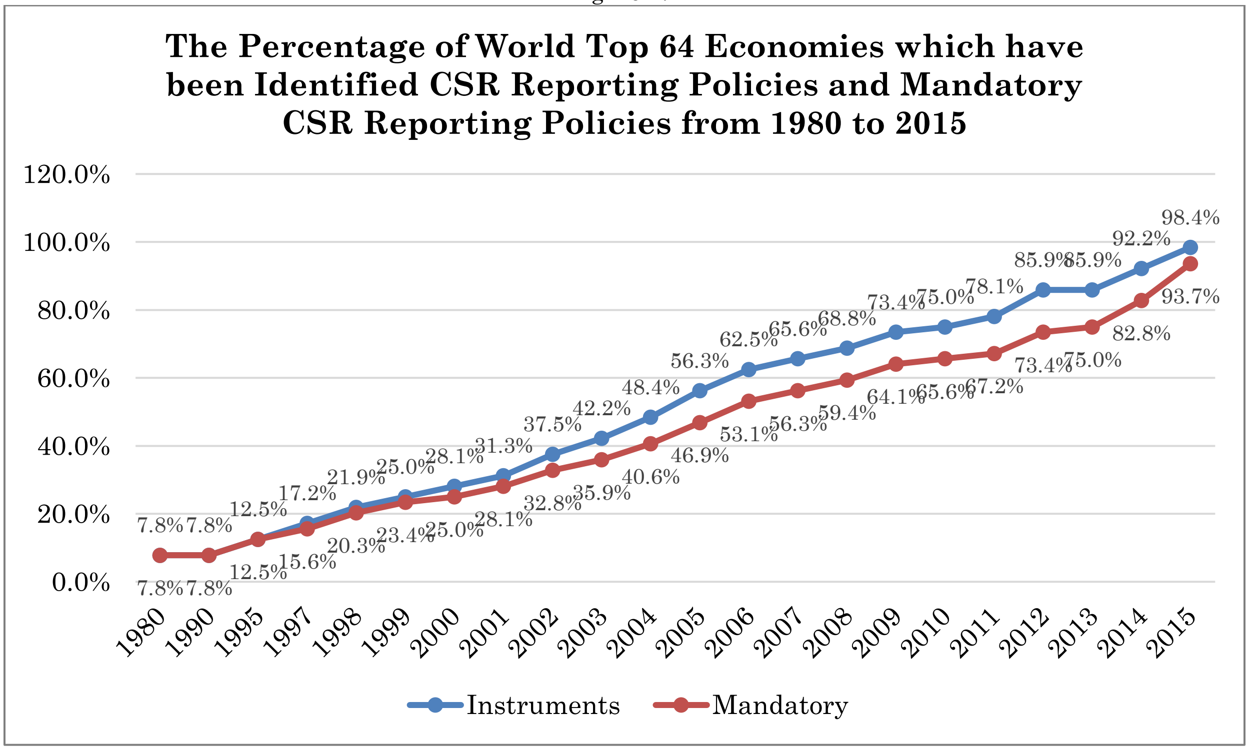


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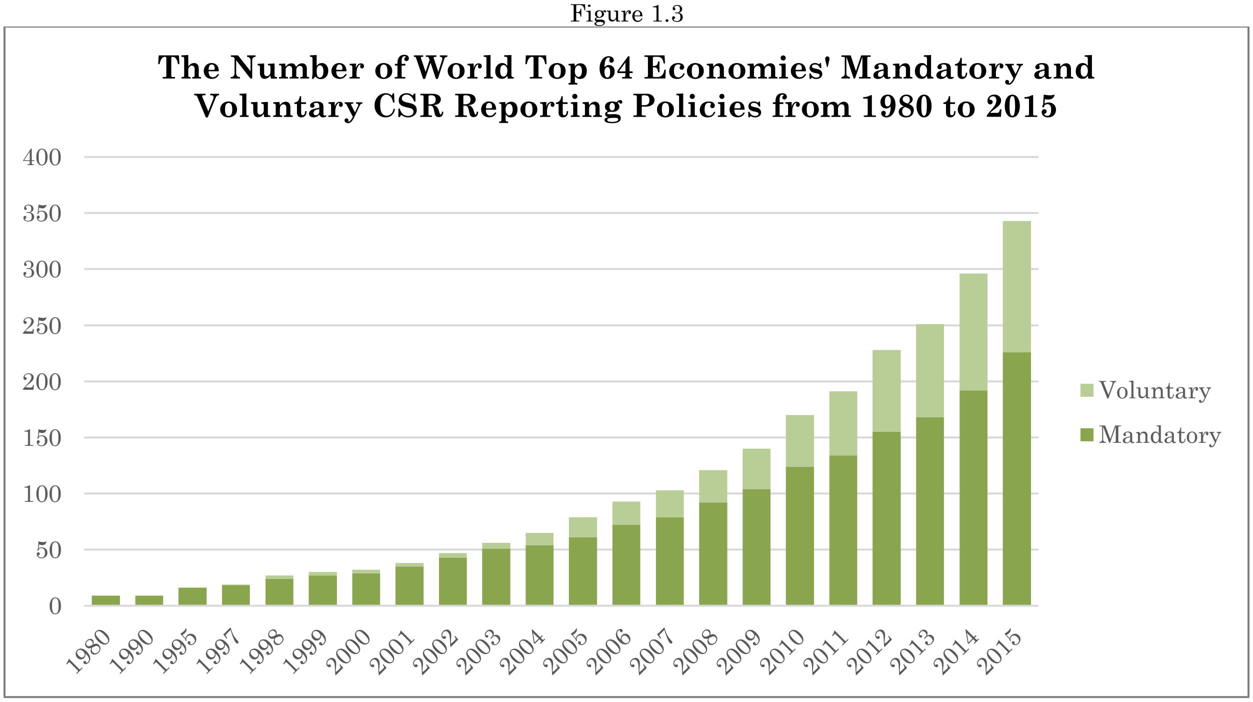
Figure 1.3



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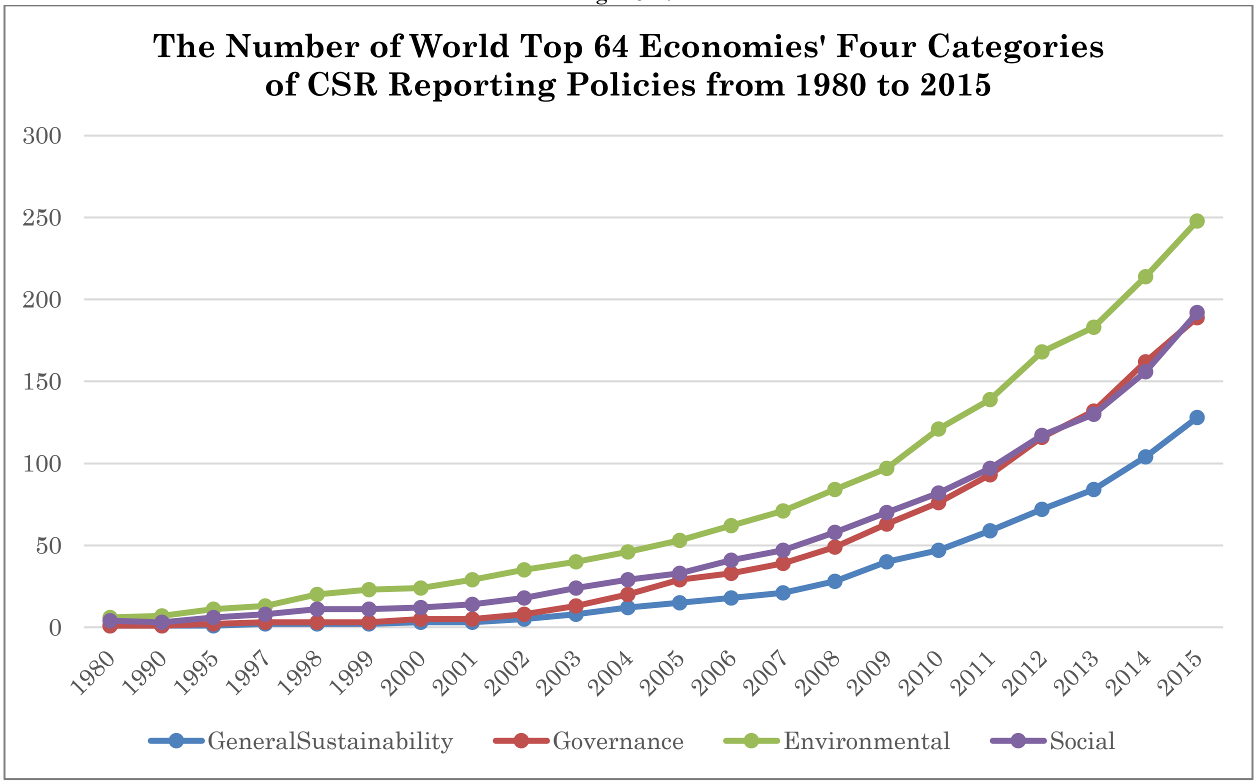


(Source: data is collected from www.carrotsandsticks.net, statistics is done by author

Table 1.1 The List of 64 Economies which are Included in the Carrots & Sticks Database

Austria	Czech Republic	Indonesia	Maldives	Romania	Turkey
Argentina	Denmark	Ireland	Mexico	Russia	Ukraine
Bangladesh	Ecuador	Israel	Netherlands	Singapore	United Arab Emirates
Belgium	Finland	Italy	Nigeria	Slovakia	United Kingdom
Bolivia	France	Ivory Coast	Norway	South Africa	U.S.A.
Brazil	Germany	Japan	Pakistan	South Korea	Venezuela
Canada	Greece	Kazakhstan	Peru	Spain	Vietnam
Chile	Hong Kong	Kenya	Philippines	Sweden	Zimbabwe
Colombia	Hungary	Kuwait	Poland	Switzerland	Australia
China	Iceland	Lithuania	Portugal	Taiwan	
Cyprus	India	Malaysia	Qatar	Thailand	

In Figure 1.1 to Figure 1.4, we move the starting time of our statistics back to 1980 to better reflect an accelerating trend of the development of CSR reporting instruments after the year 2000. The small number of CSR reporting instruments before 1980 reflected the early environmental reporting legislation or labor protection reporting requirement. The slightly increasing trend between 1980 and 2000 reflected a transition period when sustainable development was put on the global agenda. From Figure 1.1 to Figure 1.4, we can see that environmental performance is currently the top target of CSR reporting regulation, which reflects the most urgent concern by the public and might also be due to the relatively earlier starting time that this issue aroused the public's attention through pollution and global climate change. In the following sections 1.2.1 to 1.2.3, we take a short review of three development stages of global CSR reporting instruments. Much of this is provided from information in the Carrots&Sticks website. In section 1.2.4, we further take an overview of the development of CSR reporting instruments in U.S.A. as an example.

1.2.1 Early Forms: 1960s to 1970s

The early CSR reporting regulation dates back to 1960s to 1970s. It appeared in the form of environmental reporting legislation or labor protection reporting requirement in France, USA, Japan and Malaysia. In France, the law, which was voted through on July 7, 1977 as Code du Travail, Article L2323-71, mandated all companies with more than 300 employees to publish a social review that included more than 100 performance indicators (*Carrots and Sticks-Promoting Transparency and Sustainability*, pg. 79, 2010).

In the United States, the Clean Air Act, Securities and Exchange Commission Regulation legislation, and the Equal Employment Opportunity Act were passed in early 1970s. The Clean Air Act (CAA), enacted in 1970, requires the Environmental Protection Agency (EPA) to establish national ambient air quality standards for certain common and widespread pollutants based on the latest science. The EPA has set air quality standards for six common "criteria pollutants": particulate matter (also known as particle pollution), ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, and lead. The EPA issues mandatory reporting requirements for emissions from companies / facilities based on the CAA.

The US Securities and Exchange Commission (SEC) has required public companies to disclose the material effects that compliance with environmental laws may have on earnings, capital expense, or competitive positions through SEC Regulation S-K, 17 C.F.R. § 229.101 since 1970s. Item 101 has generally led to the disclosure of environmental compliance expenses, as well as soil, groundwater and other remediation costs.

The US Equal Employment Opportunity Act of 1972 made an amendment to Section 709(c), Title VII, US Civil Rights Act of 1967. It mandates annual filing regarding of employment records, including the racial and gender profiles of employees , to determine whether unlawful employment practices have been or are being committed.

In Japan, The Waste Management and Public Cleansing Law (Waste Management Law) was established in 1970 along with other pollution-related laws by the Diet. It regulates the party that generates, stores or transports waste. It also requires the generator that emits a large quantity of waste to report the status of executing a waste management plan to the prefectural governors as specified by Ordinance of the Ministry of the Environment. The Law has undergone major revisions in 1976, 1991, 1997, 2000 and 2006 in response to societal changes. Also, the energy conservation law was introduced in 1979 following the oil crises in the 1970s. Under this law, companies that consume a certain amount of energy have the obligation to report publicly the amount of energy consumed (*Carrots and Sticks-Promoting Transparency and Sustainability*, pg. 52, 2010).

In Malaysia, the Factories and Machinery Act (FMA) enacted in 1964 proposed reporting requirement for manufacturing, mining, quarrying and construction industries. It includes provisions on safety, health and welfare of employees handling and working around machinery. It sets requirements for the public notification of accidents and occurrence of dangerous diseases.

1.2.2 Transition Period: 1980s to 1990s

In 1980s, with increasing concern about the accelerating deterioration of the environment and natural resources and the consequences of that deterioration for economic and social development sustainability development, sustainable development was put on the global agenda.

In 1987, the global consensus on the implication of "sustainable development" was proposed in the report of forty-second session of general assembly of the World Commission on Environment and Development. The "sustainable development" was interpreted as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations, 1987). It called on a new approach to economic growth, not only to eradicate the poverty but also to enhance the resource base on which present and future generations.

Under this calling, the main development of CSR reporting regulation during this period is that more legislation on environmental protection was enacted. During 1980s and 1990s, 12 countries enacted law, act, decree or article to require firms to fulfill their responsibilities in energy usage saving and pollutant release reduction and report their environmental related information. The list of countries and their regulation instruments is presented in Table 1.2.

Table 1.2 Regulation Instruments on Environmental Protection between 1980s and 1990s

No.	Country	Initiated Year	Regulation Instrument	Mandatory or Voluntary
1	Australia	1998	National Pollutant Inventory	Mandatory
2	Belgium	1995	Article 4.1.8 of VLAREM	Mandatory
3	Canada	1999	Canadian Environmental Protection Act	Mandatory
4	Finland	1997	The Finnish Accounting Act	Mandatory
5	Japan	1998	Law concerning the Rational Use of Energy	Mandatory
6	India	1986	Environment (Protection) Act 1986	Mandatory
7	Mexico	1997	Clean Industry Certificate	Voluntary
		1998	Official Mexican Standard on Wastewater Quality	Mandatory
8	Norway	1998	The Norwegian Accounting Act	Mandatory
9	South Africa	1998	National Environment Management Act	Voluntary
10	Sweden	1998	Guidelines on environmental info in the Director's Report section of the Annual Report	Voluntary
11	U.S.A.	1988	Energy Planning and Community Right-to-Know Act Section	Mandatory
12	Venezuela	1995	Decree 883, 638-N° 1.257 (on improving air quality)	Mandatory
		1995	Decree No.883 on water quality	Mandatory
		1998	Decree No.2635 on hazardous materials	Mandatory

(Source: www.carrotsandsticks.net)

At the meantime, a small number of countries enacted act, guidelines or regulation to require firms to report employment related information and promote gender balance, diversity in the workplace, and securing the safety, health and welfare of persons at work. These countries include Finland, Norway, South Africa, Sweden, and Chile.

1.2.3 Fast Growth: 2000 to present

After entering year 2000, five factors have played important roles in shaping the fast development of CSR regulation. These five factors are global climate change and environmental pollution, the promotion from international organizations, the increasing attention to prevent financial risk and rebuild trust after the global financial crisis of 2008, the increasing trend of economic globalization and the increasing expectation from stakeholders and civil society on governments to regulate firms' behaviors.

The first dominant factor in driving the fast development of CSR regulation since year 2000 is the accelerating climate change and the environmental pollution. In 1990s, there has been a realization of the impact of human activities on climate, particularly the impact of increasing concentrations of greenhouse gases in the atmosphere. In 1993, The World Meteorological Organization (WMO) began to publish WMO Statement on the Status of the Global Climate annually. In their first statement, although a number of climate anomalies and extreme events happened and an increase in global surface average air temperature was observed in 1993, it was uncertain to claim these events as climate change (WMO, 1993). However, in a report on global climate change released in January 2001, a detailed study of human influence on climate was made and the report concluded that most of the observed warming observed over the last 50 years is attributable to human activities (IPCC, 2001). In 2016, global warming continued, setting a new record at about 1.1°C above the pre-industrial period. Also, carbon dioxide reached new highs at 400.0 ± 0.1 parts per million in the atmosphere (WMO, 2016). Globally, more than 80% of people living in urban areas that monitor air pollution are exposed to air quality levels that exceed the WHO limits. While all regions of the world are affected, populations in low-income cities are the most impacted (WHO, 2016). Correspondingly, the number of CSR regulation instruments on firms' environmental performance constitutes around 70% of total CSR regulation instruments from 2000 to 2015.

The second factor in driving the development of CSR regulation is the promotion from international organizations. These international organizations developed decision making tools or partnered with governments to help governments to take action towards a more sustainable economy. Particularly, two international organizations formed comprehensive partnerships with governments. They are Global Reporting Initiative (GRI) and the Organization for Economic Co-operation and Development (OECD) Guidelines for

Multinational Enterprises. GRI's mission is to empower decision makers everywhere, through their sustainability standards and multi-stakeholder network, to take action towards a more sustainable economy and world. In June 2000, GRI launched the first global framework for comprehensive sustainability reporting *Sustainability Reporting Guidelines on Economic, Environmental, and Social Performance*, which promoted the formation of global consensus on a triple-bottom-line of economic, environmental and social performance in firms' sustainability reporting (GRI's History, GRI website; *Sustainability Reporting Guidelines*, GRI, June 2000). The contribution of GRI reporting guideline is that it enlarged the scope of CSR from environmental issues to a broader scope including corporate governance, economic imperative, environmental imperative and social imperative. Soon after, this triple-bottom-line has been accepted as modern standard definition of corporate social responsibility (CSR) (*What is CSR?*, UNIDO). Before year 2000, the percentages of instruments on general sustainability, corporate governance, and social imperative among the number of total CSR regulation instruments are relatively stable at around 9%, 12%, and 39%. However, by 2015, influenced by the new global consensus, the percentage of instruments on general sustainability, corporate governance, and social imperative increased to 38%, 55%, and 55%. Up to 2016, 40 countries and regions' governments have mentioned, recommended, or required GRI guidelines in their total 70 CSR reporting regulation instruments (*GRI referred in policy & regulation*, GRI). As for OECD Guidelines for Multinational Enterprises, 44 adhering governments – representing both OECD and non-OECD member countries from all regions of the world – encourage their enterprises to observe the Guidelines wherever they operate (*Brief Description of OECD Guidelines for Multinational Enterprises*, Carrots & Sticks).

The third factor which shaped the development of CSR regulation after year 2008 is the increasing attention in to prevent financial risk and rebuild trust after the global financial crisis of 2008. A trust barometer survey by Edelman across 20 countries with 4475 respondents between Nov. 5th and Dec. 14th 2008 showed that trust in business dropped in 9 countries, especially in countries which suffered severely from financial crisis like U.S., Italy, Mexico, Spain, India and Ireland (Edelman, 2009). In CSR regulation history, we observed accelerated growth trend in the number of CSR regulation instruments on firms' governance after 2008. Between 2000 and 2008, 46 new CSR regulation instruments on firms' governance were issued among top 64 economies while between 2008 and 2015 150 new CSR regulation instruments on firms' governance were issued. By April 2016, around one third of all sustainability reporting instruments are issued by stock exchanges and financial market regulators (*Carrots&Sticks*, 2016). And around 40% of all sector specific reporting instruments target financial services sector (*Carrots&Sticks*, 2016). This may reflect an increasing attention in regulating firms' governance to prevent financial risk and rebuild trust in business by issuing new CSR regulation instruments on firms' governance. In Table 1.3, we summarized some examples of this type of CSR regulation instrument after 2008.

Table 1.3 Examples of Regulation Instruments on Firms' Governance after 2008

Country	Initiated Year	Regulation Instrument	Mandatory or Voluntary
U.S.A.	2010	Dodd–Frank Wall Street Reform and Consumer Protection Act (Section 1502, 1504)	Mandatory
Italy	2009	Directors' report on financial statements	Voluntary
	2009	Legislative Decree no. 150/2009	Mandatory
Mexico	2012	Federal Law on Anti-corruption Practices in Public Contracts	Mandatory
Spain	2011	Spanish Sustainable Economy Law	Voluntary
	2012	Guide for management report by listed companies	Voluntary
	2013	Ministerial Order on Corporate Governance	Mandatory
India	2009	Ministry of Corporate Affair, Corporate Social Responsibility Voluntary Guidelines	Voluntary
	2011	Guidance Note on Non-Financial Disclosures	Voluntary
	2011	National Voluntary Guidelines on Social, Environmental & Economic Responsibilities of Business, 2011 (1st edition 2009).	Voluntary
UK	2010	UK Stewardship Code	Voluntary
	2012	UK Corporate Governance Code	Mandatory
France	2010	Corporate Governance Code of Listed Corporations	Mandatory
	2010	Art 224, Grenelle Act II	Mandatory
	2010	Art 225, Grenelle Act II	Mandatory

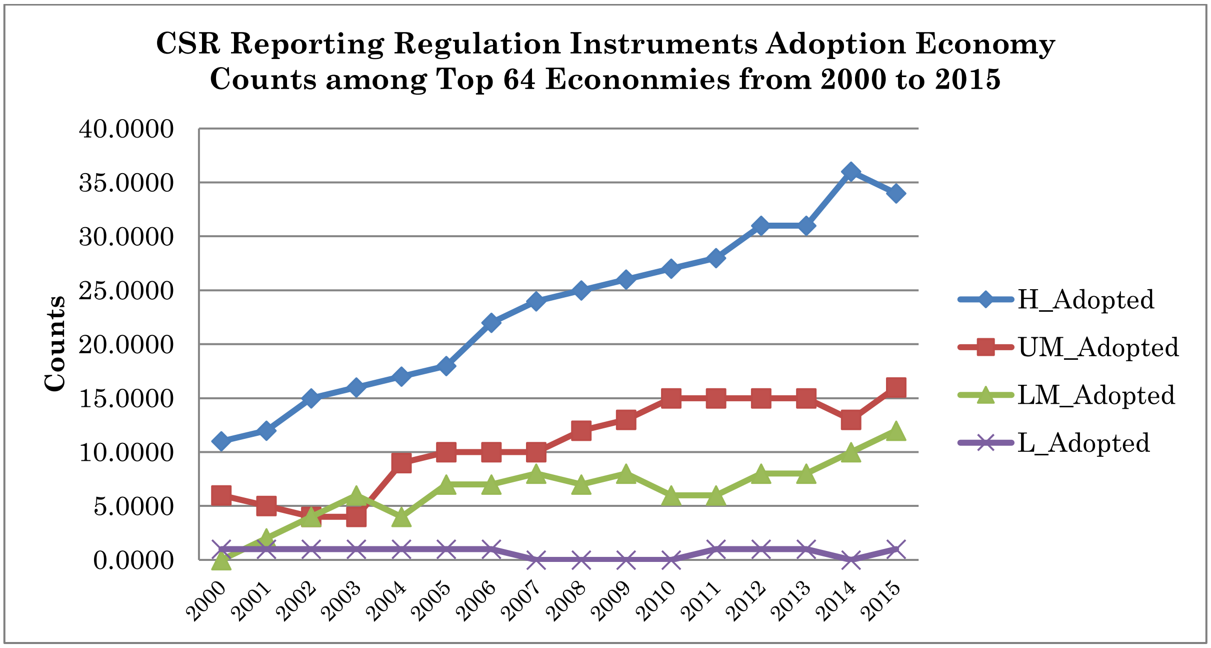
(Source: www.carrotsandsticks.net)

The fourth factor which stimulates the growth of CSR regulation is the increasing trend of economic globalization. The economic connections among countries becomes more and more closer with increasing world exported and imported value of 1.029 trillion US dollars (measured in 2010 US dollars) in year 2000 to 3.608 trillion US dollars (measured in 2010 US dollars) in 2015 (Trade Map-International Trade Statistics, International Trade

Centre). A new phenomenon in international trade is that governments or private bodies of developed countries began to propose environmental and health requests or import limits on imports from developing countries. Two studies: Environmental Requirements and Market Access 2005 by OECD and Trade and Environment Review 2006 by the United Nations Conference on Trade and Development (UNCTAD) have taken comprehensive studies on the trade effects of such requirements on developing countries. Environmental and health requirements were widely found in trade products of manufactured goods like textile, aromatic amines in textiles, leather goods, plastic and PVC, gasoline, products of agriculture, forestry and fishing, products of organic agriculture, and etc (OECD, 2005). Although these requirements and their effects on developing countries have been brought to the attention of WTO's Committee on Trade and Environment (CTE), the answer from CTE to this issue is not to weaken environmental standards, but to enable exporters to meet them (CTE, website). In fact, this is what has happened in developing countries in reality.

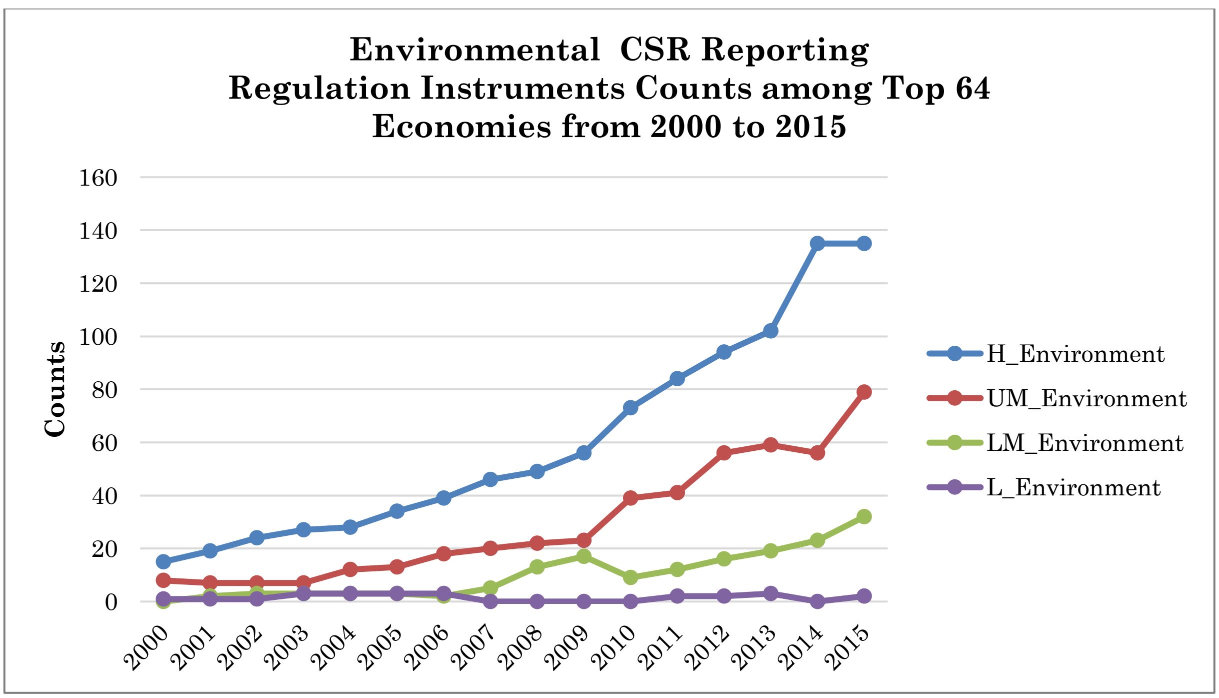
In Figure 1.5, we depicted the counts of the number of economies which had adopted CSR regulation instruments in each year. We classified economies into four groups according to historical classification based on GNI per capita by the World Bank: high-income economy (H), upper-middle-income economy (UM), lower-middle-income economy (LM), and low-income economy (L). In Figure 1.6, we depicted the counts of the number of environmental CSR regulation instruments in each type of economy by income. We can observe that number of CSR regulation instrument adoption economies among middle-income economies (both UM and LM economies) and the number of environmental CSR regulation instruments among middle-income economies keeps increasing over the years. It is worth to mention that in the past 15 years from 2000 to 2015, most world economies' GNI per capita have increased. The number of high-income economies among our 64 economies increased from 28 to 35 and the number of low-income economies decreased from 10 to 1, while the number of middle-income economies increased slightly from 26 to 28. Considering this dynamic change of classification of economy, the real impacts of environmental and health requirements on a developing country may be larger than what is shown in these two figures.

Figure 1.5 CSR Regulation Instruments Adoption Counts



(Source: Trade Map, International Trade Centre)

Figure 1.6 Environmental CSR Regulation Instruments Counts



(Source: Trade Map, International Trade Centre

The fifth factor which stimulates the growth of CSR regulation is the increasing expectation from stakeholders and the civil society on governments to regulate firms' behaviors. The main stakeholders of firms include consumers, shareholders, community, employee, business partners, governments, and general public especially for big firms which have significant environmental and social impacts. With the development of economy and society, stakeholders and civil society's impacts become more and more important and they gain more and more channels to express their complaints and request, which finally urge governments to take actions by introducing CSR regulation policies. Since late 1990s, civil society has evolved significantly. The number of international non-governmental organizations (NGOs) was reported to have increased from 6,000 in 1990 to more than 69,000 in 2016 (WEF, 2013; UIA, 2016). The world stock market capitalization increases from 25.1 trillion dollars in year 2000 (measured in 2010 U.S. dollars) to 67.1 trillion dollars in year 2015 (measured in 2010 U.S. dollars) (World Bank Open Data).

Although it is hard to summarize all the impacts of stakeholders and the civil society on governments globally from 2000 to present, we can acquire some understanding of advances in some areas and in some countries. For example, according to Edelman Trust Barometer 2002 on 850 opinion leaders from U.S., UK, France and Germany, around 50% respondents agree or strongly agree with the statement that the government needs to be more involved in oversight and regulation of private enterprise in their country (Edelman, 2002, pg.38). However, in Edelman Trust Barometer 2009 on 4475 people from 20 countries who were college-educated, in top 25%of household income in each age group and self-reported significant media consumption and engagement in public policy, 75% respondents say that government should intervene to regulate industry or nationalize companies to restore public trust (Edelman, 2009, pg.2).

For another example related with consumer protection, we found some evidence from China. From 1985 to 2000, the number of consumer complaint in China kept in increasing each year which aroused the attention of the Chinese government. Since then, the Chinese government began to make consumer protection laws and enforced consumer protection regulation. From 2004, we observed a gradually decreasing trend in the number of consumer complaints and the quality related complaints rate (%). Particularly, the decreasing trend in the quality related complaints rate (%) accelerates after 2008 when Chinese government began to issue CSR regulation policies. However, the resolution rate (%) also decreases gradually, which is probably due to the increasing complexity and new areas of consumer complaints with the development of the market that recalls governments to improve the legislation and regulation. The detailed trends are shown in Figure 1.7.

Globally, the State of Consumer Protection Survey 2015 by Consumer International which has 200 member organizations in more than 100 countries found that 40% of members felt that one of the top three advances in consumer protection they had witnessed since 2012 is new legislation (Consumer International, 2015).

Figure 1.7

(Data Source: China Consumer Association, www.cca.org.cn)

As for impacts from community members on governments to regulate firms, we also found an impressive example from India. In 2003, India's Centre for Science and Environment published a report saying that because of drilling underground water to produce beverage, Coca-Cola caused water crisis in several villages. Also, Coca-Cola discarded chemical wastes without being disposed thus caused pollution to the farmland the reduction to the harvest. Besides, Coca-Cola needs to use 4 liters water to produce 1 liter beverage, discharging 3 liters polluted wastewater which further polluted clean water and land. On seeing this report, local village residents protested against Coca-Cola factory and forced local government to stop grant Coca-Cola factory production license (*International Finance News*, August 22nd, 2006).

Finally, on examples of the change of the general public's expectation towards governments, we would like to cite some evidence from China again. In 2008, a public survey showed that 37.7% respondents listed environmental pollution as one of top issues they concerned with (www.gov.cn, 2009). However, in 2015, a survey by China Youth Daily through Lightspeed GMI among 2611 people, 63% respondents listed environmental pollution abatement as their top expectation towards the Chinese government (www.xinhuanet.com, 2015).

1.2.4 Country Examples: CSR Reporting Regulation in U.S.A. and China

To get a complete impression on how CSR reporting regulation policies are developed in one country, we further take an overview of CSR reporting instruments in U.S.A and in China. Detailed information about each instrument is listed in Table 1.4 and Table 1.5.

From the timeline of the development of sustainable reporting instruments in U.S.A., we can see that the earliest form of instrument originates from legislation on environmental issues in 1970's, particularly on environmental pollution of air and water. Later on, the regulation scope on environmental issues is extended to greenhouse gas emissions by issuing new Acts or policies. A careful examination on the initiated date and content of each instrument reveals that some reporting instruments are clearly sparked by firms' governance crisis or financial crisis in U.S.A., like The Sarbanes-Oxley Act (2002) sparked by Enron scandal and the Arthur Andersen incident in year 2002, and Dodd–Frank Wall Street Reform and Consumer Protection Act (Section 1502, Section 1504) (2010) sparked by global financial crisis of 2008.

A striking feature of the CSR reporting instruments in U.S.A. is that most instruments are in the form of legislation, particularly on some extremely important environmental issues and hot social issues. This feature is different from the early definition of CSR represented by European Commission (2002), which defines CSR as "a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders *on a voluntary basis*". However, changing from long term voluntary basis to regulation basis as in U.S.A. is consistent with a global trend of CSR regulation practice, especially targeting large companies. To acknowledge this new trend in CSR regulation practice, European Commission (2011) updates its definition of CSR as "the responsibility of enterprises for their impacts on society". Although the scope of firms' social responsibility is still quite broad, vague on some aspects, and depend on the size of a company, it is a global trend that the whole society is pushing firms to integrate at least some of firms' social impacts into their business operation. And this trend is still growing.

The CSR reporting regulation in China starts from year 2006 and develops fast. The

CSR reporting regulation is triggered by more and more salient environmental pollution and social problems brought by firms' business activities accompanied with fast economic growth of China. It is also taken as a strategy to promote the transformation of China's economic growth mode and economic structure adjustment. The target companies are state-owned companies and listed companies in Shenzhen Stock Exchange and Shanghai Stock Exchange. A feature of China's CSR reporting regulation policies is that it emphasizes on promoting CSR through regulating financial sectors' behaviors, particularly on banks' crediting process, green bond, and green credit policies. Relatively speaking, the regulation scope focuses more on environmental aspect and sustainable development.

Although more and more policies are enacted in China require firms to fulfil CSR and disclose CSR information, especially environmental performance information, the CSR reporting requirement is quite general and standards on what CSR information to be disclosed are not very clearly defined. Compared with U.S.A., there is lack of law enforcement of CSR reporting regulation in China.

It is worth mentioning that only policies released by central government and big cities like Shanghai or sector regulators in China are included in the database of Carrots&Sticks. In fact, to respond to central government's guidelines, local governments have also issued guidelines on CSR separately. Besides, several industry associations also issued guidelines on industry CSR, including textile, tea, real estate, leather, mining, construction and so on.

Table 1.4 An overview of CSR reporting instruments in U.S.A.

Initiated Year	Regulation Instrument	Issuer Type	Type of the Instrument	M/V	Regulation Category	Reporting Requirement
1970	Clean Air Act (CAA)[1]	Federal Government	Legislation	M	Environmental	The EPA issues mandatory reporting requirements for emissions from companies / facilities based on the CAA, including six common "criteria pollutants": particulate matter (also known as particle pollution), ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, and lead.
1971	Securities and Exchange Commission (SEC) Regulation S-K, 17 C.F.R. § 229.101	Financial Regulators	Legislation	M	Environmental	All listed companies are required to disclose the material effects that compliance with environmental laws may have on earnings, capital expense, or competitive positions.
1972	Clean Water Act (CWA)[2]	Federal Government	Legislation	M	Environmental	Large companies are required to report results for the analytes listed in their discharge permits.
1972	Equal Employment Opportunity Act	US Equal Employment Opportunity Commission, federal agency	Code of conduct or guideline	M	Social	The US Equal Employment Opportunity Commission mandates annual filing regarding the accessibility of employment records to determine whether unlawful employment practices have been or are being committed, including the racial and gender profiles of employees.
1988	Emergency Planning and Community Right-to-Know Act Section 313 – Toxic Release Inventory (TRI)	Federal Government	Legislation	M	Environmental	Companies with more than 10 full-time employees to submit data on emissions of specified toxic chemicals to the US EPA, filling a toxic chemical release inventory form (Form R) annually.
2002	The Sarbanes-Oxley Act	Federal Government Financial Regulator	Legislation	M	Governance	It contains 11 different "titles" and imposed new reporting requirements for US-listed companies to increase corporate transparency (mainly corporate governance).
2009	Mandatory Reporting of Greenhouse Gases Rule (74 FR 56260)	EPA	EPA regulation	M	Environmental	It requires reporting of greenhouse gas (GHG) data and other relevant information from large sources and suppliers in the United States.
2010	Dodd–Frank Wall Street Reform and Consumer Protection Act (Section 1502, Section 1504)	Finance/ Treasury	Legislation	M	Social & Governance	Section 1502, requiring [some] annual report issuers to disclose their connections with conflict minerals. Section 1504 requires annual report issuers that commercially develop oil, natural gas, or minerals to disclose certain payments made to the US or a foreign government.

[1] It requires the EPA to establish national ambient air quality standards for certain common and widespread pollutants based on the latest science.
2 The CWA's National Pollutant Discharge Elimination System (NPDES) Program regulates point sources that discharge pollutants into waters of the United States. Compliance monitoring under the NPDES Program encompasses a range of techniques, including Discharge Monitoring Report reviews which requires major and selected minor permittees under NPDES program to report results for the analytes listed in their permit.

Table 1.4 (cont.)

2010	Regulation S-K	Financial Regulators	Code of conduct or guideline	M	Environmental	It sets forth disclosure requirements for all SEC filings (i.e. financial statements). The 2010 SEC guidance on disclosure of environmental risks and compliance with environmental law helps to explain how disclosure requirements within Reg S-K are related to climate change concerns.
2010	California Transparency in Supply Chains Act	Local Government	Legislation	M	Social	Large retailers and manufacturers (above $100,000,000 in annual world-wide revenues) are required to provide consumers with information regarding their efforts to eradicate slavery and human trafficking from their supply chains and to educate consumers on how to purchase goods produced by companies that responsibly manage their supply chains.
2010	SEC Guidance Regarding Disclosure Related to Climate Change	The Securities and Exchange Commission	Code of conduct or guideline	V	Environmental	It provides guidance to listed companies regarding the Commission's existing disclosure requirements as they apply to climate change matters.
2011	Chemical Data Reporting (CDR) Rule[3]	Federal Government	Legislation	M	Environmental	It requires manufacturers (including importers) to provide the EPA information on the chemicals they manufacture domestically or import into the United States.
2012	Benefit Corporation Legislation	State Government	Legislation	V	General sustainability /ESG	"Benefit Corporations" are required to make available to the public an annual benefit report that assesses their overall social and environmental performance against a third party standard.
2014	NYSE Section 303A Corporate Governance Rules, 2014	NYSE Stock Exchange	Code of conduct or guideline	M	Governance	Listed companies are required to "adopt and disclose a code of business conduct and ethics."

(Source: www.carrotsandsticks.com)

Note:
1. "M/V" means Mandatory or Voluntary.
2. "ESG" means Environmental, Social and Governance.

[3] It is issued under the Toxic Substances Control Act (TSCA).

Table 1.5 An overview of CSR reporting instruments in China

Initiated Year	Regulation Instrument	Issuer Type	Type of the Instrument	M/V	Regulation Category	Reporting Requirement
2006	Shenzhen Stock Exchange Social Responsibility Guidelines for Listed Companies	Shenzhen Stock Exchange	Code of conduct or guideline	M	Social	According to the guidelines, the exchange encourages listed companies to establish a social responsibility mechanism and prepare social responsibility reports on a regular basis. The guidelines list the key points which should be included and disclosed in social responsibility reports. The disclosure was initially voluntary but Shenzhen Stock Exchange changed the policy in 2008 and required mandatory disclosure for all companies in SZSE 100 index (100 companies). Since the exchange released the guidelines on social responsibility for listed companies, it has been actively training the 488 companies listed on the exchange on how to apply them.
May 2008	Notice of Improving Listed Companies' Assumption of Social Responsibilities	Shanghai Stock Exchange	Code of conduct or guideline	V	General sustainabili ty/ESG/	Listed companies should establish a CSR strategy from at least four aspects and the CSR report should include details of the work performed by the company in promoting sustainability development. For example, this may include protection of employee health and safety via quality control of the company products or promoting a sustainable environment and ecosystem through pollutant reduction.
May 2008	Guidelines on Environmental Information Disclosure by Companies Listed on the Shanghai Stock Exchange	Shanghai Stock Exchange	Code of conduct or guideline	M	Environmen t	These guidelines encourage listed companies to disclose the following environmental information, either as part of their CSR report or in a separate report: company environmental protection policy, annual environmental protection objective and effect; annual total energy consumption; environmental protection investment and environmental technology development status; emission/pollutant types, quantity, concentration and destination; construction of environmental protection equipment and operational status; production waste treatment, disposal and recycling status; the environmental improvement agreement (signed voluntarily by the company) that the company has entered into with the Ministry of Environmental Protection; awards the company has received from the Ministry of Environmental Protection; other information disclosed at the discretion of the company.

Table 1.5 (cont.)

2008	Green Securities Policy [2008] No.24	The Ministry of Environmental Protection & China Securities Regulatory Commission	Legislation	M	Environmental	It requires companies listed on the stock exchange to disclose more information about their environmental record.
2008	Shanghai Municipal Local Standards on Corporate Social Responsibility	Shanghai Municipal Bureau of Quality and Technical Supervision	Standard	M	Voluntary	The standards emphasize the following four major legal and moral responsibilities: (1). Equity Responsibility: Labor & employee management; (2). Environmental Responsibility: Resource treatment and environment protection; (3). Integrity Responsibility: Ethical business behavior for stakeholders; (4). Harmonious Responsibility: Government/Public sector relationships and contributions. The local government encourages the enterprises to self-assess their CSR performance annually or periodically, and release the results to the community and employees.
2008	Guidelines to the State-owned Enterprises Directly under the Central Government on Fulfilling Corporate Social Responsibilities	The State-owned Assets Supervision and Administration Commission of the State Council	Code of conduct or guideline	M	General sustainability/ESG	They were proposed by the 17th CPC National Congress and gave the impetus to Central State-owned Enterprises (CSOEs) to fulfill corporate social responsibilities, so as to realize the comprehensive and sustainable development of social and environmental aspects of enterprises. According to the guidelines, the main contents of fulfilling CSR by CSOEs include: insisting on a legal and honest way of business operation, constantly improving their ability to make sustainable profits, improving product quality and service, strengthening resource conservation and environmental protection, promoting independent innovation and technological advancement, ensuring production safety, protecting legal rights of employees, and participating in social public welfare programs. The guidelines also set out the main measures for CSOEs to fulfill CSR, such as establishing CSR fulfillment mechanisms and CSR information reporting systems.
2008	Environmental Information Disclosure Act	The State Environmental Protection Administration of China	Legislation	M	Environmental	The Clause 4 in this Act states that corporations should disclose environmental information based on a combination of voluntary and mandatory principle. The Clause 19 states that corporations are encouraged to voluntarily disclose the following: environmental protection guidelines, annual targets and results, annual resource utilization, environmental investment and description of environmental technologies, pollution levels, density, types, and disposal method, environmental protection construction and operating status, waste generation, voluntary environmental agreements with the agencies, and implementation status of corporate social responsibility.

Table 1.5 (cont.)

2008	Guidelines on Social Responsibility for Industrial Corporations and Federations	China Federation of Industrial Economics	Code of conduct or guideline	V	General sustainability/ ESG	According to the guidelines, all industrial companies and industrial federations of China are encouraged to establish a CSR system in four sectors: management, regulations, information and supervision, in order to run business in a methodical and regulated way. The guidelines state that the content of a CSR report should cover eight aspects: public statement, scientific development, environmental protection, energy conservation, production safety, interests of employees, interests of stakeholders and social commonwealth. The guidelines recommend more than 80 key indicators related to economic performance, employment of employees, labor contract, production safety, social insurance, energy consumption and emission, environmental protection, company credit, etc. These indicators are encouraged to be disclosed in the CSR report.
2009	Guidelines on Corporate Social Responsibility for Banking Financial Institutions in China	China Banking Association (CBA)	Code of conduct or guideline	V	General sustainability/ESG	The guidelines are applicable to all banking financial institutions with a corporate status in China. The guidelines elaborate on CSR from three perspectives: economic responsibility, social responsibility and environmental responsibility, and also make recommendations for management control mechanisms and systems in relation to implementing CSR in financial institutions. It encourages all banks to submit an annual CSR report to CBA by the end of June of next year.
2012	Green Credit Guidelines	The China Banking Regulatory Commission	Code of conduct or guideline	V	Environmental	The guidelines state the requirements of green credits to banks from 6 aspects: general principles, organization structure adjustment, management system, environmental and social risk management in the crediting process, information disclosure, and supervision.
2013	Guidelines on Environmental Protection in Foreign Investment and Cooperation	The Chinese Ministry of Commerce & Ministry of Environmental Protection	Code of conduct or guideline	V	Environmental	The guidelines call on state-owned companies to address environmental protection, community relations and other considerations in investments overseas. Clause 18 encourages companies to publish companies' environmental performance information periodically.
2014	Guidelines for Social Responsibility in Outbound Mining Investments	China Chamber of Commerce of Metals, Minerals & Chemicals Importers & Exporters	Code of conduct or guideline	V	General sustainability/ESG	The Guidelines lay out of a series of principles for companies conducting activities relating to mining internationally. These principles largely span corporate social responsibility. It states that companies should report on their material impacts and disclose their ethical, social, and environmental performance to their stakeholders in ways that are appropriate and meaningful to their needs.
2015	PBOC launches green financial bonds on the interbank bond market–Announcement [2015] No. 39	The People's Bank of China (Central Bank)	Code of conduct or guideline	M	Environmental	Clause 12 in this announcement encourages green bond issuers to publish annual audited evaluation reports on the progress and environmental performance of the projects endorsed by the green bond.

Table 1.5 (cont.)

2015	Guidelines on Insurance Industry Social Responsibility	China Insurance Regulatory Commission	Code of conduct or guideline	V	General sustainability/ESG	It requires insurance companies to fulfill their CSR. The point 15 under Clause 5 requires insurance companies to compile annual CSR report in accordance with relevant guidance and publish by April 30 of next year.
2016	China Green Bond Endorsed Project Catalogue (2015 Edition)	The Green Finance Committee of China Society of Finance and Banking	Code of conduct or guideline	M	Environmental	It provides the first detailed catalogue of China green bond endorsed projects, which provide official reference to future green bond approval and registry, green bond audit, green bond evaluation and related information disclosure.

(Source: www.carrotsandsticks.net, revised by the author)

1.3 Empirical Estimates

1.3.1 Proxy Variables of Drivers

Based on our above review of the key drivers in shaping the fast development of CSR regulation, we developed eleven proxy variables for these drivers. First, for global climate change, a proper measurement would be the change in the global annual temperature in a recent year from the average global annual temperature in the pre-industrial period, i.e. before 1750. However, the problem with using this measurement as a proxy variable is that there would be no variability in the independent variable across countries. An alternative choice of the proxy variable is to use country level annual temperature change in a recent year from a country's annual temperature in pre-industrial period before 1750. However, data limitations preclude our use of this variable. Since climate change is strongly related greenhouse gas emissions, we could think about using total greenhouse gas emissions per year at country level as alternative proxy variables.

Second, for environmental pollution, the most urgent concern by the public is air pollution. And the air quality index which is mostly related with health is $PM_{2.5}$ pollution. Therefore, we selected $PM_{2.5}$ pollution as the proxy variable for environmental pollution.

Third, for the promotion from international organizations, it is actually hard to measure it directly. An alternative way is to measure the existing number of policies which have mentioned, recommended, adopted or required the guidelines or tools provided by the international organizations in each country. We focus on measuring the promotion efforts by two main international organizations, GRI and OECD Guidelines for Multinational Enterprises, which have formed comprehensive partnerships with governments. To measure GRI's promotion effort, we referred to GRI's self-report *GRI referred in policy & regulation*. We use the ratio of CSR policies among all CSR policies in which GRI sustainability reporting guidelines have been mentioned, recommended, adopted or required in a country till a certain year as the accumulative promotion effort by GRI in a country till a certain year. To measure OECD Guidelines for Multinational Enterprises' promotion effort, since there is no self-report statistics on how many policies have mentioned, recommended, adopted or required OECD Guidelines, we referred to the list of OECD national contact points in 2001 and 2015 (OECD, 2001, 2005). The Governments adhering to the OECD Guidelines are required to set up a National Contact Point (NCP) whose main role is to further the effectiveness of the Guidelines by undertaking promotional activities, handling enquiries, and contributing to the resolution of issues that may arise from the alleged non-observance of the guidelines in specific instances. We created a dummy variable of OECD guidelines promotion. For countries which have set up an OECD guidelines national contact point, the value of dummy variable is 1, otherwise it is zero. Then, we standardized two promotion effort variables to have the same standard deviation of 1 and then summed up two variables together as the proxy variable for international organizations' promotion effort.

Fourth, for the increasing attention in regulating firms' governance after the global financial crisis of 2008, it is impossible to measure the attention level of a country directly. However, the attention level may be related with multiple factors and we may use major factors as proxy variables. The major factors may include the economic development level of a country and the size of its stock market of a country. Therefore, we will use GDP and stock market capitalization (%GDP) as proxy variables for economic development level and the size of stock market.

Fifth, we constructed an international trade CSR policies spillover variable and a geopolitical CSR policies spillover variable as the proxies for economic globalization. The international trade spillover variable is defined as the weighted sum of the number of export destination countries' CSR reporting regulation instruments. The weight is the sum of exports to a destination country within a certain period. Also, we constructed a geopolitical spillover variable by using a country's border neighbors' weighted existing number of CSR reporting regulation instruments. The weight is the average population of a border neighbor country within a certain period.

Sixth, for the increasing expectation from stakeholders and civil society on governments, since it is closely related with the level of economic and social development, we selected four variables as proxy variables: country total GDP, GNI per capita, stock market capitalization (%GDP) and Democracy Index. The Democracy Index we used is from The Economist Intelligence Unit. This Democracy Index is a "thick" concept (Coppedge et al., 2011). It is based on five categories: electoral process and pluralism; civil liberties; the functioning of government; political participation; and political culture (Kekic, 2007).

1.3.2 Data

The CSR regulation instrument data is collected from the Carrots & Sticks Database (www.carrotsandsticks.net). The website collected a dataset of CSR reporting regulation instruments of 64 economies, for the 2016 edition of the Carrots & Sticks report. It classified CSR reporting regulation instruments by countries and also includes the initial year of an instrument, its type, whether it is mandatory or voluntary, and other characteristics. It allows searching CSR reporting instruments either by countries and regions or by the scope of regulation, but it does not provide the function of downloading the dataset. We manually collected the time series data of the existing number of total CSR reporting regulation instruments in a country until a certain year from this website.

The macroeconomic and environmental data, including GDP, GNI per capita, population, GDP deflator, stock market capitalization (%GDP), total greenhouse gas emissions, and PM2.5 air pollution (mean annual exposure by micrograms per cubic meter), is collected from the World Bank. The democracy data is collected from the democracy index compiled by The Economist Intelligence Unit since 2006. The international exports data is collected from the International Trade Centre (http://www.trademap.org/Index.aspx). The bordering countries data is read from the world map.

After matching CSR policies data with macroeconomic, environmental, international trade and international organizations' promotion effort data, we got 55 countries in the sample. The 55 countries are listed in Table 1.6. The summary statistics of data is provided in Table 1.7.

Table 1.6 The List of 55 Countries

Austria	Cyprus	India	Malaysia	Romania	Turkey
Argentina	Czech Republic	Indonesia	Mexico	Russia	Ukraine
Bangladesh	Denmark	Ireland	Netherlands	Singapore	United Kingdom
Belgium	Ecuador	Israel	Nigeria	Slovakia	U.S.A.
Bolivia	Finland	Italy	Norway	South Africa	Australia
Brazil	France	Ivory Coast	Pakistan	South Korea	
Canada	Germany	Japan	Peru	Spain	
Chile	Greece	Kazakhstan	Philippines	Sweden	
Colombia	Hungary	Kenya	Poland	Switzerland	
China	Iceland	Kuwait	Portugal	Thailand	

Table 1.7 Summary Statistics of Variables

Variable	Mean	S.D.	Min	Max
Total Policies Diff	5.29	4.01	0	16
Mandatory Policies Diff	3.56	2.75	0	11
Voluntary Policies Diff	1.96	2.09	0	10
GS Policies Diff	2.11	2.09	0	9
Governance Policies Diff	3.11	2.29	0	10
Environmental Policies Diff	4.00	3.46	0	14
Social Policies Diff	3.15	2.60	0	11
Democracy Index in year 2006	7.15	1.81	2.97	9.88
GNI per capita in year 2000	13204.18	12746.72	270	43490.00
GDP in year 2000	5.67e+11	1.52e+12	8.40e+09	1.03e+13
Stock Market Capitalization (%GDP) in year 2000	63.86	61.26	0.78	256.85
GHG Emissions per capita in year 2000	0.011	0.009	0.001	0.056
PM2.5 Air Pollution, mean annual exposure (μg/m³) in year 2000	22.42	16.01	5.80	72
EW Total Policies Diff	8.42	2.03	2.85	13.00
EW Mandatory Policies Diff	5.48	1.45	0.91	8.21
EW Voluntary Policies Diff	3.13	0.97	0.77	5.52
EW General Sustainability (GS) Policies Diff	2.78	1.03	1.18	6.09
EW Governance Policies Diff	4.16	0.95	2.66	7.26
EW Environmental Policies Diff	6.03	1.89	2.09	12.24
EW Social Policies Diff	4.29	1.05	2.09	7.86
MW Total Policies Diff	7.21	4.23	0.93	16
MW Mandatory Policies Diff	5.00	3.13	0	14
MW Voluntary Policies Diff	2.57	2.46	0	10
MW General Sustainability (GS) Policies Diff	2.70	1.88	0	7
MW Governance Policies Diff	3.29	2.05	0	7.76
MW Environmental Policies Diff	5.04	3.35	0.51	11.56
MW Social Policies Diff	3.41	2.10	0	7.63
International Organizations Promotion Proxy Diff	-7.27e-11	0.67	-0.63	2.33

Note: The summary statistics are summarized based on the pooling data of base year 2000 (year 2006 for *Democracy Index*) and end year 2015.

1.3.3 Empirical Models

Since making regulation instruments usually take several years, the potential correlations between proxy variables of CSR regulation drivers and the development of CSR regulation may only be observable over a long-time period. Therefore, we choose to use long differences' models as our empirical specification. Since the change in the number of policies may depend on the level of a country's characteristics, we also include regressors in a level form which have not been differenced. The long differences mean changes of a variable between year 2000 and 2015. Since there might be two-way relations between long differences of GHG emissions and CSR policies as well as long between long differences of $PM_{2.5}$ pollution level and CSR policies, we use long differences between year 1995 to 2005 for these two variables. The level form means the value of a variable in the base year 2000.

To check whether some variables have long tails, we draw a C.D.F. graph for each variable. The C.D.F. graphs are provided in Appendix A.1. Most variables' C.D.F. curves are close to the fitted normal distribution. However, the C.D.F. curves of GDP in both level form and differences, GNI per capita in both level form and differences, 4 categories of international trade CSR policies spillover variable in level forms, all categories of geographical CSR policies spillover variable in the level forms, total GHG emissions per capita in the level form, $PM_{2.5}$ air pollution in both level form and differences all have long tails. Therefore, we take the logarithm form for all variables.

A complete model specification is as follows:

$$\Delta\ln(\mathrm{Y}+1) = \beta_0 + \beta_1\Delta\ln\boldsymbol{X}_1 + \beta_2\Delta\ln(\boldsymbol{X}_2+1) + \beta_3 ln\boldsymbol{X}_{\mathbf{1}} + \beta_4 ln(\boldsymbol{X}_2+1) + \varepsilon \qquad (1)$$

There are seven different dependent variables that we explain using the above model specification. They are: the existing number of total CSR reporting regulation policies, the existing number of mandatory CSR reporting regulation policies, the existing number of voluntary CSR reporting regulation policies, the existing number of CSR reporting regulation policies which are related with firms' general sustainability, the existing number of CSR reporting regulation policies which are related with firms' CSR governance, the existing number of CSR reporting regulation policies which are related with firms' environmental CSR, and the existing number of CSR reporting regulation policies which are related with firms' social CSR. Since all dependent variables are count variables which may take a value of 0, we add 1 to the dependent variable before we take the logs. Because unobservable variables are likely to impact all dependent variables, we estimate models via seemingly unrelated regressions (SUR).

The partition of independent variable $\boldsymbol{X}$ is as follows: $\mathbf{X}_1 + \mathbf{X}_2 = \mathbf{X}$. Particularly, $\mathbf{X}_2$ contains two types of variables: the sum of top 5 exports destination countries' CSR policies in the same category with the dependent variable weighted by trade volume and the sum of bordering countries' CSR policies in the same category with the dependent variable weighted by population. $\mathbf{X}_1$ includes 8 variables: democracy index, GNI per capita, GDP, stock market capitalization (%GDP), and international organizations' accumulative promotion effort, PM2.5 air pollution (mean annual exposure by $\mu g/m^3$) and total greenhouse gas emissions per capita. In all, there are 10 independent variables in the model specification (1).

The construction of the long differences of the weighted sum of top 5 exports destination countries' CSR policies is proceeded by summing up the long differences of CSR policies from top 5 export destination countries in a specific category, weighted by total exports volume to a destination country between year 2000 and 2015. The ranking of top 5 exports destination countries is based on the total exports volume between year 2000 and 2015 to a destination country. In the case that CSR policies data is not available for a top 5 export destination country, we move down along the ranking to use the next export destination country. The long differences of the weighted sum of bordering countries' CSR policies is constructed by summing up the long differences of CSR policies in a specific category, weighted by the average population between year 2000 and 2015. In the case that a bordering countries' CSR policies data is not available, we just exclude it from our calculation. In the case that no bordering country's CSR policies data is available, we use the nearest country whose CSR policies data is available to construct the variable. The level form of these two groups of variables are constructed in the same way by using the same weights as specified above.

Since we have in total 16 independent variables in the complete model specification, to select a parsimonious set of covariates to form more concise models, we also use Lasso estimates based on Least Angle Regression (LARS) model selection algorithm (Efron, Hastie, Johnstone, and Tibshirani, 2004) to estimate refined models. The LARS algorithm is developed based on the classic Forward Stepwise Regression (Forward Selection) and Forward Stagewise Selection. The motivation for the LARS algorithm is to use a simple formula which "allows Forward Stagewise to be implemented using fairly large steps, though not as large as a classic Forward Selection" and reduces the computational burden. (Efron et al., 2004, p.408). The LARS procedure described in Efron et al. (2004) roughly works as follows: it starts with all coefficients equal to zero, and find the predictor most correlated with the response, say x_1. Then, it takes the largest step possible the direction of this predictor until some other predictor, say x_2, has as much correlation with the current residual. Instead of continuing along x_1, LARS proceeds in a direction equiangular between the two predictors until a third variable x_3 earns into the "most correlated" set. LARS then proceeds equiangularly between x_1, x_2 and x_3, that is, along the "least angle direction," until a fourth variable enters, so on. Based on the homotopy method in the papers by Osborne, Presnell and Turlach (2000a, b), a minor modification of LARS algorithm can provide full set of Lasso solution and it improves the Lasso estimation procedure by defining a clearer and more efficient algorithm. A small simulation study comparing the LARS, Lasso and Stagewise algorithm carried out by Efron et al. (2004) shows that the three algorithms performed almost identically, and rather well.

Following the suggestion of Efron et al. (2004), we select a refined model for each equation which has the smallest C_p-type selection criterion among all LARS-Lasso estimators. Assume that given $\mathbf{x}$'s, y is generated according to an homoskedastic model

$$\boldsymbol{y} \sim (\boldsymbol{\mu}, \sigma^2\mathbf{I}) \tag{2}$$

The C_p-type selection criterion of a LARS-Lasso estimator with k regressors is defined by

$$C_p(\widehat{\boldsymbol{\mu}}_k) = \frac{\|\boldsymbol{y} - \widehat{\boldsymbol{\mu}}_k\|^2}{\bar{\sigma}^2} - n + 2k \tag{3}$$

As a robustness check, we also estimated models in which potential social economic drivers are differenced over a lagged period from year 1995 to 2005. And we estimated refined models with lagged social economic drivers by using LARS-Lasso estimates as well. The results of the robustness check are relegated to our appendix.

1.3.4 Results

1.3.4.1 Complete Model Estimates and Refined Model Estimates

We first use variance inflation factors (VIF) to detect the collinearity problems among variables of interests. The VIF's for all variables of interest are smaller than 10. However, we find that VIF's for differences of GNI per capita, differences of GDP, and GNI per capita in year 2000 are larger than 10 in all models. Particularly, the VIF's for differences of GNI per capita and differences of GDP are quite similar. We first drop differences of GNI per capita since it has the biggest VIF among three variables. Then, we recheck VIF's for the rest variables. This time, only the VIF of GNI per capita in year 2000 is larger than 10. We then further drop GNI per capita in year 2000. After dropping differences of GNI per capita and GNI per capita in year 2000, the VIF's of all variables are smaller than 10.

We then check the correlation matrices of residuals of each group of revised models after excluding the collinearity problems. Overall, the correlation coefficients between residuals are between 0.074 and 0.870. Based on the strength of the correlation coefficient of residuals, the use of SUR model is justified. While the benefit of using SUR model over separate OLS model for some equations may not be salient due to weaker correlation coefficients of residuals.

The SUR estimates for complete models are presented in Table 1.9. Throughout this dissertation, we keep using same symbols in presenting estimation results. The meaning of symbols is specified in Table 1.8. The LARS-Lasso estimates for refined models are presented in Table 1.10. The graphs of LARS-Lasso estimates and graphs of the C_p curve for each equation are provided in Appendix A.2. Full interpretation of the estimates results are provided in Section 1.3.4.2 to Section 1.3.4.7 below.

Table 1.8 The Meaning of Symbols in Presenting Estimation Results

Symbol	Meaning
–	Not applicable
Dropped	Dropped from regression because of insignificance
Boldface	t value is greater than 1
***	Significant level at 0.001
**	Significant level at 0.01
*	Significant level at 0.05
.	Significant level at 0.1

Table 1.9 The SUR Estimates for Complete Long Differences Models

Policies Change / *Long Differences in logs-Long Differences in logs & Level in logs*	(1) Total	(2) Mandatory	(3) Voluntary	(4) General Sustainability	(5) CSR Governance	(6) Environmental CSR	(7) Social CSR
Intercept	**-2.225·**	**-1.510**	**-2.596***	**-2.345***	**-1.722·**	**-1.443**	**-2.501***
	(1.110)	(1.196)	(1.028)	(1.051)	(0.898)	(1.101)	(0.995)
Differences in log Democracy 2006 and log Democracy 2015	0.262	-0.885	0.889	0.400	0.621	-0.295	-0.066
	(1.069)	(1.215)	(0.999)	(1.003)	(0.849)	(1.099)	(0.949)
Differences in log GDP 2000 and log GDP 2015	**0.462**	0.325	0.075	**0.387**	**0.281**	**0.317**	**0.383**
	(0.293)	(0.332)	(0.280)	(0.280)	(0.238)	(0.303)	(0.265)
Differences in log Stock Market Capitalization (%GDP) 2000 and log Stock Market Capitalization (%GDP) 2012	**-0.187**	-0.079	0.063	**-0.183**	-0.026	-0.099	**-0.198**
	(0.167)	(0.181)	(0.158)	(0.150)	(0.131)	(0.168)	(0.147)
Differences in log GHG emissions per capita 1995 and log GHG emissions per capita 2005	0.104	0.171	0.516	0.109	0.365	0.291	0.196
	(0.548)	(0.612)	(0.527)	(0.521)	(0.447)	(0.563)	(0.502)
Differences in log PM2.5 air pollution 1995 and log PM2.5 air pollution 2005	**1.511·**	-0.029	**1.430·**	**0.938**	**0.675**	**1.446·**	**0.995**
	(0.803)	(0.811)	(0.789)	(0.704)	(0.617)	(0.806)	(0.687)
Differences in log Weighted Average Top 5 Exports Destination Countries' CSR Policies 2000 and log Weighted Average Top 5 Exports Destination Countries' CSR Policies 2015	0.107	0.157	**-0.337**	**0.564***	-0.200	0.151	**0.662***
	(0.384)	(0.409)	(0.314)	(0.255)	(0.324)	(0.314)	(0.299)
Differences in log Weighted Average Bordering Countries' CSR Policies 2000 and log Weighted Average Bordering Countries' CSR Policies 2015	**-0.148**	0.049	**-0.160**	**-0.116**	0.036	**-0.148**	**-0.168**
	(0.112)	(0.140)	(0.110)	(0.113)	(0.097)	(0.110)	(0.103)
Differences in log International Organizations' Accumulative Promotion Effort 2000 and log International Organizations' Accumulative Promotion Effort2015	**0.037**	0.009	0.003	**0.048·**	0.020	**0.034**	**0.034**
	(0.027)	(0.029)	(0.030)	(0.025)	(0.023)	(0.028)	(0.024)
Log Democracy 2006	0.239	0.275	**0.762**	0.099	**0.507**	-0.199	-0.0008
	(0.497)	(0.536)	(0.474)	(0.481)	(0.405)	(0.512)	(0.454)
Log GDP 2000	**0.269*** ***	**0.155·**	**0.244****	**0.226****	**0.183****	**0.220****	**0.241****
	(0.075)	(0.081)	(0.072)	(0.072)	(0.061)	(0.079)	(0.068)
Log Stock Market Capitalization (%GDP) 2000	**-0.164**	0.001	-0.063	-0.035	0.005	-0.137	-0.037
	(0.134)	(0.144)	(0.140)	(0.129)	(0.111)	(0.139)	(0.124)
Log GHG emissions per capita 2000	-0.125	0.057	0.006	-0.011	0.069	-0.101	-0.077
	(0.145)	(0.158)	(0.135)	(0.137)	(0.116)	(0.154)	(0.132)
Log PM2.5 Air Pollution (mean annual exposure by micrograms per cubic meter) 2000	**-0.290**	-0.067	-0.044	-0.148	-0.063	**-0.281**	**-0.222**
	(0.201)	(0.219)	(0.194)	(0.197)	(0.167)	(0.208)	(0.188)
Log Weighted Average Top 5 Exports Destination Countries' CSR Policies 2000	-0.339	0.312	-0.444	**1.039**	**1.135***	-0.154	**0.610**
	(0.339)	(0.324)	(1.103)	(0.630)	(0.507)	(0.308)	(0.401)
Log Weighted Average Bordering Countries' CSR Policies 2000	0.032	-0.261	0.606	-1.685	0.040	-0.111	**-0.263**
	(0.171)	(0.306)	(0.703)	(1.843)	(0.315)	(0.312)	(0.249)
Log International Organizations' Accumulative Promotion Effort till year 2000	-0.084	-0.031	-0.093	-0.083	-0.113	0.042	-0.034
	(0.149)	(0.159)	(0.150)	(0.145)	(0.127)	(0.159)	(0.139)
Adjusted R^2	0.08580	-0.054056	0.24338	0.116722	0.155645	0.033742	0.22447

Table 1.10 The LARS-Lasso Refined Long Difference Models Estimates

Policies Change	(1) Total	(2) Mandatory	(3) Voluntary	(4) General Sustainability	(5) CSR Governance	(6) Environmental CSR	(7) Social CSR
Long Differences in logs-Long Differences in logs & Level in logs							
Intercept	**-0.846**	**-1.246***	**-1.976*****	**-2.366*****	**-1.386****	**-2.158***	**-1.670****
	(0.592)	(0.560)	(0.524)	(0.667)	(0.487)	(0.833)	(0.536)
Differences in log Democracy 2006	–	–	–	0.634	–	–	–
and log Democracy 2015	–	–	–	(0.816)	–	–	–
Differences in log GDP 2000 and log	–	–	–	**0.261**	–	**0.330**	–
GDP 2015	–	–	–	(0.174)	–	(0.210)	–
Differences in log GHG emissions	–	–	–	–	–	0.048	0.336
per capita 1995 and log GHG emissions per capita 2005	–	–	–	–	–	(0.476)	(0.357)
Differences in log PM2.5 air	–	–	**1.268***	**0.926·**	**0.908***	**0.655**	**0.976***
pollution 1995 and log PM2.5 air pollution 2005	–	–	(0.485)	(0.514)	(0.417)	(0.549)	(0.485)
Differences in log Weighted Average	–	–	–	**0.760***	–	**0.637***	**0.395**
Top 5 Exports Destination	–	–	–	(0.304)	–	(0.274)	(0.292)
Countries' CSR Policies 2000 and log Weighted Average Top 5 Exports Destination Countries' CSR Policies 2015	–	–	–	–	–	–	–
Differences in log International	–	–	**0.040***	**0.041***	**0.028·**	**0.028**	–
Organizations' Accumulative Promotion Effort 2000 and log International Organizations' Accumulative Promotion Effort2015	–	–	(0.019)	(0.020)	(0.016)	(0.022)	–
Log GDP 2000	**0.132***	**0.160****	**0.211*****	**0.204*****	**0.169*****	**0.184****	**0.173*****
	(0.053)	(0.050)	(0.047)	(0.054)	(0.043)	(0.061)	(0.046)
Log GHG emissions per capita 2000	–	–	–	–	–	-0.069	–
	–	–	–	–	–	(0.126)	–
Log Weighted Average Top 5	–	–	–	**1.573**	**1.670***	–	–
Exports Destination Countries' CSR Policies 2000	–	–	–	(0.988)	(0.675)	–	–
Log Weighted Average Bordering	–	–	–	–	–	-0.349	–
Countries' CSR Policies 2000	–	–	–	–	–	(0.385)	–
N	55	55	55	55	55	55	55
Adjusted R^2	0.08872	0.1465	0.3424	0.248	0.2788	0.1858	0.2606
F-Statistics	F(1,53) =6.258 , p-value: 0.01549	F(1,53)=10 .27, p-value: 0.002289	F(3,51)=1 0.37, p-value: 1.948e-05	F(7,47)=3.544, p-value: 0.003878	F(4,50)=6.2 18, p-value: 0.0003847	F(8,46)=2.541, p-value: 0.02216	F(4,50) =5.757, p-value: 0.00068 49

1.3.4.2 Total CSR Regulation Policies Development

For the development of the number of total CSR reporting policies between 2000 and 2015, we find two significant drivers from the complete model estimates: the GDP in year 2000 of a country and differences in log $PM_{2.5}$ air pollution in 1995 and log $PM_{2.5}$ air pollution in 2005. A country with higher GDP in year 2000 tends to develop more CSR policies. In another word, larger economy tends to issue more CSR policies, possibly due to more regulation needs accompanied with larger economy. And a country with higher deterioration of air pollution level between 1995 and 2005 tends to issue more CSR policies. However, the refined model only selects one variable: the GDP in year 2000 to be included in the refined model. The estimates from the complete model and the refined model on the impact of GDP in year 2000 are consistent, although the estimate by the refined model is smaller than the estimate by the complete model.

Besides, we also find that six factors have weakly significant impacts on the development of total CSR policies from estimates based on the complete model, for which the significant level is below 0.1 but the t-value is greater than 1. We highlighted these factors in bold in Table 1.9 and Table 1.10 for easy reference.

Among these six weakly significant factors, the difference of log GDP, and the difference of log international organization's accumulative promotion efforts both have positive impacts on driving the development of total CSR policies. In another word, the economy growth and the growing trend in accumulative promotion efforts from international organizations both may be positive factors to drive the development of total CSR policies.

However, the other four factors are found to have weakly significant negative impacts on driving the development of CSR policies: difference of log Stock Market Capitalization (%GDP), difference of log weighted sum of bordering countries' CSR total policies, the log Stock Market Capitalization (%GDP) in year 2000, and the log $PM_{2.5}$ air pollution level in year 2000. To interpret these weak negative impacts, we take a more careful examination on these four factors. Some clues and speculation we formed are provided as follows.

First, after reviewing the stock market capitalization (%GDP) from year 2000 to 2012 and countries' GNI per capita in year 2000, we found that in year 2000, 44% of high income level countries' stock markets are overvalued, which have stock market capitalization larger than 100% GDP. From year 2000 to 2012, 76% of high income level countries (measured in year 2000) have negative stock market capitalization (%GDP) change. While among countries which have positive stock market capitalization (%GDP) change from year 2000 to 2012, 81.8% are middle income level and low income level countries. Thus, we may possibly interpret negative stock market capitalization (%GDP) between year 2000 and 2012 to be the extent to remove financial bubbles while positive stock market capitalization (%GDP) change between year 2000 and 2012 to be the development of undervalued stock market or less developed stock market in middle and low income level countries. And high Stock Market Capitalization (%GDP) in year 2000 is more likely to be an overvalued market and low Stock Market Capitalization (%GDP) in year 2000 is more likely to be an undervalued market. Therefore, combining the weakly negative estimates for both the difference of log Stock Market Capitalization (%GDP) and log Stock Market Capitalization (%GDP) in year 2000, it is likely that the faster that a country removes its financial bubbles, the more total CSR policies are issued. Also, the faster that a country with less developed stock market to develop its stock market, the more total CSR policies are possibly to be issued.

Second, for the negative impact of the weighted sum of bordering countries' total CSR policies in 2000 is that the regional differences in the development of total CSR regulation policies may become larger between 2000 and 2015.

Third, one possible explanation for the negative impact of the $PM_{2.5}$ air pollution (mean annual exposure by $\mu g/m^3$) in 2000 is that different countries may be at the different stages in addressing the air pollution in year 2000. Some country may begin to deal with air pollution and enact legislation to improve air quality at an earlier time. For example, U.S. enacted Clean Air Act in 1970 to improve air quality. Therefore, by year 2000, the low $PM_{2.5}$ pollution level in that country may reflect the great attention paid by that country in addressing the environmental and social problems and the high $PM_{2.5}$ pollution level in a country may reflect little attention paid by that country in addressing the environmental and social problems. In another world, the $PM_{2.5}$ pollution level in year 2000 might be negatively correlated with the extent of attention paid by a country in addressing the environmental problems. One evidence to support our guessing is that we also found that $PM_{2.5}$ pollution level is negatively correlated with the development of environmental and social CSR regulation policies but not related with the development of other categories of CSR policies. Therefore, the negative impact of $PM_{2.5}$ pollution level may reflect that a country with greater attention in addressing environmental and social issues are more likely to issue CSR policies.

1.3.4.3 Mandatory and Voluntary CSR Regulation Policies Development

For the development of the number of mandatory CSR reporting regulation policies between 2000 and 2015, the only significant driver we find is the GDP in year 2000 of a country. The estimates from the complete model and the refined model on the impact of GDP in year 2000 are consistent and quite similar.

For the development of the number of voluntary CSR reporting regulation policies between 2000 and 2015, the complete model estimates suggest that there are two significant factors. The refined model estimates are consistent with the complete model estimates and suggest that there is one more significant factors. In all, the three significant factors are: the difference of log $PM_{2.5}$ pollution level, the difference of log international organization's promotion efforts, and the log GDP in year 2000. In another word, it seems that the deterioration of air pollution level, the economy growth, and the growing trend in accumulative promotion efforts from international organizations may all be positive factors to drive the development of voluntary CSR policies.

Besides, we also find three weakly positive factors. Both differences in the log weighted average top 5 exports destination countries' voluntary CSR policies and differences in the log weighted average bordering countries' voluntary CSR policies are weakly negative correlated with the development of voluntary CSR policies. The log Democracy Index in year 2006 is weakly positive correlated with the development of voluntary CSR polices. It may suggest that the difference between the development of voluntary CSR policies among trade partner countries and among bordering countries increases over the period 2000 and 2015 and a more democratic institution and political environment may facilitate the development of voluntary CSR polices.

1.3.4.4 General Sustainability CSR Regulation Policies Development

Both complete model estimates and the refined model estimates consistently identify three significantly correlated factors with the development of general sustainability CSR reporting regulation policies. While the refined model identifies one more significantly correlated factors. In total, the four significantly correlated factors are: the difference in log $PM_{2.5}$ pollution, the difference in log weighted average top 5 exports destination countries' general sustainability CSR policies, the difference in the log international organizations' accumulative promotion efforts, and the log GDP in year 2000. All of these four factors are estimated to be positively related with the development of general sustainability CSR policies. In another word, the deterioration of air pollution, the international trade spillover effects, the promotion efforts from international organizations, and the size of an economy may all be positive factors in driving the development of general sustainability CSR policies.

Besides, we also find four weakly significant factors to the development of general sustainability CSR policies based on both the complete model estimates and refined model estimates. Particularly, we find that the difference of log GDP and the log average top 5 exports destination countries' general sustainability CSR policies in year 2000 both have weakly positive impacts. In another word, faster GDP growth and international trade spillover effect may both be weak positive factors to drive the development of general sustainability CSR policies. Similar to the result with total CSR policies estimates, we find that the difference of log Stock Market Capitalization (%GDP) has a weak negative impact on the development of general sustainability CSR policies. The same speculation as we proposed in interpreting the result for total CSR policies may apply here. Also, the difference in log weighted average bordering countries' general sustainability CSR policies is estimated to have a weakly negative impact. This results may indicate that the reginal difference in the development among bordering countries' general sustainability CSR policies increases over the period 2000 to 2015.

1.3.4.5 CSR Governance Regulation Policies Development

For the development of the number of CSR reporting regulation policies which are related with CSR governance between 2000 and 2015, both complete model estimates and the refined model estimates consistently identify two significantly correlated factors with the development of CSR governance regulation policies. While the refined model identifies two more significantly correlated factors. In total, the four significantly correlated factors are: the difference in log $PM_{2.5}$ pollution, the difference in the log international organizations' accumulative promotion efforts, the log GDP in year 2000 and the log weighted average top 5 exports destination countries' CSR governance regulation policies in year 2000. All of these four factors are estimated to be positively related with the development of CSR governance policies. In another word, higher deterioration of air pollution between 1995 and 2005, more promotion efforts from international organizations, the economy size, and the international trade spillover effect all may have positive impacts on the development of CSR governance policies.

Since the correlations between the residual from CSR governance policies equation and the residuals from other three equations: general CSR policies equation, environmental CSR policies equation and the social CSR policies equation are relatively high, between 0.682 and 0.870, SUR estimates for CSR governance policies also suggest some weakly significant factors due to improved efficiency in estimation. Particularly, we find two weakly positive factors in driving the development of CSR governance policies: the difference of log GDP and the log Democracy Index in year 2006. In another word, faster economy growth and more democratic institution and political environment may both facilitate the development of CSR governance polices.

1.3.4.6 Environmental CSR Regulation Policies Development

For the development of the number of CSR reporting regulation policies which are related with environmental CSR between 2000 and 2015, we find a consistent significant positive factor: log GDP in year 2000 by both complete model estimates and refined model estimates. Besides, the complete model estimates suggest that the difference in log $PM_{2.5}$ air pollution between 1995 and 2005 is significantly positive related with the development of environmental CSR policies. And the refined model estimates suggest that the difference in log weighted average top 5 exports destination countries' environmental CSR policies is another significant positive factor. In short, the size of an economy, the deterioration of air pollution and international trade spillover effect may be three main factors in driving the development of environmental CSR reporting policies.

Since the correlations between the residual from environmental CSR policies equation and the residuals from other equations except for the voluntary CSR policies equation are relatively high, between 0.682 and 0.759, SUR estimates for environmental CSR policies also suggest three weakly significant factors due to improved efficiency in estimation. Among them, one weakly positive factor is the difference of log GDP. Thus, it is likely that the growth rate of GDP may be a weak factor in driving the development of environmental CSR policies. On the other hand, we find two weakly negative factors: log $PM_{2.5}$ pollution level in year 2000 and the log weighted average bordering countries' environmental CSR policies in year 2000. The argument we proposed in interpreting the weak negative impact of $PM_{2.5}$ pollution level on the development of total CSR reporting policies in Section 1.3.4.2 can be applied here. While the weak negative impact of the geopolitical spillover effect may suggest that the regional difference in the development of environmental CSR policies may become larger between year 2000 and year 2015.

1.3.4.7 Social CSR Regulation Policies Development

For the development of the number of CSR reporting regulation policies which are related with social CSR between 2000 and 2015, we find a consistent significant positive factor: log GDP in year 2000 by both complete model estimates and refined model estimates. Besides, the complete model estimates suggest that the difference in log weighted average top 5 exports destination countries' environmental CSR policies is significantly positive related with the development of environmental CSR policies. And the refined model estimates suggest that the difference in log $PM_{2.5}$ air pollution between 1995 and 2005 is another significant positive factor. In short, the size of an economy, the deterioration of air pollution and international trade spillover effect may be three main factors in driving the development of social CSR reporting policies.

According to the complete model estimates, both log GDP in year 2000 and the difference of log weighted average top 5 exports destination countries' social CSR polices are two significant positive factors. Particularly, the estimate for the international trade spillover effect is around 3 times of the estimate for the size of economy in year 2000, suggesting that the international trade spillover effect might be a stronger driver.

Besides, we also find that the difference of log GDP, the difference of log international organizations' accumulative promotion efforts, the log weighted average top 5 exports destination countries' social CSR policies in year 2000 all three have weakly significant positive impacts on driving the development of social CSR policies by complete model estimates. In another word, the economy growth rate, the growing accumulative promotion efforts from international organizations, and the international trade spillover effect in year 2000 all might be weak drivers to the development of social CSR policies.

On the other side, we find four weakly significant negative factors from the complete model estimates, including the difference of the log Stock Market Capitalization (%GDP), the difference of log weighted average bordering countries' social CSR policies, the log $PM_{2.5}$ air pollution level in year 2000, and the log weighted average bordering countries' social CSR policies in year 2000. The speculation we proposed to interpret the weakly negative impacts from stock market capitalization (%GDP) and the log $PM_{2.5}$ air pollution level in year 2000 for total CSR policies in Section 1.3.4.2 can be applied here. The weakly negative impacts from bordering countries may suggest that the regional difference in the development of social CSR policies may become larger between year 2000 and year 2015.

1.4 Robustness Check

The changes of potential social economic drivers and the development CSR reporting policies are not necessarily in the same period. It is likely that drivers change first and then follows the CSR reporting policies development. As a robustness check, we also estimated models in which GDP and Stock Market Capitalization (%GDP) are differenced over a lagged period from year 1995 to 2005. And we estimated refined models with lagged social economic drivers by using LARS-Lasso estimates as well. The results of the robustness check are relegated to our Appendix A.3 Table A- 1 and Table A- 2.

The results from complete model estimates and refined model estimates with lagged differences of GDP and Stock Market Capitalization in Appendix A Table A- 1 and Table A- 2 show that the significant factors for all seven equations are consistent with the significant factors we've identified before using same period differences of GDP and Stock Market Capitalization. However, the SUR estimates results suggest that the lagged differences of GDP and Stock Market Capitalization are less relevant to the development of CSR policies than same period differences of these two variables. The weakly significant factors identified by SUR estimates using lagged differences of GDP and Stock Market Capitalization are basically consistent with SUR estimates using same period differences of these two variables. The LARS-Lasso estimates for total CSR policies and mandatory CSR policies are the same with before. For voluntary CSR policies and CSR governance policies, the LARS-Lasso refined models using lagged differences of GDP and Stock Market Capitalization include more covariates than LARS-Lasso refined models using same period differences of these two variables. However, the significant impact factors identified by two types of refined models are basically consistent. For general sustainability CSR policies, environmental CSR policies, and social CSR policies, the LARS-Lasso refined models using lagged differences of GDP and Stock Market Capitalization include less covariates than LARS-Lasso refined models using same period differences of these two variables. However, the significant impact factors identified by two types of refined models are still basically consistent.

In summary, for all six equations except for the equation for mandatory CSR policies, adjusted R^2's of six equations estimated by SUR using same period differences of GDP and Stock Market Capitalization are higher than adjusted R^2's of seven equations estimated by SUR using lagged differences of these two variables. And for all six equations except for the equation for social CSR policies, adjusted R^2's of six equations estimated by SUR using same period differences of GDP and Stock Market Capitalization are higher than adjusted R^2's of six equations estimated by SUR using lagged differences of these two variables.

1.5 Conclusions

In this chapter, we use both SUR and LARS-Lasso methods to estimate complete long differences models and refined long difference models on potential drivers to the development of CSR reporting regulation policies.

On the basis of these results, it appears that the GDP level of a country is the most significant and robust association with the development of all seven categories of CSR reporting regulation policies. This is possibly due to the reason that larger economies may have more CSR regulation needs. Besides, the deterioration of $PM_{2.5}$ air pollution level, the international trade spillover effect, and the international organization promotion effort are estimated to be significant and robust associations with some categories of CSR policies.

Particularly, the deterioration of $PM_{2.5}$ air pollution level is a significant and robust association related with the development of voluntary CSR policies. And it might also be strongly associated with the total CSR policies, general sustainability CSR policies, CSR governance policies, environmental CSR policies and social CSR policies. The international trade spillover effect is a significant and robust association with the development of general sustainability, while it might also be strongly related with the development of environmental and social CSR policies. Besides, the international organization promotion effort is estimated to be a significant and robust association with the development of general sustainability CSR policies, and might be strongly correlated with the development of voluntary CSR policies and CSR governance polices.

We also identify some factors which have weakly significant impacts on the development of CSR policies, including the same period economy growth rate and the Democracy Index in year 2006. Particularly, the size of the stock market of a country is not a direct driver in the development of CSR regulation policies. Rather, the extent that a country removes financial bubbles in its stock market may have a positive impact in driving the development of CSR regulation policies. Also, a more democratic institution and political environment may facilitate the development of voluntary CSR polices and CSR policies related with CSR governance. After 15 years' development, it is likely that the regional differences in the development of CSR regulation policies among bordering countries become larger. The total greenhouse gas emissions per capita is estimated to be not significantly associated with the development of any CSR regulation policies. It is possible that the attention paid by a country in addressing the environmental and social problems may matter in the development of environmental and social CSR regulation policies. However, without additional data, we could not further verify conjecture.

The limitation of our study is the measurement of CSR policies development. Right now, we are using the count of CSR policies as the proxy variable for the development of CSR policies. However, different CSR policies may have different regulation scope and the stringency of each CSR policy may also be different. Thus, different CSR policies are not necessarily treated equally. Future study may focus on developing a cross-country and cross-period comparable evaluation index for the regulation scope and the quality of each CSR policy to better examine the drivers to this global trend.

Chapter 2
Is There Financial Incentive for Firms to Fulfill CSR under CSR Reporting Regulation? Evidence from China

2.1 Introduction

Driven by regulation, the global CSR reporting rate is growing fast. Based on KPMG 2015 survey, over the years from 2011 to 2015, 90% to 95% of the 250 largest companies (G250) in the world report on their corporate responsibility activities (KPMG, 2015, pg.30). Also, among top 100 firms in 45 countries, namely 4500 firms worldwide, the average CSR reporting rate across the globe is 73% (KPMG, 2015, pg.33). However, for mandatory CSR reporting regulation to achieve its goal, it is crucial to provide financial incentives for firms to fulfill their CSR obligation and report their CSR performance.

Thus, it is important to ask whether there is financial incentive for firms to fulfill their CSR obligation and report their CSR performance or not. In another word, is there a link between firms' CSR performance and financial performance? (Q1) Particularly, can publishing CSR reports motivate firms to fulfill their CSR obligation? (Q2)

In this chapter, we answer these two questions by empirically analyzing a large panel data set from China after CSR reporting regulation. The data set includes 120 top firms from China spanning from year 2007 to 2013. The total revenue of sampled firms constitutes around half of China's non-agriculture GDP. Particularly, we introduce the factor of firms' CSR reports and reporting behaviors into our study, which has not been considered by most studies of CSR since these studies were done when CSR reporting was practiced voluntarily (Orlitzky, Schmidt, Rynes, 2003; Margolis, Elfenbein, and Walsh, 2007).

Intuitively, we conjecture that CSR performance might be related with financial performance through two links. First, there might be an operational effect through improved stakeholder relationship management, better market CSR performance and better employee relationship which may generate higher profit to firms. Second, there might be a signaling effect through reported CSR performance. The reported CSR performance can be viewed as self-reported signals, relatively to education as an authority-report signal in job market, which may reveal firms' moral types. We define the moral type as how a firm evaluates its externality. High moral type firms give the same negative externality more negative evaluation than low moral type firms do and give the same positive externality more positive evaluation than low moral type firms do. Further, the moral type of a firm is defined to be influenced by two clusters of factors. One cluster of factors is a firm's inner factors, like the entrepreneurship and corporate culture. The other cluster of factors is outer factors coming from the society, like social morality, industry morality, consumers' pressure, investors' pressure, media' pressure, regulation policy, and other stakeholders' pressure. In the short-run, a firm's moral type is relatively fixed, say one-year period, but in the long-run it is changeable, depending on the impacts of inner factors and outer factors. A firm's moral type is relevant to its stakeholders from two aspects: first, what hidden actions a firm may take which will influence the interest of stakeholders; second, what impacts on the society and the environment a firm may bring which stakeholders concern. We interpret a firm's CSR performance level as the level of externality that a firm choose to generate within the range of $(-\infty, +\infty)$. If we assume that firms maximize net return from their business operation and externality[4], which equals to the sum of business return and CSR performance return minus the cost of business activities and CSR activities, a firm's reported CSR performance level may enable stakeholders to conjecture a firm's moral type and form their strategy on how to interact with a firm based on their conjecture. In practice, firms' CSR reports are published annually. Correspondingly, stakeholders may update their beliefs on firms' moral types annually and adjust their strategy towards firms. It is worth a mention that CSR activities' cost not only includes the direct cost of fulfilling CSR but also includes the indirect loss from unfulfilling CSR, like lawsuit, boycott, strike, regulation, bad corporate reputation etc.

[4] We could transform a firm's evaluation on its externality into an equivalent financial return.

To detect the operational effect, we investigate whether a firm's CSR performance has an impact on financial performance and how four dimensions of CSR performance (CSR management performance, market CSR performance, social CSR performance and environmental CSR performance) are related with financial performance.

To detect the signaling effect, we include lagged CSR performance, the interaction term of lagged CSR performance and a reporting dummy, and the reporting dummy into the regressions on financial performance. If significant effects are found for the interaction term and the reporting dummy, this would suggest that reported CSR performance has a different impact on firms' financial performance from unreported CSR performance, which may provide some evidence for the existence of signaling effect. Since the reputation may take time to build up, the reporting records may also matter in the signaling effect. Therefore, we classified firms into three types: Leaders who initiated CSR reporting before or since 2008 and keep publishing CSR reports every year (the reporting dummy equals 1 for all periods), Followers who initiated CSR reporting after 2008 and keep publishing CSR reports every year (the reporting dummy switches from zero to 1 only once) and The Uncommitted who never publish CSR report or only publish CSR reports once or twice discontinuously between 2008 and 2013 (the reporting dummy is almost zero) and conducted partitioned regressions.

We find that both current year CSR performance and lagged CSR performance have an impact on firms' financial performance. Better current year CSR performance has an effect on increasing profitability (net profit/ROA/total revenue) but it is also associated with higher total operating costs. The examination of the link between four aspects of CSR performance and firms' financial performance suggests that the strength and the direction of the link may depend on a firm's CSR reporting records type, how a firm practices CSR, and time horizon. Overall, social CSR performance has the most consistent positive effects on profitability among full sample and all types. Lagged market CSR performance and CSR management performance also have a positive effect on profitability. The link between environmental CSR performance and financial performance is very limited and in general negative. A possible explanation to this finding is that stakeholders in China may mainly use social CSR performance as an indicator of firms' moral type while the public perception of environmental CSR performance as an indicator of firms' moral type is still low.

Next, by isolating the signaling effect of CSR reports and reporting records, we find that lagged reported CSR performance has a different impact on financial performance from unreported CSR performance. Lagged unreported CSR performance increases the total operating costs and has a negative effect on the profitability. However, lagged reported CSR has a conditional signaling effect on firms' profitability. The conditional signaling effect is that when lagged reported CSR performance is beyond a critical level the impact of lagged reported CSR performance on profitability is positive, while when lagged reported CSR performance is below this critical level the impact of lagged reported CSR performance on profitability is negative. The critical level may reflect stakeholders' beliefs on the CSR performance level which may differentiate high moral type firms from low moral type firms.

From partitioned regressions, we find that current year CSR performance has an effect on increasing total revenue and profitability for all three types. It also has an effect of increasing total cost for Leaders and Followers but no significant effect on The Uncommitted' total cost. This finding provides good evidence that both Leaders and Followers have invested in fulfilling CSR but The Uncommitted haven't. In the long run, there is a positive effect of lagged reported CSR performance on Leaders, a conditional effect of lagged reported CSR performance on Followers and negative effect of lagged unreported CSR performance for The Uncommitted, which might suggest adverse selection effect for The Uncommitted.

Our results are of value to policy makers, firms and of relevance to the signaling model literature. First, it is helpful to policy makers to be assured the existence of the financial incentive for firms to fulfill CSR performance and publish CSR reports. Policy makers can promote firms to have better CSR performance by enhancing the standard of CSR performance level in differentiating high moral type firms from low moral type firms in public awareness. By doing so, police makers could also provide incentives to The Uncommitted firms to become content in fulfilling their CSR. Second, these results are helpful to firms to be certain about the financial benefits to fulfill CSR. Third, since CSR reporting can be viewed as self-report signals and the function of CSR reports as valid signals lies heavily on the trustworthiness of CSR reports considering its self-publishing feature. It would be worth exploring how the quality of self-report signals would influence the equilibrium. This theoretical exploration could be an extension to Spence (1972) job market signaling model, in which education can truthfully reflect a worker's ability as an authority-report signal. Therefore, our results provide primary empirical foundation for the future theoretical work. Particularly, the new theoretical exploration will be presented in another paper (Wen & Liu, working paper).

The following of this chapter is organized as follows. In section 2.2, we will take a brief review on CSR and CSR regulation in China. In section 2.3, we will give a descriptive summary of our data. In section 2.4, we present our results on empirical analysis of overall CSR performance index, CSR reporting and financial performance. In section 2.5, we will further to take an empirical analysis of four CSR performance subindices, CSR reporting and financial performance. In section 2.6, limitations and future studies are discussed.

2.2 CSR and CSR Regulations in China

According to the latest definition of CSR by United Nations Industrial Development Organization, "Corporate Social Responsibility is a management concept whereby companies integrate social and environmental concerns in their business operations and interactions with their stakeholders."

CSR has attracted attention from businesses and stakeholders since 1960s (De George 2011) and earned scholarly perception since 1970s (Markus Kitzmueller and Jay Shimshack, 2012). For around 40 years before year 2000, CSR was practiced voluntarily and most studies on CSR were built on the basis that it is a voluntary behavior by business which "exceeds levels set by obligatory regulation or standards enforced by law". (Markus Kitzmueller and Jay Shimshack, 2012)

However, with the increasing concern "about the accelerating deterioration of the human environment and natural resources and the consequences of that deterioration for economic and social development" and the emphasis of "the need for a new approach to economic growth, as an essential prerequisite for eradication of poverty and for enhancing the resource base on which present and future generations depend" (*Report of the World Commission on Environment and Development*, General Assembly Resolution 42/187, United Nations, 11 December 1987), and at the pressure from the public: consumers, investors, NGO's and other stakeholders, who is demanding an increased role for governments in addressing the growing environmental and social problems with the economic development, as well as the need to address trust crisis after the global financial crisis in 2008 (*Carrots and Sticks-Promoting Transparency and Sustainability*, 2010, pg.6), governments began to make CSR mandatory through CSR reporting regulation since year 2000.

In China, the number of annual CSR reports grows fast from 32 reports in 2006 to 1703 reports in 2015 (*White Book of Chinese CSR Reports 2015*). The rapid increasing CSR reporting rate in China is mainly due to China's governments and China's two stock markets' regulation requirements since 2006. In year 2006, in the modified China's Corporate's Law, it added a new clause, article 5 clause 1, saying that "firms must take their social responsibility when conducting businesses". Besides, 3 environmental administrative rules and 26 regulation documents were enacted. Also in year 2006, two stock exchanges in China (Shenzhen Stock Exchange and Shanghai Stock Exchange) suggested listed companies to publish CSR report together with their financial report each year. In January 2008, State-Owned Assets Supervision and Administration Commission of the State Council issued a document of A Guidance for Central-Government Owned Enterprise to Fulfill CSR. In year 2008, both stock markets further required listed firms to publish CSR report each year. The underlying reason for these regulation requirements is the trust crisis in China's market. In China, the 1st issue of consumption concern is the product quality. In 2011, China Consumer's Association has accepted 607,263 consumer complaints and 50.2% are about product's quality. With a lot of news reports by Chinese media on the problems of product security and product quality, like toxic infant milk powder, toxic drug capsule, high mercury levels in cosmetics, China's consumers' confidence in firms in providing high quality products and behaving ethically is weaker than ever before. It is through the regulation requirement of CSR reporting that China's government is making an effort to rebuild a good market order and prevent socially irresponsible behaviors of firms.

On the other side, Chinese Academy of Social Science Chinese CSR Research Center (CASS CSR Research Center), a national academic research institute was established in 2008. The CASS CSR Research Center began to release *Chinese CSR Reports Writing Guidance* since 2009 (CASS-CSR). This report writing guidance provides a specific guidance to each industry. In 2015, 64% Chinese CSR reports referred to some disclosure standards to organize their CSR reports and more and more firms turn to refer to CASS-CSR.

2.3 Data

2.3.1 Data source

Our CSR performance evaluation data come from *Research Report on Corporate Social Responsibility of China* (2009, 2010, 2011, 2012, 2103, and 2014) by CASS CSR Research Center. Since 2009, it began to publish Research Report on Corporate Social Responsibility of China on top companies in China annually, including top 100 state-owned companies, top

100 private companies, and top 100 foreign companies in China. In the report, it developed an evaluation framework of CSR performance by decomposing CSR performance into four parts: CSR management performance, market responsibility performance, social responsibility performance, and environmental responsibility performance and evaluating a firm's CSR performance by using a weighted sum formula:

$$CSR\ performance\ Index = B_i + \sum_{j=1}^{4} W_{jk} A_{ij}$$

where $W_{jk}$is the weight of j^{th}CSR performance component (one of the 4 parts mentioned above) in industry k (Each industry may have a difference weight for the same CSR performance component), A_{ij} is the score that firm i got in j^{th}CSR performance component, $B_i$is the adjustment score by considering the rewards a firm got on CSR performance, the negative coverage on a firm's CSR performance, and the creativity in a firm's CSR practice. For each component of CSR performance, they further developed a series of subindices to evaluate a firm's CSR performance. In *Research Report on Corporate Social Responsibility of China* (2014), there were 80 subindices in total to evaluate a firm's CSR performance. The definition of four aspects of CSR performance and details of 80 subindices are listed in Table 2.1.

The CSR performance index is evaluated based on 4 kinds of information sources: (1). Firms' CSR reports;(2). Firms' accounting annual report; (3). Firms' website; (4). Coverage on news media's website and government's websites.

Firms' financial performance data was collected manually by author from firms annual accounting reports published on Shenzhen Stock Exchange, Shanghai Stock Exchange and China Foreign Exchange Trade System & National Interbank Funding Center.

Table 2.1 China CSR Performance Evaluation Indices (*Research Report on CSR of China, 2014*)

CSR Components	CSR Issues	CSR Performance Evaluation Indices
CSR Management (CSR-1)	CSR Management (CSR-1.1)	(1).CSR vision; (2).CSR issues; (3).CSR annual plan; (4).CSR leading organs; (5).CSR organization system; (6).CSR management system; (7). Stakeholders Identification; (8).Stakeholders' expectation and firms' response action; (9).The interactive stakeholders' participation system; (10). CSR report publication (Yes/No); (11).Third party auditing in CSR reports; (12).CSR column on firm's website; (13).CSR reports on special issues; (14).CSR activities which involves firm's executive leaders
Market CSR (CSR-2)	Shareholders' Equity (CSR-2.1)	(1).Investor relations management; (2).Total revenue; (3). Net profit; (4). Total asset; (5). Asset-liability ratio
	Supply Chain Management (CSR-2.2)	(1).Supplier management; (2).Supplier list; (3). Supplier qualification requirement; (4). Responsible purchasing institution and guidelines; (5).Promote suppliers to practice CSR
	Customer Relationship Management (CSR-2.3)	(1). Customer relations management; (2).After-sales services system; (3).Active response to customers' complains; (4).Customers' information protection; (5). Customer satisfaction survey; (6). Product quality management and certification; (7).Legal advertising
	R&D (CSR-2.4)	(1).R&D support institution and measures; (2).R&D staff number and ratio; (3).R&D investment; (4).Newly developed patents number
	Industry Special Issues	Other industry specific market CSR index
Social CSR (CSR-3)	Legal Operation (CSR-3.1)	(1).Policies of legal operation; (2).Anti-corruption and business bribery measures; (3).Tax payment; (4).Total employee numbers during the reporting period
	Employee Relationships (CSR-3.2)	(1).Fare employing institution; (2).Employment contract signing ratio/Collective contract coverage ratio; (3).Social insurance coverage ratio; (4).Unionized staff ratio; (5).Prohibition of forced or compulsory labor; (6). Protection for employee personal information and privacy; (7).Average annual level; (8).Female manager ratio; (9).Disabled employee ratio/number; (10).Democratic management and transparent managerial affairs; (11).Financial aid to employee who are in difficulties; (12).Protection to special groups (e.g. pregnant women, nursing women, etc.); (13).employee satisfaction ratio; (14).Employee turnover rate; (15).Employee training program; (16).Performance on employee training; (17).Employee career development channel; (18). Incentive mechanism for employee
	Community Relationships (CSR-3.3)	(1).Community interactive participation institution; (2).Policy on support to employee localization; (3).Support to purchasing localization; (4).Support to education of community members; (5).Partnership with local government and NGO; (6).Charity policy/foundation; (7).Support to employee volunteer institution/Performance on employee volunteer activities; (8).Donations
	Production Safety (CSR-3.4)	(1).Production safety management system; (2).Safety emergency management institution; (3).Safety education and training; (4).Performance on safety training; (5).Investment on production safety; (6).Casualties
	Industry Special Issues	Other industry specific social CSR index
Environmental CSR (CSR-4)	Green Business (CSR-4.1)	(1).Environmental management system and certification; (2).Environmental protection training and education; (3).Total environmental protection input; (4).Total amount of energy consumption; (5).Total amount of water usage; (6).R&D on environmental protection equipment; (7).Green office; (8).Action towards climate change; (9).Greenhouse gas discharge amount and emission reduction amount
	Industry Special Issues	Other industry specific environmental CSR index

2.3.2 Descriptive Statistics

Top 100 state-owned companies and top 100 private companies from *Research Report on Corporate Social Responsibility of China* (2009, 2010, 2011, 2012, 2103, and 2014) by CASS CSR Research Center are selected to form our sample. After matching the CSR performance index data and firms' financial performance data, we got an unbalanced panel data set of 120 firms. A brief summary of the panel data is as follows in Table 2.2:

Table 2.2 Panel Data Summary

Year	The Number of Firms whose CSR performance data is available	The Number of Firms whose financial data is available	The Number of Firms whose CSR data and financial data matches
2007	0	111	0
2008	62	116	62
2009	120	118	118
2010	120	120	120
2011	120	120	120
2012	120	120	120
2013	119	115	115

The industries distribution in the panel data is summarized in Table 2.3. In the sample, the state-owned firms constitute 62.5% and private firms constitute 37.5%. According to China's National Industries Classification (GB/T 4754-2011), our sample includes 35 industries out of 88 industries in non-agricultural and non-government sectors. The annual total revenue of firms in our sample constitutes around 43% to 48% GDP of non-agricultural sectors.

We also differentiate firms into three types: Leaders, Followers, and The Uncommitted based on their CSR reporting behaviors. The definitions and statistics are summarized in Table 2.4. Particularly, for Followers (in total 33 firms), we checked how many firms initiate to publish CSR reports each year. The statistics are in Table 2.5. The average CSR performance index evolution of 3 types over the year is depicted in Figure 2.1.

Table 2.3 Industries Distribution

Industry Code	Industry Name	Number of Firms in the Sample
1	Ferrous metal smelting and rolling processing	12
2	Mechanical and equipment manufacturing	3
3	Automotive	8
4	Real Estate Exploitation	1
5	Technochemistry Product Manufacturing	7
6	Food and Beverage	2
7	Retailing	6
9	Electronic product and parts manufacturing	1
10	Computer and computer-related equipment manufacturing	10
11	Banking	2
12	Wholesale Trade	1
13	Railway Logistics	7
14	Construction	2
15	Communication Equipment Manufacturing	1
17	Mining	2
18	Fabricated Metal Product	4
19	Household Appliances Manufacturing	5
20	Oil and gas mining	2
21	Electric power manufacturing	4
22	Pharmaceuticals	1
23	Insurance	1
26	Non-mental Mineral Product Industry	1
27	Coal Mining and washing	3
29	Communication Service	3
30	Tourism	1
33	Electricity Supply Industry	2
43	Multi-industry companies	18
45	Water Transportation	3
46	Air Transportation	5
47	Other Transportation Manufacturing	2
Total: 30		120

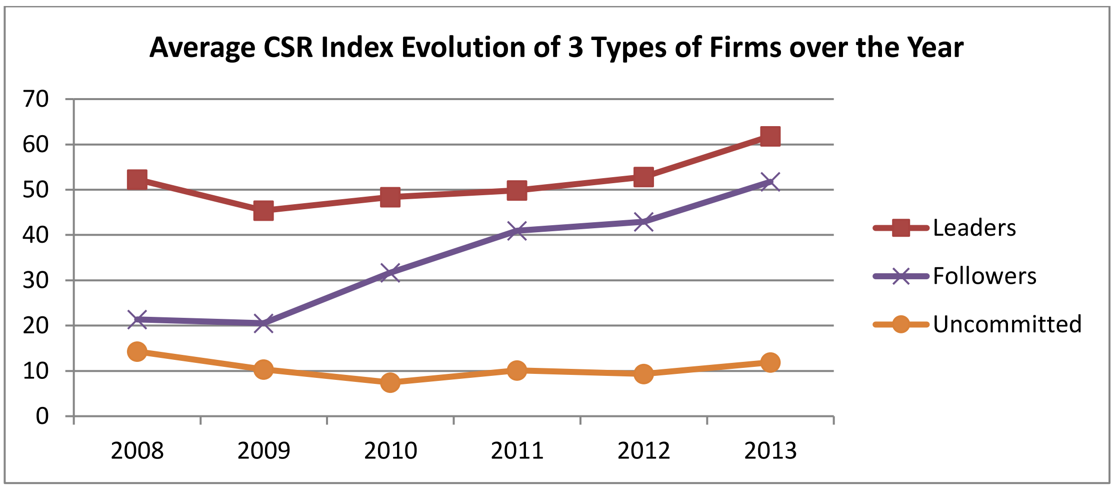
Table 2.4 CSR Reporting Behavior Types

Types	Definition	The Number of Firms in the Panel
Leaders	A firm which begins to publish CSR reports before/from 2008 and continuously	56
Followers	A firm which begins to publish CSR reports after 2008 and continuously	33
The Uncommitted	A firm which begins to publish CSR reports after 2008 but not continuously; And A firm which never publishes CSR report	31

Table 2.5 Followers CSR Reporting Initiation Statistics

Year	The Number of Firms which initiate to publish CSR Reports
2008	0
2009	16
2010	9
2011	4
2012	4
2013	0

Figure 2.1 Average CSR Index Evolution



2.4 Empirical Analysis of CSR Index, CSR Reporting and Financial Performance

2.4.1 Full Sample Regressions

To investigate the impacts of current year's CSR performance and last year's CSR performance on firms' financial performance, we evaluate models listed as follows[5] for four different measurements of firms' financial performance: net profit, the logarithm of total revenue, ROA, and the logarithm of total operating cost. Usually, there is a lag in firms' self-releasing CSR reports. The CSR report on current year will usually be released in the first quarter of next year. Therefore, we only consider CSR Reporting Dummy's effect and its interaction term for last year CSR performance index.

[5] We didn't include random effects within models here because random effects within models require balanced panel data. If we trim our unbalanced panel data to be balanced panel data, we will lose a lot of observations. Besides, since we only include one firm size control variable, it is more persuasive to believe that there are other unobservable variables which may correlate with the variables of interest.

(1a). *Pooled OLS*

$$y_{it} = \beta_0 + \beta_1 CSRIndex_{it} + \beta_2 CSRIndex_{it-1} + \beta_3 CSRIndex_{it-1} \cdot Reporting_{it-1} + \beta_4 Reporting_{it-1} + \beta_5 X_{it} + u_{it}$$

(1b). *One-way Fixed Effects Within*

$$y_{it} = \beta_1 CSRIndex_{it-1} + \beta_2 CSRIndex_{it-1} + \beta_3 CSRIndex_{it-1} \cdot Reporting_{it-1} + \beta_4 Reporting_{it-1} + \beta_5 X_{it} + a_i + u_{it}$$

(1c). *Between*

$$\bar{y}_{it} = \beta_1 \overline{CSRIndex}_{it} + \beta_2 \overline{CSRIndex}_{it-1} + \beta_3 \overline{CSRIndex}_{it-1} \cdot \overline{Reporting}_{it-1} + \beta_4 \overline{Reporting}_{it-1} + \beta_5 \bar{X}_{it} + a_i + \bar{u}_{it}$$

In equations (1a) to (1c), y_{it} represents four different financial measurements. Since there is negative net profit in our sample, we use net profit in the level form measured in Chinese currency yuan. In all equations, $CSRIndex_{it}$ is the CSR performance index of firm i in year t. $CSRIndex_{it-1}$ is the last year CSR performance index of firm i in year t. $Reporting_{it-1}$ is a reporting dummy variable. $Reporting_{it-1} = 1$ if firm i published its CSR report in year *t-1* and $Reporting_{it-1} = 0$ if firm i didn't publish its CSR report in year *t-1*. X_{it} is the firm size control variable and $lnX_{it}$is the logarithm of X_{it}. In most cases, we select total asset at the beginning of the accounting year as the firm size control variable. For net profit equations, besides total asset, we also select total revenue as the firm size control variable. For total revenue equations, we also select total operating cost as the firm size control variable. Note that we only use one firm size control variable for each equation and never use two control variables together. In all one-way fixed effects within equations and between equations, a_i is the unobservable individual effect. In all equations, $u_{it}$is an error term. In all between equations, for each firm i, we average one-way fixed effects within equation over the time.

It is important to note that due to the unavailability of the production data we are missing the total quantity produced data. However, a firm with higher total quantity produced may be a leader firm in its industry and a leader firm may confront more government supervision and social pressure on CSR performance. As a result, a leader firm tends to have better CSR performance than competitor firms in an industry. Thus, total production quantity and CSR performance may also be positively related. Hence, there might be endogeneity problem of CSR performance index variables and reporting dummy variable. To avoid endogeneity problem, we will use IV's for CSR performance index variables, the interaction term of CSR performance index and reporting dummy, and the reporting dummy variable. Thus, the only exogenous variable in our model would be total asset.

To avoid the potential endogeneity of $CSRIndex_{it}$, $CSRIndex_{it-1}$, $Reporting_{it-1}$, and the interaction term $CSRIndex_{it-1} \cdot Reporting_{it-1}$, we use instrument variables for all these terms in all equations. For CSR performance index, we mainly use last year average CSR performance index of other firms in similar size in the sample (*CSRSizeIV* or *CSRNSizeIV*, definitions are in Table 2.14) and last year other firms' CSR reporting rate in the industry (*LCSRR*, definition is in Table 2.14)[6]. To construct *LCSRR*, we referred to multiple sample sources to form an enlarged sample size to calculated *LCSRR*. The details on how we constructed *LCSRR* are presented in Table 2.7. *LCSRR* is also used as an IV for reporting dummy variable. For the interaction term of CSR performance index and CSR reporting dummy variable, we use the interaction term of *CSRSizeIV* or *CSRNSizeIV* and the predicted probability of CSR reporting and the interaction term of *LCSRR* and the predicted probability of CSR reporting as IV's. Table 2.6 presented how we constructed predicted probability of CSR reporting. The reduced form equations for suspicious endogenous variables are presented in Table 2.8 to Table 2.13. The variable definitions are presented in Table 2.14. The positive links between *CSRNSizeIV*, *LCSRR*, and *ConsumerDummy* and CSR reporting Dummy in Table 2.6 indicate that firms are more likely to publish CSR reports when other similar size firms' CSR performance is improved, last year's industry CSR reporting rate increases, and when a firm produces consumer good. The negative links between *Ownership* and CSR reporting Dummy in Table 2.6 indicates that the order of CSR reporting probability among the ownership types is central government-owned enterprise>state-owned financial firm>local government-owned firm>private enterprise. In another word, the more government supervision a firm may confront, the more likely a firm may publish CSR reports.

[6] It would be better to use last year average CSR performance index of other firms in the same industry rather than last year average CSR performance index of other firms in similar size. However, the number of firms belonging to the same industry in the sample is very limited and may change from year to year so that last year average CSR performance index of other firms in the same industry calculated from the sample is not significantly correlated with *CSRIndex* in the reduced form equation.

Table 2.6 Predicted Probability of CSR Reporting

Dependent Variable: CSR Reporting Dummy		
	Full Sample Pooled OLS	
Variables	Estimate	t-value
(Intercept)	0.381142***	5.757
	(0.066204)	
CSRNSizeIV	0.007944***	6.746
	(0.001178)	
LCSRR	0.373766***	7.151
	(0.052265)	
ConsumerDummy	0.122128***	4.133
	(0.029551)	
Ownership	-0.083784***	-6.484
	(0.012922)	
N	647	
Adjusted R^2	0.3562	
F-statistic	F(4,647)=91.04, p-value: < 2.2e-16	

Table 2.7 Construction of *LCSRR*

Industry Code	Industry Name	Sample Size in Panel Data (120 Firms)	Sample Size for calculating LCSRR	Sample Source for calculating LCSRR
1	Fabricated metal products	10	43	(1),(2)
2	Mechanical and equipment manufacturing	3	26	(1)
3	Automotive	8	30	(1)
4	Real estate	1	31	(1)
5	Technochemistry Product Manufacturing	7	7	(2)
6	Foods and beverage	2	35	(1)
7	Retailing	5	32	(1)
9	Computer and computer-related equipment manufacturing	1	16	(1)
10	Banking	10	25	(1)
12	Railway Logistics	1	2	(2),(4)
13	Construction	6	7	(2)
14	Communication Equipment Manufacturing	2	11	(1)
15	Mining	1	7	(2)
17	Consumer-electronics	2	22	(2),(5)
18	Oil and gas mining	4	8	(1)
19	Electronic power manufacturing	7	11	(1)
20	Pharmaceuticals	2	21	(1)
21	Insurance	4	6	(2)
22	Textiles	1	8	(2)
23	Apparel&Shoes&Hat	1	8	(2),(6)
27	Coal Mining and washing	3	9	(2)
29	Communication Service	3	11	(1)
30	Tourism	1	4	(2),(4)
43	Multi-industry	19	Not Applicable	(1),(2),(3),(7),(8)
45	Water transportation	3	4	(2)
46	Air-transport	5	6	(2)
47	Railway transportation equipment manufacturing	2	2	(2),(4)

Notes:

1. Sample Sources:

(1). The CSR Development Index of Key Industries in Research Report on Corporate Social Responsibility of China (2012, 2013, 2014);

(2). The CSR Development Index of Top 300 Firms in China (2009, 2010, 2011, 2012, 2013, 2014);

(3). The list of Typical Wholesale Enterprises from Ministry of Commerce of People's Republic of China Department of Circulation Development;

(4). Internet Search for China' national firms;

(5). 2015 China's Top 10 Consumer Electronic Firms in main consumer electronics categories;

(6). China's Top 10 Apparel Brands in main apparel categories;

(7).Top 10 Papermaking Firms in China

(8). Listed Companies in Agriculture and Animal Husbandry Industry which published CSR reports in 2013 monitored by A study on China's CSR reports 2012-2013 by Syn Tao (A CSR consultancy company).

2. Multi-industry:

The IV's for multi-industry companies are calculated by a weighted sum of industry reporting rates of the industries from which the revenue to the firm constitutes above 10% in that firm's annual total avenue. The weights equals to the relative share of the revenue from a certain industry compared to other main revenue contributing industries. The revenue data come from firms' annual accounting reports.

Table 2.8 Full Sample Net Profit OLS Model Reduced Form Equations

	Full Sample Net Profit Pooled OLS Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	0.530449	(Intercept)	2.9960e+00
		(2.285560)		(2.3848e+00)
	CSRNSizeIV	0.717181***	TotalRevenue	1.0158e-11**
		(0.061489)		(3.1015e-12)
	LCSRR	22.373960***	CSRNSizeIV	5.9533e-01***
		(3.025293)		(6.9929e-02)
			LCSRR	2.3056e+01***
				(3.0212e+00)
	N	651	N	643
	Adjusted R^2	0.32528	Adjusted R^2	0.33239
	F(2,648)=157.272, p-value: < 2.22e-16		F(3,639)=107.044, p-value: < 2.22e-16	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	1.9389e+00	(Intercept)	3.6081e+00
		(2.5087e+00)		(2.5561e+00)
	Asset1	7.2784e-13 ·	TotalRevenue	1.0182e-11**
		(4.3528e-13)		(3.1532e-12)
	LCSRNSizeIV	6.8394e-01***	LCSRNSizeIV	5.9694e-01***
		(7.1355e-02)		(7.7187e-02)
	LLCSRR	2.0750e+01***	LLCSRR	2.0953e+01***
		(3.2511e+00)		(3.2284e+00)
	N	532	N	527
	Adjusted R^2	0.31309	Adjusted R^2	0.31562
	F(3,528)=81.1089, p-value: < 2.22e-16		F(3,523)=81.2987, p-value: < 2.22e-16	
LCSR_R	Variables	Estimate	Variables	Estimate
	(Intercept)	8.575026***	(Intercept)	9.4748e+00***
		(1.763577)		(1.7850e+00)
	LCSRNSizeIV_P_Reporting	0.729333***	TotalRevenue	9.4635e-12**
		(0.080823)		(3.5038e-12)
	LLCSRR_P_Reporting	11.616813**	LCSRNSizeIV_P_Reporting	6.0768e-01***
		(4.396870)		(9.1535e-02)
			LLCSRR_P_Reporting	1.3598e+01**
				(4.4785e+00)
	N	533	N	527
	Adjusted R^2	0.34044	Adjusted R^2	0.34071
	F(2,530)=137.963, p-value: < 2.22e-16		F(3,523)=91.1404, p-value: < 2.22e-16	
LReporting	Variables	Estimate	Variables	Estimate
	(Intercept)	3.6058e-01***	(Intercept)	3.4427e-01***
		(2.9324e-02)		(2.9423e-02)
	Asset1	2.4692e-14**	TotalRevenue	2.5780e-1***
		(8.2513e-15)		(5.4868e-14)
	LLCSRR	6.8713e-01***	LLCSRR	6.6798e-01***
		(5.8597e-02)		(5.8045e-02)
	N	572	N	567
	Adjusted R^2	0.23199	Adjusted R^2	0.24689
	F(2,569)=86.5281 on 2 and 569 DF, p-value: < 2.22e-16		F(2,564)=93.0997, p-value: < 2.22e-16	

Table 2.9 Full Sample Net Profit Between Model Reduced Form Equations

	Full Sample Net Profit Between Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	-6.12584	(Intercept)	-6.12584
		(4.90223)		(4.90223)
	CSRNSizeIV	0.83258***	CSRNSizeIV	0.83258***
		(0.13213)		(0.13213)
	LCSRR	26.92572***	LCSRR	26.92572***
		(6.87623)		(6.87623)
	n	119	n	119
	T	4--6	T	4--6
	N	651	N	651
	Adjusted R^2	0.41733	Adjusted R^2	0.41733
	F(2,116)=43.4206, p-value: 8.3853e-15		F(2,116)=43.4206, p-value: 8.3853e-15	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	-5.16446	(Intercept)	-5.16446
		(4.52571)		(4.52571)
	LCSRNSizeIV	0.81684***	LCSRNSizeIV	0.81684***
		(0.12824)		(0.12824)
	LLCSRR	26.93079***	LLCSRR	26.93079***
		(6.65865)		(6.65865)
	n	119	n	119
	T	3--5	T	3--5
	N	533	N	533
	Adjusted R^2	0.42422	Adjusted R^2	0.42422
	F(2,116)=44.689, p-value: 4.078e-15		F(2,116)=44.689, p-value: 4.078e-15	
LCSR_R	Variables	Estimate	Variables	Estimate
	(Intercept)	5.57958 ·	(Intercept)	5.57958 ·
		(3.17110)		(3.17110)
	LCSRNSizeIV_P_Reporting	0.77083***	LCSRNSizeIV_P_Reporting	0.77083***
		(0.15667)		(0.15667)
	LLCSRR_P_Reporting	16.22618 ·	LLCSRR_P_Reporting	16.22618 ·
		(9.38317)		(9.38317)
	n	119	n	119
	T	3--5	T	3--5
	N	533	N	533
	Adjusted R^2	0.43712	Adjusted R^2	0.43712
	F(2,116)=47.1541, p-value: 1.0302e-15		F(2,116)=47.1541, p-value: 1.0302e-15	
LReporting	Variables	Estimate	Variables	Estimate
	(Intercept)	0.293087***	(Intercept)	2.8286e-01***
		(0.064636)		(6.2893e-02)
	LLCSRR	0.886324***	TotalRevenue	2.6739e-13*
		(0.135264)		(1.0830e-13)
			LLCSRR	8.0766e-01***
				(1.3536e-01)
	n	119	n	119
	T	3--5	T	3--5
	N	574	N	567
	Adjusted R^2	0.26394	Adjusted R^2	0.30055
	F(1,117)=42.9356, p-value: 1.589e-09		F(2,116)=25.8543, p-value: 5.1802e-10	

Table 2.10 Full Sample Net Profit One-way Fixed Effects Within Model Reduced Form Equations

	Full Sample Net Profit One-way Fixed Effects Within Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	CSRSizeIV	0.331189***	CSRNSizeIV	0.369231***
		(0.067993)		(0.079814)
	LCSRR	14.412806***	LCSRR	13.985549***
		(3.367525)		(3.450827)
	n	119	n	119
	T	4--6	T	4--6
	N	651	N	651
	Adjusted R^2	0.10026	Adjusted R^2	0.097245
	F(2,530)=37.2161, p-value: 7.5161e-16		F(2,530)=35.947, p-value: 2.2924e-15	
LCSRIndex	Variables	Estimate	Variables	Estimate
	LCSRSizeIV	0.219977**	LCSRSizeIV	0.219977**
		(0.084214)		(0.084214)
	LLCSRR	10.494742**	LLCSRR	10.494742**
		(3.559067)		(3.559067)
	n	119	n	119
	T	3--5	T	3--5
	N	533	N	533
	Adjusted R^2	0.041537	Adjusted R^2	0.041537
	F(2,412)=11.6982, p-value: 1.1444e-05		F(2,412)=11.6982, p-value: 1.1444e-05	
LCSR_R	Variables	Estimate	Variables	Estimate
	LCSRSizeIV_P_Reporting	0.36723**	LCSRSizeIV_P_Reporting	0.36723**
		(0.11425)		(0.11425)
	LLCSRR_P_Reporting	8.32087 ·	LLCSRR_P_Reporting	8.32087 ·
		(4.53730)		(4.53730)
	n	119	n	119
	T	3--5	T	3--5
	N	533	N	533
	Adjusted R^2	0.070679	Adjusted R^2	0.070679
	F(2,412)=20.7315, p-value: 2.6375e-09		F(2,412)=20.7315, p-value: 2.6375e-09	
LReporting	Variables	Estimate	Variables	Estimate
	LLCSRR	0.481085***	LLCSRR	0.481085***
		(0.056473)		(0.056473)
	n	119	n	119
	T	3--5	T	3--5
	N	574	N	574
	Adjusted R^2	0.10901	Adjusted R^2	0.10901
	F(1,454)=72.572, p-value: 2.3906e-16		F(1,454)=72.572, p-value: 2.3906e-16	

Table 2.11 Full Sample TR/ROA/TC Pooled OLS Model Reduced Form Equations

	Full Sample Total Revenue/ROA/ Total Operating Cost Pooled OLS Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	-127.612731***	(Intercept)	-96.50935***
		(13.890609)		(26.31793)
	lnAsset1	5.774984***	lnTotalOperatingCost	4.51810***
		(0.618314)		(1.17536)
	CSRNSizeIV	0.316366***	CSRNSizeIV	0.28142*
		(0.072088)		(0.11024)
	LCSRR	13.319884***	LCSRR	21.96546***
		(3.011657)		(3.54963)
	N	647	N	477
	Adjusted R^2	0.40514	Adjusted R^2	0.2885
	F(3,643)=147.51, p-value: < 2.22e-16		F(3,473)=64.6946, p-value: < 2.22e-16	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	-138.192351***	(Intercept)	-78.61563**
		(15.079245)		(25.89780)
	lnAsset1	6.245984***	lnTotalOperatingCost	3.64637**
		(0.668568)		(1.13910)
	LCSRNSizeIV	0.258529**	LCSRNSizeIV	0.37673***
		(0.080378)		(0.11020)
	LLCSRR	11.051617***	LLCSRR	20.79577***
		(3.196772)		(3.77142)
	N	532	N	397
	Adjusted R^2	0.40638	Adjusted R^2	0.2812
	F(3,528)=122.031, p-value: < 2.22e-16		F(3,393)=51.9765, p-value: < 2.22e-16	
LCSR_R	Variables	Estimate	Variables	Estimate
	(Intercept)	-148.235805***	(Intercept)	-73.59568*
		(17.143559)		(28.85722)
	lnAsset1	6.634831***	lnTotalOperatingCost	3.56134**
		(0.721663)		(1.21752)
	LCSRNSizeIV_P_Reporting	0.254331**	LCSRNSizeIV_P_Reporting	0.40135**
		(0.090934)		(0.12233)
	LLCSRR_P_Reporting	11.271491**	LLCSRR_P_Reporting	15.84435**
		(4.086215)		(5.17420)
	N	532	N	397
	Adjusted R^2	0.43031	Adjusted R^2	0.30815
	F(3,528)=134.716, p-value: < 2.22e-16		F(3,393)=59.2088, p-value: < 2.22e-16	
LReporting	Variables	Estimate	Variables	Estimate
	(Intercept)	-2.3512361***	(Intercept)	-2.119169***
		(0.2433834)		(0.360075)
	lnAsset1	0.1119449***	lnTotalOperatingCost	0.104185***
		(0.0099832)		(0.014689)
	LLCSRR	0.3832592***	LLCSRR	0.479790***
		(0.0603682)		(0.067501)
	N	572	N	424
	Adjusted R^2	0.36021	Adjusted R^2	0.26002
	F(2,569)=161.499, p-value: < 2.22e-16		F(2,421)=74.6829, p-value: < 2.22e-16	

Note: ROA/TC pooled OLS reduced form equations are the same with equations in column I.

Table 2.12 Full Sample TR/ROA/TC Between Model Reduced Form Equations

	Full Sample TR/ROA/ TC Between Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	-128.65785***	(Intercept)	-186.8453***
		(29.11572)		(-4.8533)
	lnAsset1	5.75561***	lnTotalOperatingCost	8.4725***
		(1.34664)		(1.5788)
	CSRNSizeIV	0.34925*	LCSRR	24.3180**
		(0.17008)		(7.7113)
	LCSRR	13.15049 ·		
		(7.01238)		
	n	119	n	95
	T	3--6	T	2--6
	N	647	N	477
	Adjusted R^2	0.47936	Adjusted R^2	0.36331
	F(3,115)=37.7297, p-value: < 2.22e-16		F(2,92)=27.6191, p-value: 4.03e-10	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	-129.31262***	(Intercept)	-5.16446
		(27.68970)		(4.52571)
	lnAsset1	5.73652***	LCSRNSizeIV	0.81684***
		(1.26284)		(0.12824)
	LCSRNSizeIV	0.33392*	LLCSRR	26.93079***
		(0.15984)		(6.65865)
	LLCSRR	13.80193*		
		(6.75958)		
	n	119	n	119
	T	3--5	T	3--5
	N	532	N	533
	Adjusted R^2	0.49966	Adjusted R^2	0.42422
	F(3,115)=41.0383, p-value: < 2.22e-16		F(2,116)=44.689, p-value: 4.078e-15	
LCSR_R	Variables	Estimate	Variables	Estimate
	(Intercept)	-144.62301***	(Intercept)	5.57958 ·
		(31.19621)		(3.17110)
	lnAsset1	6.44271***	LCSRNSizeIV_P_Reporting	0.77083***
		(1.32867)		(0.15667)
	LCSRNSizeIV_P_Reporting	0.44481**	LLCSRR_P_Reporting	16.22618 ·
		(0.14419)		(9.38317)
	n	119	n	119
	T	3--5	T	3--5
	N	532	N	533
	Adjusted R^2	0.51552	Adjusted R^2	0.43712
	F(2,116)=65.103, p-value: < 2.22e-16		F(2,116)=47.1541, p-value: 1.0302e-15	
LReporting	Variables	Estimate	Variables	Estimate
	(Intercept)	-2.405066***	(Intercept)	-215.3177***
		(0.456099)		(41.5519)
	lnAsset1	0.113893***	lnTotalOperatingCost	9.3652***
		(0.019113)		(1.6981)
	LLCSRR	0.396242**	LLCSRR	27.6589**
		(0.144017)		(8.3206)
	n	119	n	95
	T	3--5	T	1--5
	N	572	N	397
	Adjusted R^2	0.43504	Adjusted R^2	0.38334
	F(2,116)=46.7485, p-value: 1.289e-15		F(2,92)=30.1394, p-value: 8.5669e-11	

Note: ROA/TC between model reduced form equations are the same with equations in column I.

Table 2.13 Full Sample TR/ROA/TC One-way Fixed Effects Within Model Reduced Form Equations

	Full Sample TotalRevenue/ROA/TC One-way Fixed Effects Within Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	lnAsset1	4.129717*	CSRSizeIV	0.331189***
		(1.804742)		(0.067993)
	CSRNSizeIV	0.316112***	LCSRR	14.412806***
		(0.083812)		(3.367525)
	LCSRR	10.971805**		
		(3.780693)		
	n	119	n	119
	T	3--6	T	4--6
	N	647	N	651
	Adjusted R^2	0.10828	Adjusted R^2	0.10026
	F(3,525)=26.9473, p-value: 3.1845e-16		F(2,530)=37.2161, p-value: 7.5161e-16	
LCSRIndex	Variables	Estimate	Variables	Estimate
	lnAsset1	8.116852***	LCSRSizeIV	0.219977**
		(1.990335)		(0.084214)
	LCSRSizeIV	0.174428*	LLCSRR	10.494742**
		(0.083535)		(3.559067)
	n	120	n	119
	T	3--5	T	3--5
	N	540	N	533
	Adjusted R^2	0.053787	Adjusted R^2	0.041537
	F(2,418)=15.6069, p-value: 2.9051e-07		F(2,412)=11.6982, p-value: 1.1444e-05	
LCSR_R	Variables	Estimate	Variables	Estimate
	lnAsset1	7.48532**	LCSRSizeIV_P_Reporting	0.36723**
		(2.31225)		(0.11425)
	LCSRSizeIV_P_Reporting	0.36583***	LLCSRR_P_Reporting	8.32087 ·
		(0.09354)		(4.53730)
	n	119	n	119
	T	3--5	T	3--5
	N	532	N	533
	Adjusted R^2	0.08209	Adjusted R^2	0.070679
	F(2,411)=24.432, p-value: 9.4221e-11		F(2,412)=20.7315, p-value: 2.6375e-09	
LReporting	Variables	Estimate	Variables	Estimate
	LLCSRR	0.481085***	lnTotalOperatingCost	0.057915**
		(0.056473)		(0.021520)
			LLCSRR	0.463990***
				(0.076092)
	n	119	n	95
	T	3--5	T	1--5
	N	574	N	424
	Adjusted R^2	0.10901	Adjusted R^2	0.11088
	F(1,454)=72.572, p-value: 2.3906e-16		F(2,327)=27.4535, p-value: 9.5163e-12	

Note: ROA/TC between model reduced form equations are the same with equations in column I.

Table 2.14 Variable Definitions

Variable Definitions

1) Net Profit: The annual net profit measured in Chinese Yuan.

2) Asset1: The total asset at the beginning of the accounting year.

3) lnAsset1: The log of Asset1.

4) TotalRevenue: The annual total revenue measured in Chinese Yuan.

5) lnTotalRevenue: The log of TotalRevenue.

6) ROA: The ratio of Net Profit over Asset1.

7) lnTotalOperatingCost: The log of annual total operating cost.

8) CSRIndex: The current year CSR Index score evaluated by *Research Report on Corporate Social Responsibility of China*.

9) LCSRIndex: The last year The current year CSR Index score evaluated by *Research Report on Corporate Social Responsibility of China*.

10) LReporting: The last year Reporting Dummy. The Reporting Dummy is a binary variable which records whether a firm published its CSR report or not in a certain year. The Reporting Dummy equals 0 if the firm didn't publish its CSR report in a certain year and the Reporting Dummy equals 1 if the firm published its CSR report in a certain year.

11) LCSR_R: The interaction term of LCSRIndex and last year Reporting Dummy.

12) CSRNSizeIV: The neighborhood CSR Index average of a firm. The neighborhood consists of 20 other firms according to firms' annual total revenue.

13) LCSRNSizeIV: The last year neighborhood CSR Index average of a firm.

14) CSRSizeIV: The CSR Index average of firms at a similar size scale. There are threee scales: (1). $[10^{11}, +\infty)$ Chinese Yuan; (2). $[10^{10}, 9.9999\times10^{10}]$ Chinese Yuan; (3). $(-\infty, 10^{10})$Chinese Yuan.

15) LCSRSizeIV: The last year CSR Index average of firms at a similar size scale.

16) LCSRR: The last year other firms' CSR reporting rate in an industry.

17) LLCSRR: The year befor the last year other firms' CSR reporting rate in an industry.

18) CSRNSizeIV_P_Reporting: The interaction term of CSRNSizeIV and the Probability of Reporting.

19) LCSRNSizeIV_P_Reporting: The interaction term of last year CSRNSizeIV and last year's Probability of Reporting.

20) CSRSizeIV_P_Reporting: The interaction term of CSRSizeIV and the Probability of Reporting.

21) LCSRSizeIV_P_Reporting: The interaction term of last year CSRSizeIV and last year's Probability of Reporting.

22) LCSRR_P_Reporting: The interaction term of LCSRR and the Probability of Reporting.

23) LLCSRR_P_Reporting: The interaction term of last year LCSRR and last year's Probability of Reporting.

24) ConsumerDummy: A binary variable which equals 1 if a firm's product is a consumer good and equals 0 if not.

25) Ownership: A category variable which records the ownership type of a firm. The coding is as follows:

Ownership Type	Code
Central Government-owned Enterpriese	1
State-owned Financial Firm	2
Local Government-owned Firm	3
Private Enterprise	4

Since Pearson's product-moment correlation between *CSRIndex* and *LCSRIndex* is 0.8298485, there might be a concern of collinearity problem between *CSRIndex* and *LCSRIndex*. We also estimate all equations without *CSRIndex* as a comparison. The estimation results are presented in Table 2.15 to Table 2.18[7]. To avoid the bias caused by dropping variables, we only refer to the estimations without *CSRIndex* when Pearson's product-moment correlation between *CSRIndex* and *LCSRIndex* from the reduced form equations (first stage OLS regression) is greater than 0.98. This case happens in full sample net profit between IV estimations (ρ=0.988), full sample TR/ROA/TC pooled OLS (ρ=0.986) and between IV estimations (ρ =0.998), Leaders net profit between IV estimations (ρ =0.981), Leaders TR/ROA/TC between IV estimations (ρ =0.9999525), Followers net profit between IV estimations (ρ =0.981), The Uncommitted net profit between IV estimations (ρ=0.9897) and The Uncommitted TR/ROA/TC between IV estimations (ρ=0.986).

It did require some patience to carefully interpret the results. It is noticeable that the signs before *LCSR_R* by full sample net profit pooled OLS IV estimation and one-way within IV estimation (Table 2.15 column (1a).I and (1b).I) reverse and the signs before *LReporting* by full sample net profit pooled OLS IV estimation and one-way within IV estimation (Table 2.15 column (1a).I and (1b).I) also reverse. At the first glance, one may think that we should accept results by one-way within IV estimation (Table 2.15 column (1b).I) and reject results by pooled OLS IV estimation (Table 2.15 column (1a).I) because one-way fixed effects within IV model controls the unobservable individual effect and all time-invariant effects while pooled OLS IV estimations don't. However, on second thought, we may reach different conclusions.

First, *LReporting* is time-invariant for Leaders (*LReporting*=1) and The Uncommitted (*LReporting*=0 for most observations), therefore, the estimate of *LReporting* by one-way within IV estimations only reflect the effect of Followers when they initiate to publish CSR reports. Thus, pooled OLS IV estimation may better reflect the effect of *LReporting* on the full sample.

Second, the Pearson's product moment correlation of *CSRIndex* and *LCSRIndex* is relatively high (95% C.I.=[0.8016275, 0.8543792]) on the full sample. This implies that we may view variable *LCSRIndex* as a variable which has somewhat feature of time-invariance

[7] Quite some firms don't report their total operating cost, therefore, the sample size used to estimate TC models is much smaller than the full sample.

and the difference result from pooled OLS IV estimation and one-way fixed effects within IV estimation may suggest that the impact of time-invariance part inside the *LCSRIndex* dominate the total impact of *LCSRIndex*. Let's illustrate this by using a simplified assumption and derivation as below.

Assume that $CSRIndex_{it-1} = x_{it-1} + \bar{x}_{it-1}$, where x_{it} is time-variant part for firm i and $\bar{x}_{it-1}$ is time-invariant part for firm i, which is simply the average of lagged *CSRIndex* over the time of firm i. One-way fixed effects within model canceled out $\bar{x}_{it-1}$ and only use x_{it-1} to estimate the partial effect of $CSRIndex_{it-1}$. This is true if we agree that $\beta_1 CSRIndex_{it-1}$=$\beta_1 x_{it-1} + \beta_1 \bar{x}_{it-1}$ or $\beta_1 CSRIndex_{it-1}$=$\beta_1 x_{it-1} + \beta_2 \bar{x}_{it-1}$ but β_2 is very small. However, if in fact β_2 is so large that it dominates the total effect, we cannot use β_1 estimated by one-way fixed effects within model to reflect the partial effect of $CSRIndex_{it-1}$. Instead, pooled OLS IV estimations may better reflect the partial effect of $CSRIndex_{it-1}$.

Third, we can further find supportive evidences to pooled OLS IV estimations from between IV estimations. The estimation results for *LCSR_R* by between IV estimations with or without *CSRIndex* (Table 2.15 column (1c).I and column (1c).III) are consistent with pooled OLS IV estimations.

Based on these observations, we would conclude that the estimation results by pooled OLS IV estimations give a more precise estimation of the partial effect of *LCSR_R* and *LReporting* than one-way fixed effects within IV estimation. However, one-way fixed effects within IV estimations reflect the impact of time-variant change of these two variables.

Thus, Table 2.15 suggests two different kinds of effects of lagged CSR performance on full sample net profit by pooled OLS IV estimations with *CSRIndex* (Table 2.15 column (1a).I). If a firm didn't publish its CSR report on last year, there is a weakly negative effect of *LCSRIndex* on net profit. However, if a firm published its CSR report on last year, a conditional effect on net profit is suggested by *LCSRIndex*, *LCSR_R* and *LReporting* together. The conditional effect is that if a firm published its CSR report on last year and last year's CSR performance index is greater than 34.97, the effect of lagged CSR performance index on net profit will be positive and increasing and if a firm published its CSR report but last year's CSR performance index is smaller than 34.97, the effect of last year's CSR performance index on net profit will be negative and increasing. The difference between the effects of reported lagged CSR performance and unreported lagged CSR performance is very likely due to the signaling benefit of reported CSR performance. As far as for the negative effect of *LCSR_R* by one-way within IV estimations with *CSRIndex* (Table 2.15 (1b).I), it may imply that in the short run, the effect of reported lagged CSR performance on full sample net profit is negative. However, in the long run, we only found a significant positive effect of *LCSR_R* on full sample net profit by between IV estimation (Table 2.15 column (1c).III). The difference between the short run effect and long run effect may suggest that signaling benefit may take some time to happen in a longer time period, not right after a firm sends a signal.

The positive effect of *LReporting* on full sample net profit by one-way within IV estimations with *CSRIndex* (Table 2.15 (1b).I) also requires some careful thinking to interpret. Note that *LReporting* =1 for Leaders all the time and *LReporting* =0 for The Uncommitted most of the time. Although these two types have quite different *LReporting* records, one-way within model measures them as the same by taking time-demeaned variables. Therefore, there exist some measurement distortion on *LReporting* and we should not rely on the estimate for *LReporting* on full sample by one-way within IV estimation very much.

In Table 2.16, we also find two different kinds of effects of lagged CSR performance on full sample TR by pooled OLS IV estimation without *CSRIndex* (Table 2.16 column (2a).III). If a firm didn't publish its CSR report on last year, there is a positive effect of *LCSRIndex* on TR. However, if a firm published its CSR report on last year, a conditional effect on TR is suggested by *LCSRIndex* and *LReporting* together. The conditional effect is that if a firm published If a firm published its CSR report last year and last year's CSR performance index is greater than 30.11, the effect of lagged CSR performance index on total revenue will be positive and increasing and if a firm published its CSR report but last year's CSR performance index is smaller than 30.11, the effect of last year's CSR performance index on total revenue will be negative and increasing.

In the short run, a negative effect of *LCSRIndex* on TR is suggested by one-way within IV estimation with *CSRIndex* (Table 2.16 column (2b).I). A weak positive effect of *LCSR_R* on TR is suggested by one-way within IV estimation with *CSRIndex* (Table 2.16 column (2b).I), which may be ascribed as a signaling effect. While the total effect of reported lagged CSR performance on full sample TR is still negative in the short run by considering estimates of *CSRIndex* and *LCSR_R* together (Table 2.16 column (2b).I). Note that we didn't take the estimate of *LReporting* on full sample TR into consideration because of potential distortion mentioned above. In the long run over the time, a positive effect of *LCSR_R* on TR is suggested by between IV estimations without *CSRIndex* (Table 2.16 column (2c).III), which is very likely suggesting a positive signaling effect by reported lagged CSR performance in the long run.

Similarly, the results on total operating cost in Table 2.18 suggest two different kinds of effects of lagged CSR performance on full sample TC by pooled OLS IV estimation without *CSRIndex* (Table 2.16 column (4a).II). If a firm didn't publish its CSR report on last year, there is a positive effect of *LCSRIndex* on TC. However, if a firm published its CSR report on last year, a conditional effect on TC is suggested by *LCSRIndex* and *LReporting* together. The conditional effect is that if a firm published its CSR report last year and last year's CSR performance index is greater than 29.03, the effect of lagged CSR performance index on TC will be positive and increasing. And if a firm published its CSR report but last year's CSR performance index is lower than 29.03, the effect of last year's CSR performance index on TC will be negative and increasing. In the short run, we didn't observe significant effect from either *LCSRIndex* or *LCSR_R* on full sample TC by one-way within IV estimation. However, in the long run, we found a positive effect of *LCSR_R* on full sample TC by between IV estimations without *CSRIndex* (Table 2.18 column (4c).II). These results may imply that better unreported CSR performance will result in higher TC but there might be two opposite effects by better reported CSR performance, a TC increasing effect caused by inputs to improve CSR performance and a TC reducing effect caused by improved efficiency in communication with stakeholders. Overall, the TC increasing effect overwhelms the TC reducing effect for higher CSR performance index in the long run.

Finally, we find weak negative effect of *LCSRIndex* on full sample ROA and weak positive effect of *LCSR_R* on full sample ROA by pooled OLS IV estimation (Table 2.17 column (3a).II). However, by taking the estimate of *LReporting* into consideration together, both unreported lagged CSR performance and reported lagged CSR performance have weak negative effect on full sample ROA by pooled OLS IV estimation (Table 2.17 column (3a).II). And we found significant negative effect of *LCSRIndex* on full sample ROA by both one-way within IV estimation and between IV estimation (Table 2.17 column (3b).I and column (3c).II). This is probably because that the impacts of last year CSR performance index on ROA are opposite to each other on different types by pooled OLS IV estimations and only significant on some group in within models. We will look at this in more details in the next section of partitioned regressions.

As far as for *CSRIndex*, we observe that there are positive effects of *CSRIndex* on net profit by one-way within IV estimation either taking *Asset1* or *TotalRevenue* as firm size control variable (Table 2.15 (1b).I and (1b).II), TR by pooled OLS IV estimation taking *lnTotalOperatingCost* as firm size control variable and by one-way within IV either by taking *lnAsset1* or *lnTotalOperatingCost* as firm size control variable (

Table 2.16 (2a).II, (2b).I, and (2b).II), and ROA by one-way within IV estimation (Table 2.17 (3b).I). There might be two explanations for that. First, market CSR performance subindex of CSR performance index includes measuring firms' financial performance, like total revenue (CSR-2.1.2 in Table 2.1) and net profit (CSR-2.1.3 in Table 2.1). Thus, it might be due to the construction of market CSR performance subindex itself. Second, some items in CSR management performance subindex and social CSR performance subindex of CSR performance index may induce improved stakeholder relationship or production efficiency, like stakeholders identification (CSR-1.1.7 in Table 2.1), stakeholders' expectation and firms' response action (CSR-1.1.8 in Table 2.1), the interactive stakeholders' participation system (CSR -1.1.9 in Table 2.1), and employee relations (CSR-3.2 in Table 2.1). A further exploration on CSR subindex and financial performance shows that current year market CSR performance has a positive effect on net profit while negative effect on TR on full sample by pooled OLS IV estimation (the results are presented in Table 2.47 column (1a).I and Table 2.48 column (2a).I in Section 2.5). And we observe weak positive effect of current year CSR management performance on net profit by one-way within IV estimation and positive effect of current CSR management performance on TR by pooled OLS IV estimation, one-way within IV estimation and between IV estimation (the results are presented in Table 2.47 column (1b).I and Table 2.48 column (2a).I, (2b).I and (2c).I in Section 5). Also, we observe positive effect of current year social CSR performance on net profit and TR by pooled OLS IV estimation and one-way within IV estimation (results are presented in Table 2.47 column (1a).I & (1b).I and Table 2.48 column (2a).I & (2b).I in Section 5). Therefore, both two explanations above may apply to explain the results on *CSRIndex* here. Besides, we also observe positive effect of *CSRIndex* on TC by one-way within IV estimation (Table 2.18 (4b).I). This verifies that improving CSR performance will incur cost to do so.

Table 2.15 Full Sample Net Profit Estimation Results

Dependent Variable: NetProfit	Full Sample Net Profit OLS IV Estimations (1a)				Full Sample Net Profit One-way Fixed Effects Within IV Estimations (1b)				Full Sample Net Profit Between IV Estimations (1c)			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	3.4e+09	-2.2e+09	3.4e+09	-2.2e+09	–	–	–	–	-4.9e+09	-5.4e+10 ·	-4.9e+09	-5.4e+10 ·
	(2.8e+09)	(4.9e+09)	(2.8e+09)	(4.9e+09)	–	–	–	–	(3.2e+09)	(3.07e+10)	(3.20e+09)	(3.07e+10)
Asset1	1.37e-02***	–	1.37e-02***	–	1.64e-02***	–	1.65e-02***	–	1.28e-02***	–	1.28e-02***	–
	(3.78e-04)	–	(3.78e-04)	–	(4.60e-04)	–	(4.56e-04)	–	(7.70e-04)	–	(7.70e-04)	–
TR	–	3.62e-02***	–	3.62e-02***	–	1.62e-02***	–	1.98e-02***	–	3.15e-02*	–	3.15e-02*
	–	(5.03e-03)	–	(5.03e-03)	–	(4.44e-03)	–	(4.15e-03)	–	(1.48e-02)	–	(1.48e-02)
CSRIndex	Dropped	Dropped	–	–	8.50e+07	4.06e+08*	–	–	Dropped	Dropped	–	–
			–	–	(7.92e+07)	(1.80e+08)	–	–			–	–
LCSRIndex	-3.76e+08	-1.12e+09*	-3.76e+08	-1.12e+09*	Dropped	-1.39e+09*	Dropped	-1.10e+09*	Dropped	6.27e+09	Dropped	6.27e+09
	(2.41e+08)	(4.46e+08)	(2.41e+08)	(4.46e+08)		(5.49e+08)		(5.36e+08)		(4.44e+09)		(4.44e+09)
LCSR_R	6.93e+08***	1.58e+09***	6.93e+08***	1.58e+09***	-3.90e+08***	5.90e+08 ·	-3.68e+08***	5.15e+08	3.27e+08**	-4.90e+09	3.27e+08**	-4.90e+09
	(1.90e+08)	(3.78e+08)	(1.90e+08)	(3.78e+08)	(9.53e+07)	(3.54e+08)	(9.30e+07)	(3.54e+08)	(9.76e+07)	(3.93e+09)	(9.76e+07)	(3.93e+09)
LReporting	-1.11e+10*	Dropped	-1.11e+10*	Dropped	1.10e+10*	2.10e+10*	1.27e+10**	2.85e+10**	Dropped	Dropped	Dropped	Dropped
	(5.14e+09)		(5.14e+09)		(4.75e+09)	(1.01e+10)	(4.49e+09)	(9.52e+09)				
n	–	–	–	–	119	119	119	119	119	119	119	119
T	–	–	–	–	3--5	3--5	3--5	3--5	3--5	3--5	3--5	3--5
N	527	527	527	527	526	526	526	527	527	527	527	527
Adjusted R^2	0.78267	0.30497	0.78267	0.30497	0.59342	0.088636	0.5944	0.080257	0.76307	0.12099	0.76307	0.12099
F-statistic	F(4,522)= 491.423, p-value: < 2.22e-16	F(3,523)=77.341, p-value: < 2.22e-16	F(4,522)=491.423, p-value: < 2.22e-16	F(3,523)=77.341, p-value: < 2.22e-16	F(4,403)=346.119, p-value: < 2.22e-16	F(5,402)=10.5478, p-value: 1.5679e-09	F(3,404)=460.933, p-value: < 2.22e-16	F(4,404)=11.8103, p-value: 4.4039e-09	F(2,116)= 208.413, p-value: < 2.22e-16	F(3,115)= -8.56 , p-value: 1	F(2,116)= 208.413, p-value: < 2.22e-16	F(3,115)= -8.56 , p-value: 1

Table 2.16 Full Sample Total Revenue Estimation Results

Dependent Variable: lnTotalRevenue

	Full Sample TR Pooled OLS IV Estimations (2a)				Full Sample TR One-way Fixed Effects Within IV Estimations (2b)				Full Sample TR Between IV Estimations (2c)			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**28.470*** **	**9.791*** **	**30.576*** **	**7.576*** **	–	–	–	–	**11.172*** **	**6.493** **	**36.014*** **	**8.38756***
	(1.535)	(1.041)	(1.743)	(1.018)	–	–	–	–	(1.095)	(2.237)	(9.265)	(3.96831)
lnAsset1	**-0.257*** **	–	**-0.335*** **	–	0.177	–	**0.615***	–	**0.541*** **	–	-0.574	–
	(0.070)	–	(0.080)	–	(0.281)	–	(0.280)	–	(0.043)	–	(0.412)	–
lnTC	–	**0.570*** **	–	**0.675*** **	–	**0.406*** **	–	**0.498*** **	–	**0.711*** **	–	**0.68135*** **
	–	(0.047)	–	(0.046)	–	(0.053)	–	(0.069)	–	(0.100)	–	(0.15314)
CSRIndex	**0.155*** **	**0.065*** **	–	–	**0.119*** **	**0.090*** **	–	–	Dropped	Dropped	–	–
	(0.012)	(0.011)	–	–	(0.011)	(0.011)	–	–			–	–
LCSRIndex	**0.062*** **	**0.031** **	**0.207*** **	**0.059*** **	**-0.103***	**-0.105** **	-0.073	-0.065	Dropped	**0.023** **	Dropped	-0.18195
	(0.017)	(0.011)	(0.014)	(0.010)	(0.050)	(0.037)	(0.047)	(0.042)		(0.009)		(0.15850)
LCSR_R	Dropped	Dropped	Dropped	Dropped	0.031	0.033	**0.050***	0.040	Dropped	Dropped	**0.117** **	0.18851
					(0.028)	(0.025)	(0.023)	(0.027)			(0.042)	(0.14905)
LReporting	**-7.398*** **	**-3.650*** **	**-6.234*** **	**-2.051*** **	**-1.896*** **	Dropped	Dropped	0.980	Dropped	Dropped	Dropped	Dropped
	(0.498)	(0.587)	(0.559)	(0.548)	(0.566)			(0.757)				
N	–	–	–	–	119	95	119	95	120	95	119	95
T	–	–	–	–	3--5	1--5	3--5	1--5	3--6	1--5	3--6	1--5
N	526	397	526	397	525	396	526	396	699	397	526	397
Adjusted R^2	0.7144	0.75296	0.63055	0.73288	0.21413	0.30681	0.057046	0.2173	0.56377	0.78716	0.15809	0.60837
F-statistic	F(4,521)= 337.031, p-value: < 2.22e-16	F(4,392)= 314.739, p-value: < 2.22e-16	F(3,522)= 303.211, p-value: < 2.22e-16	F(3,393)= 373.514, p-value: < 2.22e-1	F(5,401)= 31.2415, p-value: < 2.22e-16	F(5,296)= 41.2177, p-value: < 2.22e-16	F(3,404)= 10.8045, p-value: 7.6509e-07	F(4,297)= 30.2873, p-value: < 2.22e-16	F(1,118)= 158.56, p-value: < 2.22e-16	F(2,92)=1 87.343, p-value: < 2.22e-16	F(2,116)= -36.5736, p-value: 1	F(3,91)=3 1.2109, p-value: 5.7726e-14

Table 2.17 Full Sample ROA Estimation Results

Dependent Variable: ROA	Full Sample ROA Pooled OLS IV Estimations (3a)		Full Sample ROA One-way Fixed Effects Within IV Estimations (3b)		Full Sample ROA Between IV Estimations (3c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	-0.11228355	-0.0944321			**0.3612306***	
	(0.11889668)	(0.1183235)			(0.1438144)	
lnAsset1	0.00866700	0.0079879	0.01043470	0.0155641	**-0.0055039****	0.0155641
	(0.00561204)	(0.0055963)	(0.01684041)	(0.0166342)	(0.0019240)	(0.0166342)
CSRIndex	0.00127148		**0.00190805***		Dropped	
	(0.00090625)		(0.00081486)			
LCSRIndex	**-0.00371632·**	-0.0024961	**-0.00646344*****	**-0.0056614*****	Dropped	**-0.0056614*****
	(0.00206061)	(0.0018698)	(0.00167182)	(0.0015995)		(0.0015995)
LCSR_R	0.00145684	0.0014378	Dropped	Dropped	Dropped	Dropped
	(0.00131435)	(0.0013155)				
LReporting	-0.05310044	-0.0434480	-0.04932359	Dropped	Dropped	Dropped
	(0.03725972)	(0.0366530)	(0.03208250)			
N			119	119	120	119
T			3--5	3--5	3--6	3--5
N	527	527	525	527	701	527
Adjusted R^2	0.051882	0.048436	0.095825	0.086405	0.06377	0.086405
F-statistic	F(5,521)=5.77125, p-value: 3.3779e-05	F(4,522)=6.70951, p-value: 2.8561e-05	F(4,402)=14.3761, p-value: 5.5818e-11	F(2,406)=25.6437, p-value: 3.2537e-11	F(1,118)=8.18315, p-value: 0.0050023	F(2,406)=25.6437, p-value: 3.2537e-11

Table 2.18 Full Sample TC Estimation Results

Dependent Variable: lnTotalOperatingCost	Full Sample TC Pooled OLS IV Estimations (4a)		Full Sample TC One-way Fixed Effects Within IV Estimations (4b)		Full Sample TC Between IV Estimations (4c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**33.879534*** **	**35.346623*** **	–	–	**46.1691*** **	**46.1691*** **
	(1.965327)	(2.126938)	–	–	(13.53694)	(13.53694)
lnAsset1	**-0.491224*** **	**-0.541964*** **	-0.159788	-0.076549	-1.00850 ·	-1.00850 ·
	(0.090228)	(0.097812)	(0.157750)	(0.294536)	(0.59876)	(0.59876)
CSRIndex	**0.129872*** **	–	**0.088977*** **	–	Dropped	–
	(0.015336)	–	(0.013028)	–		–
LCSRIndex	**0.104175*** **	**0.225676*** **	Dropped	**0.065613***	Dropped	Dropped
	(0.020699)	(0.016209)		(0.028024)		
LCSR_R	Dropped	Dropped	Dropped	Dropped	**0.15267***	**0.15267***
					(0.06113)	(0.06113)
LReporting	**-7.430687*** **	**-6.550343*** **	**-1.270496***	Dropped	Dorpped	Dorpped
	(0.628964)	(0.673946)	(0.549180)			
N	–	–	95	95	95	95
T	–	–	1--5	1--5	1--5	1--5
N	396	396	395	395	396	396
Adjusted R^2	0.61161	0.54408	0.15061	0.066826	0.11281	0.11281
F-statistic	F(4,391)=159.104, p-value: < 2.22e-16	F(3,392)=159.466, p-value: < 2.22e-16	F(3,297)=24.7976, p-value: 2.3988e-14	F(2,298)=14.4809, p-value: 9.958e-07	F(2,92)=-35.6919, p-value: 1	F(2,92)=-35.6919, p-value: 1

2.4.2 Partitioned Regressions

We also estimate partitioned regressions for three types based on their different CSR reporting behaviors. Since the CSR reporting dummy variables for Leaders and The Uncommitted are either all 1 or almost 0, we only include *CSRIndex* and *LCSRIndex* as independent variables for these two types. We estimate models (1a) to (1c) for each group as we did for the full sample. The reduced form equations are presented in Table 2.19 to Table 2.34. The results are presented in Table 2.35 to Table 2.46[8].

For Leaders, we found weak TR increasing effect of lagged CSR performance by pooled OLS IV estimation while significant TR increasing effect by between IV estimation (Table 2.36 column (2a).I and column (2c).III). On the other side, we found TC increasing effect of lagged CSR performance by pooled OLS IV estimation and between IV estimation (Table 2.38 column (4a).I and column (4c).II). As far as for the overall profitability, we found net profit increasing effect of lagged CSR performance by pooled OLS IV estimation and between IV estimation (Table 2.35 column (1a).I and column (1c).III) while net profit reducing effect of lagged CSR performance by one-way within IV estimation (Table 2.35 column (1b).I). We didn't observe significant results on ROA.

These results may suggest that better lagged CSR performance may have a positive signaling effect for Leaders in the long run while it will also result in higher TC in the long run. For the overall profitability, the results may suggest that better lagged CSR performance may increase the profitability in the long run while reduce the profitability in the short run.

It is noticeable that the partial effect of *LCSRIndex* on TC is larger than the partial effect of *LCSRIndex* on TR by both pooled OLS IV estimation (Table 2.36 column (2a).I and Table 2.38 column (4a).I) and between IV estimation (Table 2.36 (2c).III and Table 2.38 (4c).II). Since we have taken logarithm for both TR and TC, we could interpret results by applying elasticity concept. Let's take between IV estimation results for an example. These two results imply that to make 1 point increase in *LCSRIndex* to have positive effect on net profit, we should have $(0.067773*\%\triangle TR)*TR>(0.094352*\%\triangle TC)*TC$, i.e. $\triangle TC/\triangle TR<0.7183$. Similarly, we could interpret pooled OLS IV estimation in the same way and it would imply $\triangle TC/\triangle TR<0.414$.

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[8] Since we could not find valid IV's for The Uncommitted for one-way fixed effects within model, we were not be able to estimate one-way fixed effects within models for The Uncommitted.

Also for Leaders, we observe net profit increasing effect of *CSRIndex* by one-way within IV estimation (Table 2.35 column (1b).I and column (1b).II), TR increasing effect of *CSRIndex* by pooled OLS IV estimation and one-way within IV estimation (Table 2.36 column (2a).I and II, (2b).I and II), ROA increasing effect of *CSRIndex* by one-way within IV estimation (Table 2.37 column (3b).I), and TC increasing effect of *CSRIndex* by pooled OLS IV estimation, one-way within IV estimation (Table 2.38 column (4a).I and II, column (4b).II). A further exploration on CSR subindex and financial performance shows that current year market CSR performance has a positive effect on net profit and TR on Leaders by one-way within IV estimation (the results are presented in Table 2.51 column (1b).I and Table 52 column (2b).I in Section 5). Also, we observe significant effect of current year social CSR performance on net profit by pooled OLS IV estimation and between IV estimation and on TR by pooled OLS IV estimation and one-way within IV estimation (the results are presented in Table 2.51 column (1a).I & (1c).I and Table 2.52 column (2a).I & (2b).I in Section 2.5). And we didn't observe significant effect of current year management CSR performance on net profit or TR on Leaders (the results are also presented in Table 2.51 and Table 2.52 in Section 2.5). Therefore, the effects of *CSRIndex* on Leaders is very likely due to both construction of market CSR performance subindex itself which includes measuring firms' financial performance, like total revenue (CSR-2.1.2 in Table 2.1) and net profit (CSR-2.1.3 in Table 2.1) and the improved production efficiency induced by improve employee relations under social CSR performance subindex (CSR-3.2 in Table 2.1).

For Followers, we found two different kinds of effects of lagged CSR performance on TR by pooled OLS IV estimation (Table 2.40 column (2a).I). If a firm didn't publish its CSR report on last year, there is a positive effect of *LCSRIndex* on TR. However, if a firm published its CSR report on last year, a conditional effect on TR is suggested by *LCSRIndex*, *LCSR_R* and *LReporting* together. The conditional effect is that if a firm published its CSR report last year and last year's CSR performance index is greater than 49.4, the effect of lagged CSR performance index on TR will be positive and increasing. And if a firm published its CSR report but last year's CSR performance index is lower than 49.4, the effect of last year's CSR performance index on TR will be negative and increasing. In the short run, we found weak TR decreasing effect of *LCSRIndex* by one-way within IV estimation (Table 2.40 column (2b).I). While in the long run, we found weak TR increasing effect of *LCSR_R* by between IV estimation (Table 2.40 column (2c).I). These results may suggest that there is a positive signaling effect by reported lagged CSR performance for Followers in the long run as well as we found for full sample and Leaders.

From Followers' TC estimation results, we found a conditional effect of reported lagged CSR performance on TC by pooled OLS IV estimation (Table 2.42 column (4a).I). The conditional effect is that if a firm published its CSR report last year and last year's CSR performance index is greater than 50.19, the effect of lagged CSR performance index on TC will be negative and increasing. And if a firm published its CSR report but last year's CSR performance index is lower than 50.19, the effect of last year's CSR performance index on TC will be positive and increasing. In the long run, we found weak TC increasing effect of *LCSRIndex* by between IV estimation (Table 2.42 column (4c).I).

The estimation of overall profitability of Followers suggest two different kinds of effects of lagged CSR performance on net profit by pooled OLS IV estimation (Table 2.39 column (1a).I). If a firm didn't publish its CSR report on last year, there is a negative effect of *LCSRIndex* on net profit. However, if a firm published its CSR report on last year, a conditional effect on net profit is suggested by *LCSRIndex*, *LCSR_R* and *LReporting* together. The conditional effect is that if a firm published its CSR report last year and last year's CSR performance index is greater than 47.8, the effect of lagged CSR performance index on net profit will be positive and increasing. And if a firm published its CSR report but last year's CSR performance index is lower than 47.8, the effect of last year's CSR performance index on net profit will be negative and increasing. In the short run, the results suggest a net profit reducing effect of *LReporting* by one-way within IV estimation (Table 2.39 column (1b).I). The negative effect of *LReporting* may be due to fact that when a firm switch from non-reporting to reporting, its CSR performance index score will have a big jump but its net profit may not improve as much as the jump of its CSR performance index score compared with firms who make steady progress in their CSR performance index score by keeping publishing CSR reports. While in the long run, we found a net profit increasing effect of *LCSRIndex* by between IV estimation (Table 2.39 column (1c).III).

The estimation results of ROA by pooled OLS IV estimation for Followers (Table 2.41 column (3a).I) show a negative effect of lagged CSR performance on ROA although the negative effect may be weaken by reporting lagged CSR performance. This might be because that quite some firms identified as Followers are at the growing stage of business cycle and their total asset grows as their business grows. We may find some evidence of this by checking the partial effect of *lnAsset1* by pooled OLS IV estimation and one-way within

IV estimation (Table 2.41 (3a).I and (3b).I). All these estimates are positive which implies that as total asset increases ROA increases.

Also for Followers, we observe negative effect of *CSRIndex* on net profit by pooled OLS IV estimation and one-way within IV estimation (Table 2.39 column (1a).II and (1b).II), on ROA by one-way within IV estimation (Table 2.41 column (3b).I), while positive effect on net profit by between IV estimation (Table 2.39 column (1c).I), on total revenue by pooled OLS IV estimation and one-way within IV estimation (Table 2.40 column (2a).I, (2b).I, and (2b).II), and on TC by pooled OLS IV estimation and one-way within IV estimation (Table 2.42 (4a).I and (4b).I). It is likely that in the short run the cost of improving current year CSR performance for Followers outweigh the positive effect of current year CSR performance on profitability while in the long run the opposite applies.

For The Uncommitted, we found negative effect of *LCSRIndex* on net profit by pooled OLS IV estimation and between IV estimation (Table 2.43 column (1a).I, (1a).II and (1c).III), on TR by pooled OLS IV estimation (Table 2.44 column (2a).I) and on ROA by pooled OLS IV estimation (Table 2.45 column (3a).I). And we didn't find significant effect of *LCSRIndex* on TC.

These results may suggest that although The Uncommitted almost never publish CSR reports and there seems no way for stakeholders to acquire direct information from The Uncommitted firms to determine their moral evaluation types, adverse selection by stakeholders may happen by judging from firms' silence in no CSR reporting and third party evaluation of The Uncommitted firms' CSR performance.

On the other side, we found positive effect of *CSRIndex* on net profit by pooled OLS IV estimation (Table 2.43 column (1a).I and (1a).II), on TR by pooled OLS IV estimation (Table 2.44 column (2a).I and (2a).II), weakly on ROA by pooled OLS IV estimation (Table 2.45 column (3a).I) and on TC by pooled OLS IV estimation (Table 2.46 column (4a).I). A further exploration on CSR subindex and financial performance shows that current year social CSR performance has a positive effect on net profit and TR on The Uncommitted by pooled OLS IV estimation (the results are presented in Table 2.59 column (1a).I and Table 2.60 column (2a).I in Section 2.5). And we observed negative effect of current year management CSR performance on net profit on The Uncommitted by pooled OLS IV estimation and one-way within IV estimation (the results are presented in Table 2.59 column (1a).I and (1b).I in Section 2.5). Unfortunately, we were unable to identify qualified IV's for market CSR performance variables for The Uncommitted so we didn't include market CSR performance variables in our models. Therefore, one of possible explanations of the effects of *CSRIndex* on The Uncommitted is the improved production efficiency induced by improved employee relations under social CSR performance subindex (CSR-3.2 in Table 2.1). The positive effect of *CSRIndex* on TC may reflect the fact that better current year *CSRIndex* performance may result in higher cost overall for The Uncommitted.

Table 2.19 Leaders Net Profit Pooled OLS Model Reduced Form Equations

Leaders Net Profit Pooled OLS Model Reduced Form Equations				
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	35.508767***	(Intercept)	3.5903e+01***
		(2.670498)		(2.6892e+00)
	CSRSizeIV_P_Reporting	0.448150***	TotalRevenue	5.6256e-12 ·
		(0.066717)		(2.9473e-12)
			CSRSizeIV_P_Reporting	3.9460e-01***
				(7.2838e-02)
	N	317	N	314
	Adjusted R^2	0.1245	Adjusted R^2	0.13337
	F(1,315)=45.1205, p-value: 8.665e-11		F(2,311)=24.1975, p-value: 1.7092e-10	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	34.733500***	(Intercept)	3.5233e+01***
		(2.914847)		(2.9248e+00)
	LCSRSizeIV_P_Reporting	0.446578***	TotalRevenue	5.7627e-12 ·
		(0.079097)		(3.0424e-12)
			LCSRSizeIV_P_Reporting	3.8245e-01***
				(8.5788e-02)
	N	262	N	260
	Adjusted R^2	0.10838	Adjusted R^2	0.11806
	F(1,260)=31.8771, p-value: 4.2935e-08		F(2,257)=17.429, p-value: 7.9771e-08	

Table 2.20 Leaders Net Profit One-way Within Model Reduced Form Equations

Leaders Net Profit One-way Within Model Reduced Form Equations				
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	CSRSizeIV_P_Reporting	0.364635***	CSRSizeIV_P_Reporting	0.364635***
		(0.067686)		(0.067686)
	n	56	n	56
	T	4--6	T	4--6
	N	317	N	317
	Adjusted R^2	0.082358	Adjusted R^2	0.082358
	F(1,260)=29.0218, p-value: 1.603e-07		F(1,260)=29.0218, p-value: 1.603e-07	
LCSRIndex	Variables	Estimate	Variables	Estimate
	LCSRSizeIV_P_Reporting	0.226590*	LCSRSizeIV_P_Reporting	0.226590*
		(0.090879)		(0.090879)
	n	56	n	56
	T	4--5	T	4--5
	N	262	N	262
	Adjusted R^2	0.023029	Adjusted R^2	0.023029
	F(1,205)=6.21655, p-value: 0.013447		F(1,205)=6.21655, p-value: 0.013447	

Table 2.21 Leaders Net Profit Between Model Reduced Form Equations

	Leaders Net Profit Between Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	32.97701***	(Intercept)	32.97701***
		(6.41558)		(6.41558)
	CSRSizeIV_P_Reporting	0.50873**	CSRSizeIV_P_Reporting	0.50873**
		(0.16862)		(0.16862)
	n	56	n	56
	T	4--6	T	4--6
	N	317	N	317
	Adjusted R^2	0.1391	Adjusted R^2	0.1391
	F(1,54)=9.10234, p-value: 0.0038883		F(2,53)=4.02203, p-value: 0.023646	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	31.30377***	(Intercept)	31.30377***
		(5.98349)		(5.98349)
	LCSRSizeIV_P_Reporting	0.53988**	LCSRSizeIV_P_Reporting	0.53988**
		(0.16980)		(0.16980)
	n	56	n	56
	T	4--5	T	4--5
	N	262	N	262
	Adjusted R^2	0.15205	Adjusted R^2	0.15205
	F(1,54)=10.1086, p-value: 0.0024441		F(2,53)=4.42573, p-value: 0.016693	

Table 2.22 Leaders TR/ROA/TC Pooled OLS Model Reduced Form Equations

	Leaders TR/ROA/TC Pooled OLS Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	-31.57829	(Intercept)	35.508767***
		(20.74371)		(2.670498)
	lnAsset1	2.76956**	CSRSizeIV_P_Reporting	0.448150***
		(0.84657)		(0.066717)
	CSRSizeIV_P_Reporting	0.27676**		
		(0.08342)		
	N	316	N	317
	Adjusted R^2	0.14971	Adjusted R^2	0.1245
	F(2,313)=27.8663, p-value: 7.2832e-12		F(1,261)=23.6216, p-value: 2.0261e-06	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	-52.055007*	(Intercept)	34.733500***
		(22.491683)		(2.914847)
	lnAsset1	3.552195***	LCSRSizeIV_P_Reporting	0.446578***
		(0.913208)		(0.079097)
	LCSRSizeIV_P_Reporting	0.218336*		
		(0.096834)		
	N	262	N	262
	Adjusted R^2	0.15657	Adjusted R^2	0.10838
	F(2,259)=24.3701, p-value: 2.0066e-10		F(2,258)=17.5683, p-value: 7.029e-08	

Table 2.23 Leaders TR/ROA/TC One-way Within Model Reduced Form Equations

	Leaders TR/ROA/TC One-way Within Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	CSRSizeIV_P_Reporting	0.364635***	CSRSizeIV_P_Reporting	0.364635***
		(0.067686)		(0.067686)
	n	56	n	56
	T	4--6	T	4--6
	N	317	N	317
	Adjusted R^2	0.082358	Adjusted R^2	0.082358
	F(1,260)=29.0218, p-value: 1.603e-07		F(1,260)=29.0218, p-value: 1.603e-07	
LCSRIndex	Variables	Estimate	Variables	Estimate
	lnAsset1	6.75564*	LCSRSizeIV_P_Reporting	0.226590*
		(2.78535)		(0.090879)
	LCSRSizeIV	0.14007		
		(0.11276)		
	n	56	n	56
	T	4--5	T	4--5
	N	264	N	262
	Adjusted R^2	0.040685	Adjusted R^2	0.023029
	F(2,206)=5.66587, p-value: 0.0040238		F(1,205)=6.21655, p-value: 0.013447	

Table 2.24 Leaders TR/ROA/TC Between Model Reduced Form Equations

	Leaders TR/ROA/TC Between Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	-63.12374 ·	(Intercept)	58.10920***
		(37.16077)		(4.02267)
	lnAsset1	4.57540**	Industryranking2	-1.74578 ·
		(1.39549)		(0.89275)
	Industryranking2	-1.79295*		
		(0.82178)		
	n	56	n	56
	T	3--5	T	3--5
	N	263	N	263
	Adjusted R^2	0.21163	Adjusted R^2	0.06377
	F(2,53)=7.63217, p-value: 0.0012223		F(1,54)=3.82401, p-value: 0.055706	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	-74.90829*	(Intercept)	55.3537***
		(34.21186)		(3.8072)
	lnAsset1	4.91668***	LIndustryranking2	-1.8309*
		(1.28491)		(0.8554)
	LIndustryranking2	-1.88624*		
		(0.76442)		
	n	56	n	56
	T	3--5	T	3--5
	N	263	N	263
	Adjusted R^2	0.26286	Adjusted R^2	0.075414
	F(2,53)=10.1904, p-value: 0.00018005		F(1,54)=4.58146, p-value: 0.036853	

Table 2.25 Followers Net Profit Pooled OLS Model Reduced Form Equations

	Followers Net Profit Pooled OLS Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	3.58109	(Intercept)	3.58109
		(4.13411)		(4.13411)
	CSRSizeIV	0.63160***	CSRSizeIV	0.63160***
		(0.11066)		(0.11066)
	LCSRR	22.58266***	LCSRR	22.58266***
		(4.78714)		(4.78714)
	N	171	N	171
	Adjusted R^2	0.31073	Adjusted R^2	0.31073
	F(2,168)=38.8571, p-value: 1.3485e-14		F(2,168)=38.8571, p-value: 1.3485e-14	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	4.96114	(Intercept)	9.4045e+00*
		(4.35278)		(4.5780e+00)
	LCSRSizeIV	0.55142***	TotalRevenue	4.4444e-11*
		(0.12632)		(1.8495e-11)
	LLCSRR	22.17829***	LCSRSizeIV	2.7210e-01
		(5.18814)		(1.6586e-01)
			LLCSRR	1.9278e+01***
				(5.1951e+00)
	N	139	N	138
	Adjusted R^2	0.27595	Adjusted R^2	0.28954
	F(2,136)=26.713, p-value: 1.6397e-10		F(3,134)=18.9778, p-value: 2.567e-10	
LCSR_R	Variables	Estimate	Variables	Estimate
	(Intercept)	10.12137**	(Intercept)	1.2619e+01***
		(3.49785)		(3.1248e+00)
	LCSRSizeIV_P_Reporting	0.45067**	TotalRevenue	5.1407e-11**
		(0.15525)		(1.7123e-11)
	LLCSRR_P_Reporting	17.53267*	LLCSRR_P_Reporting	2.2458e+01***
		(6.93210)		(5.7437e+00)
	N	139	N	138
	Adjusted R^2	0.24131	Adjusted R^2	0.23346
	F(2,136)=22.2617, p-value: 4.3287e-09		F(2,135)=21.1584, p-value: 1.016e-08	
LReporting	Variables	Estimate	Variables	Estimate
	(Intercept)	0.298996***	(Intercept)	0.298996***
		(0.056477)		(0.056477)
	LCSRR	0.734490***	LCSRR	0.734490***
		(0.098871)		(0.098871)
	N	158	N	158
	Adjusted R^2	0.25801	Adjusted R^2	0.25801
	F(1,156)=55.1868, p-value: 6.7352e-12		F(1,156)=55.1868, p-value: 6.7352e-12	

Table 2.26 Followers Net Profit One-way Fixed Effects Within Model Reduced Form Equations

	Followers Net Profit One-way Fixed Effects Within Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	CSRSizeIV	0.54408**	TotalRevenue	6.9542e-11*
		(0.16200)		(3.0254e-11)
	LCSRR	34.10035***	CSRSizeIV	3.5012e-01 ·
		(8.21945)		(1.7750e-01)
			LCSRR	3.1437e+01***
				(8.3226e+00)
	n	32	n	32
	T	5--6	T	4--6
	N	171	N	169
	Adjusted R^2	0.23334	Adjusted R^2	0.25568
	F(2,137)=28.1496, p-value: 5.7358e-11		F(2,168)=38.8571, p-value: 1.3485e-14	
LCSRIndex	Variables	Estimate	Variables	Estimate
	LCSRSizeIV	0.44996*	TotalRevenue	8.8681e-11**
		(0.20830)		(3.2708e-11)
	LLCSRR	28.01626**	LCSRSizeIV	4.2686e-01*
		(9.09073)		(2.0217e-01)
			LLCSRR	1.8650e+01*
				(9.3922e+00)
	n	32	n	32
	T	4--5	T	3--5
	N	139	N	138
	Adjusted R^2	0.13856	Adjusted R^2	0.17359
	F(2,105)=11.7929, p-value: 2.3978e-05		F(3,103)=10.4048, p-value: 4.8674e-06	
LCSR_R	Variables	Estimate	Variables	Estimate
	Asset1	3.1830e-11*	TotalRevenue	1.1480e-10**
		(1.5423e-11)		(3.7479e-11)
	LCSRSizeIV_P_Reporting	1.2728e+00***	LCSRSizeIV_P_Reporting	8.1825e-01*
		(2.3160e-01)		(3.1274e-01)
			LLCSRR_P_Reporting	1.4808e+01
				(1.1383e+01)
	n	32	n	32
	T	3--5	T	3--5
	N	138	N	138
	Adjusted R^2	0.22251	Adjusted R^2	0.25746
	F(2,104)=21.7854, p-value: 1.2523e-08		F(3,103)=18.0798, p-value: 1.6836e-09	
LReporting	Variables	Estimate	Variables	Estimate
	LLCSRR	1.28345***	TotalRevenue	1.2641e-12 ·
		(0.12987)		(6.4293e-13)
			LLCSRR	1.1617***
				(1.4892e-01)
	n	32	n	32
	T	4--5	T	4--5
	N	158	N	156
	Adjusted R^2	0.34702	Adjusted R^2	0.35017
	F(1,125)=97.6693, p-value: < 2.22e-16		F(2,122)=49.4597, p-value: < 2.22e-16	

Table 2.27 Followers Net Profit Between Model Reduced Form Equations

	Followers Net Profit Between Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	5.19763	(Intercept)	5.19763
		(8.40725)		(8.40725)
	CSRSizeIV	0.65062**	CSRSizeIV	0.65062**
		(0.22157)		(0.22157)
	LCSRR	18.75590*	LCSRR	18.75590*
		(8.81584)		(8.81584)
	n	32	n	32
	T	5--6	T	5--6
	N	171	N	171
	Adjusted R^2	0.32273	Adjusted R^2	0.32273
	F(2,29)=8.01939, p-value: 0.0016895		F(2,29)=8.01939, p-value: 0.0016895	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	4.95358	(Intercept)	4.95358
		(7.37029)		(7.37029)
	LCSRSizeIV	0.59700**	LCSRSizeIV	0.59700**
		(0.21361)		(0.21361)
	LLCSRR	19.86807*	LLCSRR	19.86807*
		(8.54282)		(8.54282)
	n	32	n	32
	T	4--5	T	4--5
	N	139	N	139
	Adjusted R^2	0.34124	Adjusted R^2	0.34124
	F(2,29)=8.75723, p-value: 0.0010586		F(2,29)=8.75723, p-value: 0.0010586	
LCSR_R	Variables	Estimate	Variables	Estimate
	(Intercept)	15.75330**	(Intercept)	15.75330**
		(5.15113)		(5.15113)
	LCSRSizeIV_P_Reporting	0.55901**	LCSRSizeIV_P_Reporting	0.55901**
		(0.17764)		(0.17764)
	n	32	n	32
	T	4--5	T	4--5
	N	139	N	139
	Adjusted R^2	0.23267	Adjusted R^2	0.23267
	F(1,30)=9.90344, p-value: 0.0037113		F(1,30)=9.90344, p-value: 0.0037113	
LReporting	Variables	Estimate	Variables	Estimate
	(Intercept)	0.496028***	(Intercept)	0.496028***
		(0.079696)		(0.079696)
	LLCSRR	0.317955*	LLCSRR	0.317955*
		(0.150955)		(0.150955)
	n	32	n	32
	T	4--5	T	4--5
	N	158	N	158
	Adjusted R^2	0.12078	Adjusted R^2	0.12078
	F(1,30)=4.43645, p-value: 0.043652		F(1,30)=4.43645, p-value: 0.043652	

Table 2.28 Followers TR/ROA/TC Pooled OLS Model Reduced Form Equations

	Followers TR/ROA/TC Pooled OLS Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	-55.25614	(Intercept)	-133.2556**
		(34.48025)		(41.4640)
	lnAsset1	2.68544 ·	lnTotalOperatingCost	6.5046***
		(1.47933)		(1.7088)
	CSRSizeIV	0.49892**	LCSRR	17.9663**
		(0.15041)		(6.1524)
	LCSRR	17.36517**		
		(0.26913)		
	N	137	N	112
	Adjusted R^2	0.26913	Adjusted R^2	0.24836
	F(3,133)=17.0043, p-value: 2.0874e-09		F(2,109)=18.6738, p-value: 1.0623e-07	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	-96.80168**	(Intercept)	-135.0674***
		(32.92455)		(38.8991)
	lnAsset1	4.37025**	lnTotalOperatingCost	6.3354***
		(1.39125)		(1.5938)
	LCSRSizeIV	0.33834*	LLCSRR	19.7709***
		(0.13752)		(5.7359)
	LLCSRR	16.81152**		
		(5.28356)		
	N	137	N	112
	Adjusted R^2	0.30911	Adjusted R^2	0.27913
	F(3,133)=20.7104, p-value: 4.5075e-11		F(2,109)=21.9173, p-value: 9.9922e-09	
LCSR_R	Variables	Estimate	Variables	Estimate
	(Intercept)	-69.14766 ·	(Intercept)	-98.7126*
		(39.75884)		(48.6281)
	lnAsset1	3.28478*	lnTotalOperatingCost	4.7354*
		(1.63512)		(1.9935)
	LCSRSizeIV_P_Reporting	0.28581 ·	LLCSRR_P_Reporting	20.7136**
		(0.17172)		(6.3641)
	LLCSRR_P_Reporting	17.88309*		
		(6.85250)		
	N	138	N	112
	Adjusted R^2	0.2615	Adjusted R^2	0.21071
	F(3,134)=16.4628, p-value: 3.6437e-09		F(2,109)=15.0607, p-value: 1.6779e-06	
LReporting	Variables	Estimate	Variables	Estimate
	(Intercept)	0.433927***	(Intercept)	0.3180434***
		(0.062483)		(0.0899704)
	LLCSRR	0.582234***	LLCSRR	0.5244871***
		(0.104371)		(0.1072368)
			LCSRSizeIV	0.0046241·
				(0.0026109)
	N	138	N	139
	Adjusted R^2	0.1838	Adjusted R^2	0.20253
	F(1,136)=31.1792, p-value: 1.2316e-07		F(1,136)=31.1792, p-value: 1.2316e-07	

Table 2.29 Followers TR/ROA/TC One-way Fixed Effects Within Model Reduced Form Equations

	Followers TR/ROA/TC One-way Fixed Effects Within Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	lnAsset1	11.17988**	lnTotalOperatingCost	7.04226 ·
		(3.61292)		(3.64123)
	CSRSizeIV	0.34871*	CSRSizeIV	0.35260 ·
		(0.16902)		(0.18425)
	LCSRR	31.63695***	LCSRR	24.24521*
		(8.23535)		(9.99560)
	n	32	n	27
	T	3--6	T	3--6
	N	169	N	137
	Adjusted R^2	0.27309	Adjusted R^2	0.20832
	F(3,134)=23.4657, p-value: 2.8617e-12		F(3,107)=12.9734, p-value: 2.7234e-07	
LCSRIndex	Variables	Estimate	Variables	Estimate
	lnAsset1	19.05039***	lnTotalOperatingCost	9.97322**
		(5.59108)		(3.53414)
	LCSRSizeIV	0.37022 ·	LCSRSizeIV	0.46027*
		(0.20011)		(0.19763)
	LLCSRR	15.39822		
		(9.56871)		
	n	32	n	28
	T	4--5	T	2--5
	N	158	N	117
	Adjusted R^2	0.20146	Adjusted R^2	0.1242
	F(3,103)=12.6936, p-value: 3.9941e-07		F(2,87)=8.72296, p-value: 0.00035262	
LCSR_R	Variables	Estimate	Variables	Estimate
	lnAsset1	22.6407***	lnTotalOperatingCost	11.12347**
		(5.8747)		(4.21879)
	LCSRSizeIV_P_Reporting	1.1084***	LCSRSizeIV_P_Reporting	1.09390***
		(0.2261)		(0.25099)
	n	32	n	27
	T	3--5	T	2--5
	N	138	N	112
	Adjusted R^2	0.26985	Adjusted R^2	0.21885
	F(2,104)=29.0057, p-value: 9.7582e-11		F(2,83)=17.3921, p-value: 4.9162e-07	
LReporting	Variables	Estimate	Variables	Estimate
	lnAsset1	0.158329 ·	lnTotalOperatingCost	10.8273*
		(0.087904)		(4.3219)
	LLCSRR	1.154101***	LLCSRR	48.2958***
		(0.145522)		(11.9998)
	n	32	n	27
	T	3--5	T	2--5
	N	156	N	112
	Adjusted R^2	0.34483	Adjusted R^2	0.20413
	F(2,122)=48.1098, p-value: 3.9395e-16		F(2,83)=15.7771, p-value: 1.5588e-06	

Table 2.30 Followers TR/ROA/TC Between Model Reduced Form Equations

	Followers TR/ROA/TC Between Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	-86.98349	(Intercept)	-169.5480*
		(51.52202)		(70.3419)
	lnAsset1	4.29352 ·	lnTotalOperatingCost	7.7316*
		(2.20544)		(2.8082)
	CSRSizeIV	0.43953	LCSRR	14.3468
		(0.26686)		(9.8620)
			Industryranking2	1.4436
				(1.0521)
	n	33	n	27
	T	3--6	T	3--6
	N	176	N	137
	Adjusted R^2	0.29683	Adjusted R^2	0.32937
	F(2,30)=7.27215, p-value: 0.0026603		F(3,23)=4.83292, p-value: 0.0094253	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	-88.57338 ·	(Intercept)	-179.65832*
		(49.73662)		(66.30796)
	lnAsset1	4.10911 ·	lnTotalOperatingCost	7.92173**
		(2.15565)		(2.63505)
	LCSRSizeIV	0.35625	LLCSRR	17.12455 ·
		(0.24471)		(9.03338)
	LLCSRR	12.95785	Industryranking2	1.52936
		(8.78376)		(0.97337)
	n	32	n	27
	T	3--5	T	2--5
	N	138	N	112
	Adjusted R^2	0.38062	Adjusted R^2	0.3983
	F(3,28)=7.18564, p-value: 0.0010061		F(3,23)=6.73282, p-value: 0.0020049	
LCSR_R	Variables	Estimate	Variables	Estimate
	(Intercept)	-92.5825 ·	(Intercept)	-92.8234
		(49.7706)		(67.9539)
	lnAsset1	4.5440*	lnTotalOperatingCost	4.6509
		(2.0118)		(2.8110)
	LLCSRR_P_Reporting	15.3670 ·	LLCSRR_P_Reporting	13.1259
		(8.7924)		(10.0189)
	n	32	n	27
	T	3--5	T	2--5
	N	138	N	112
	Adjusted R^2	0.28724	Adjusted R^2	0.25658
	F(2,29)=6.72828, p-value: 0.0039771		F(2,24)=4.8695, p-value: 0.016786	
LReporting	Variables	Estimate	Variables	Estimate
	(Intercept)	0.496028***	(Intercept)	0.496028***
		(0.079696)		(0.079696)
	LLCSRR	0.317955*	LLCSRR	0.317955*
		(0.150955)		(0.150955)
	n	32	n	32
	T	4--5	T	4--5
	N	158	N	158
	Adjusted R^2	0.12078	Adjusted R^2	0.12078
	F(1,30)=4.43645, p-value: 0.043652		F(1,30)=4.43645, p-value: 0.043652	

Table 2.31 The Uncommitted Net Profit Pooled OLS Model Reduced Form Equations

	The Uncommitted Net Profit Pooled OLS Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	8.8167e+00***	(Intercept)	8.604180***
		(1.1724e+00)		(1.141884)
	Asset1	-4.9472e-11	CSRNSizeIV_P_Reporting	0.123375·
		(3.4235e-11)		(0.073847)
	CSRNSizeIV_P_Reporting	2.2375e-01*		
		(9.6572e-02)		
	N	162	N	163
	Adjusted R^2	0.032104	Adjusted R^2	0.016832
	F(2,159)=2.68839, p-value: 0.071081		F(1,161)=2.7912, p-value: 0.096726	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	9.0469e+00***	(Intercept)	8.407867***
		(1.3036e+00)		(1.254328)
	Asset1	-5.7770e-11·	LCSRNSizeIV_P_Reporting	0.118578
		(3.4676e-11)		(0.092108)
	LCSRNSizeIV_P_Reporting	2.4261e-01*		
		(1.1795e-01)		
	N	132	N	132
	Adjusted R^2	0.032627	Adjusted R^2	0.012398
	F(2,129)=2.22773, p-value: 0.1119		F(1,130)=1.65735, p-value: 0.20025	

Table 2.32 The Uncommitted Net Profit Between Model Reduced Form Equations

	The Uncommitted Net Profit Between Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	8.5102e+00***	(Intercept)	7.2882e+00**
		(2.0673e+00)		(2.1708e+00)
	Asset1	-8.2505e-11	TotalRevenue	-7.1255e-11
		(6.6838e-11)		(6.3430e-11)
	CSRNSizeIV_P_Reporting	3.4110e-01·	CSRNSizeIV_P_Reporting	5.0355e-01
		(1.9631e-01)		(3.3612e-01)
	n	31	n	31
	T	3--6	T	4--6
	N	162	N	160
	Adjusted R^2	0.087991	Adjusted R^2	0.075457
	F(2,28)=1.51106, p-value: 0.23813		F(2,28)=1.27619, p-value: 0.29484	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	8.5349e+00***	(Intercept)	7.1532e+00**
		(2.0063e+00)		(2.0238e+00)
	Asset1	-7.2773e-11	TotalRevenue	-6.1434e-11
		(5.6477e-11)		(5.6418e-11)
	LCSRNSizeIV_P_Reporting	3.4975e-01·	LCSRNSizeIV_P_Reporting	5.2520e-01
		(2.0121e-01)		(3.5052e-01)
	n	31	n	31
	T	3--5	T	3--5
	N	132	N	129
	Adjusted R^2	0.089211	Adjusted R^2	0.076512
	F(2,28)=1.5343, p-value: 0.23319		F(2,28)=1.29569, p-value: 0.28962	

Table 2.33 The Uncommitted TR/ROA/TC Pooled OLS Model Reduced Form Equations

	The Uncommitted TR/ROA/TC Pooled OLS Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	8.604180***	(Intercept)	8.604180***
		(1.141884)		(1.141884)
	CSRNSizeIV_P_Reporting	0.123375·	CSRNSizeIV_P_Reporting	0.123375·
		(0.073847)		(0.073847)
	N	163	N	163
	Adjusted R^2	0.016832	Adjusted R^2	0.016832
	F(1,161)=2.7912, p-value: 0.096726		F(1,161)=2.7912, p-value: 0.096726	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	8.407867***	(Intercept)	8.407867***
		(1.254328)		(1.254328)
	LCSRNSizeIV_P_Reporting	0.118578	LCSRNSizeIV_P_Reporting	0.118578
		(0.092108)		(0.092108)
	N	132	N	132
	Adjusted R^2	0.012398	Adjusted R^2	0.012398
	F(1,130)=1.65735, p-value: 0.20025		F(1,130)=1.65735, p-value: 0.20025	

Table 2.34 The Uncommitted TR/ROA/TC Between Model Reduced Form Equations

	The Uncommitted TR/ROA/TC Between Model Reduced Form Equations			
	I		II	
CSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	8.29522***	(Intercept)	8.29522***
		(2.04407)		(2.04407)
	CSRNSizeIV_P_Reporting	0.15904	CSRNSizeIV_P_Reporting	0.15904
		(0.14429)		(0.14429)
	n	31	n	31
	T	4--6	T	4--6
	N	163	N	163
	Adjusted R^2	0.037614	Adjusted R^2	0.037614
	F(1,29)=1.21488, p-value: 0.27943		F(1,29)=1.21488, p-value: 0.27943	
LCSRIndex	Variables	Estimate	Variables	Estimate
	(Intercept)	7.84499***	(Intercept)	7.84499***
		(1.95547)		(1.95547)
	LCSRNSizeIV_P_Reporting	0.18225	LCSRNSizeIV_P_Reporting	0.18225
		(0.15532)		(0.15532)
	n	31	n	31
	T	3--5	T	3--5
	N	132	N	132
	Adjusted R^2	0.042402	Adjusted R^2	0.042402
	F(1,29)=1.37688, p-value: 0.25018		F(1,29)=1.37688, p-value: 0.25018	

Table 2.35 Leaders Net Profit Estimation Results

Dependent Variable: NetProfit	Leaders Net Profit Pooled OLS IV Estimations (1a)				Leaders Net Profit One-way Fixed Effects Within IV Estimations (1b)				Leaders Net Profit Between IV Estimations (1c)			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**-2.34e+10***	**-9.01e+10*** **	**-2.34e+10***	**-8.22e+10*** **	–	–	–	–	-3.52e+10	-9.06e+10	-3.30e+10	-9.06e+10
	(1.08e+10)	(2.26e+10)	(1.08e+10)	(2.20e+10)	–	–	–	–	(2.55e+10)	(5.89e+10)	(2.406e+10)	(5.89e+10)
Asset1	**1.30e-02*** **	–	**1.30e-02*** **	–	**1.62e-02*** **	–	**1.68e-02*** **	–	**1.25e-02*** **	–	**1.25e-02*** **	–
	(5.035e-04)	–	(5.04e-04)	–	(6.17e-04)	–	(5.98e-04)	–	(1.26e-03)	–	(1.240e-03)	–
TotalRevene	–	**2.24e-02*** *	–	**2.37e-02*** *	–	**1.119e-02·**	–	**2.07e-02*** **	–	2.279e-02	–	2.28e-02
	–	(7.81e-03)	–	(7.772e-03)	–	(6.09e-03)	–	(6.01e-03)	–	(2.320e-02)	–	(2.32e-2)
CSRIndex	Dropped	1.09e+09	–	–	**3.912+08***	**1.30e+09*** **	–	–	**8.68e+08·**	Dropped	–	–
		(7.34e+08)	–	–	(1.33e+08)	(2.83e+08)	–	–	(5.06e+08)		–	–
LCSRIndex	**6.62e+08*** *	1.11e+09	**6.62e+08*** *	**2.10e+09*** **	**-9.07e+08*** *	-6.06e+08	**-5.05e+08***	7.29e+08	Dropped	**2.28e+09·**	**8.760e+08·**	**2.28e+9·**
	(2.20e+08)	(8.11e+08)	(2.20e+08)	(4.68e+08)	(2.50e+08)	(5.17e+08)	(2.09e+08)	(4.48e+08)		(1.28e+9)	(5.01e+08)	(1.28e+9)
LCSR_R	–	–	–	–	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–	–	–	–	–
LReporting	–	–	–	–	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–	–	–	–	–
n	–	–	–	–	56	56	56	56	56	56	56	56
T	–	–	–	–	3--5	3--5	3--5	3--5	4--6	4--5	4--5	4--5
N	261	259	261	260	260	260	260	259	315	260	261	260
Adjusted R^2	0.75493	0.24636	0.75493	0.24131	0.62633	0.13072	0.6231	0.063579	0.66326	0.10662	0.68459	0.10662
F-statistic	F(2,258)=416.946, p-value: < 2.22e-16	F(3,255)=28.3675, p-value: 7.3153e-16	F(2,258)=416.946, p-value: < 2.22e-16	F(2,257)=41.5021, p-value: 2.4027e-16	F(3,201)=285.953, p-value: < 2.22e-16	F(3,200)=13.5855, p-value: 4.2053e-08	F(2,202)=409.14, p-value: < 2.22e-16	F(2,201)=8.96817, p-value: 0.00018589	F(2,53)=59.3122, p-value: 2.9989e-14	F(2,53)=-6.48775, p-value: 1	F(2,53)=66.9035, p-value: 3.1725e-15	F(2,53)=-6.48775, p-value: 1

Table 2.36 Leaders TR Estimation Results

Dependent Variable: lnTotalRevenue	Leaders TR Pooled OLS IV Estimations (2a)				Leaders TR One-way Fixed Effects Within IV Estimations (2b)				Leaders TR Between IV Estimations (2c)			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	27.566***	7.971***	29.648***	7.642***	–	–	–	–	19.895***	2.311*	20.687***	2.311*
	(1.617)	(0.779)	(1.742)	(0.945)	–	–	–	–	(4.029)	(1.135)	(4.310)	(1.135)
lnAsset1	-0.425***	–	-0.493***	–	-0.340**	–	-0.227	–	0.083	–	0.063	–
	(0.091)	–	(0.099)	–	(0.128)	–	(0.334)	–	(0.204)	–	(0.215)	–
lnTC	–	0.575***	–	0.621***	–	0.318***	–	0.473***	–	0.915***	–	0.915***
	–	(0.038)	–	(0.044)	–	(0.054)	–	(0.058)	–	(0.045)	–	(0.045)
CSRIndex	0.146***	0.058***	–	–	0.111***	0.088**	–	–	0.069 ·	Dropped	–	–
	(0.020)	(0.007)	–	–	(0.010)	(0.012)	–	–	(0.036)		–	–
LCSRIndex	0.036	Dropped	0.185***	0.044***	Dropped	-0.026	0.096*	0.058**	Dropped	Dropped	0.068 ·	Dropped
	(0.027)		(0.020)	(0.008)		(0.022)	(0.038)	(0.021)			(0.037)	
LCSR_R	–	–	–	–	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–	–	–	–	–
LReporting	–	–	–	–	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–	–	–	–	–
n	–	–	–	–	56	43	56	45	56	46	56	46
T	–	–	–	–	3--5	1--5	3--5	1--5	4--6	1--7	4--6	1--7
N	259	238	260	199	261	190	261	199	315	276	262	276
Adjusted R^2	0.56411	0.78837	0.47833	0.70618	0.33517	0.40784	0.085892	0.28544	0.099532	0.86605	0.088111	0.86605
F-statistic	F(3,255)=114.046, p-value: < 2.22e-16	F(2,235)= 465.429, p-value: < 2.22e-16	F(2,257)= 120.487, p-value: < 2.22e-16	F(2,196)= 248.28, p-value: < 2.22e-16	F(2,203)= 76.8634, p-value: < 2.22e-16	F(3,144)= 55.9229, p-value: < 2.22e-16	F(2,203)= 12.6005, p-value: 6.9443e-06	F(2,145)= 43.3201, p-value: 1.7789e-15	F(2,53)= -11.0851, p-value: 1	F(1,44) =421.171, p-value: < 2.22e-16	F(2,53)=-11.1801, p-value: 1	F(1,44)= 421.171, p-value: < 2.22e-16

Table 2.37 Leaders ROA Estimation Results

Dependent Variable: ROA	Leaders ROA Pooled OLS IV Estimations (3a)		Leaders ROA One-way Fixed Effects Within IV Estimations (3b)		Leaders ROA Between IV Estimations (3c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**0.2522743*** **	**0.2522743*** **	–	–	**0.3612306***	**0.3612306***
	(0.0375886)	(0.0375886)	–	–	(0.1438144)	(0.1438144)
lnAsset1	**-0.0081185*** **	**-0.0081185*** **	**-0.04201417*** **	**-0.0366020*** **	**-0.0157811***	**-0.0157811***
	(0.0014194)	(0.0014194)	(0.01109073)	(0.0042973)	(0.0071885)	(0.0071885)
CSRIndex	Dropped	–	**0.00205345*** **		Dropped	
		–	(0.00042129)			
LCSRIndex	Dropped	Dropped	(0.00129954)	Dropped	0.0019459	0.0019459
					(0.0012357)	(0.0012357)
LCSR_R	–	–	–	–	–	–
	–	–	–	–	–	–
LReporting	–	–	–	–	–	–
	–	–	–	–	–	–
n	–	–	56	56	56	56
T	–	–	3--5	3--5	4--5	4--5
N	333	333	262	262	263	263
Adjusted R^2	0.089411	0.089411	0.26249	0.20452	0.010396	0.010396
F-statistic	F(1,331)=32.7168, p-value: 2.3855e-08	F(1,331)=32.7168, p-value: 2.3855e-08	F(3,203)=34.6692, p-value: < 2.22e-16	F(1,205)=72.5484, p-value: 3.4971e-15	F(2,53)=-10.6239, p-value: 1	F(2,53)=-10.6239, p-value: 1

Table 2.38 Leaders TC Estimation Results

Dependent Variable: lnTotalOperatingCost	Leaders TC Pooled OLS IV Estimations (4a)		Leaders TC One-way Fixed Effects Within IV Estimations (4b)		Leaders TC Between IV Estimations (4c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**33.915798*** **	**35.283483*** **	–	–	**26.564554*** **	**28.018988*** **
	(2.216026)	(2.334260)	–	–	(6.137689)	(6.597408)
lnAsset1	**-0.753548*** **	**-0.778391*** **	0.176924	0.263254	-0.211321	-0.261562
	(0.125630)	(0.133258)	(0.211519)	(0.483123)	(0.304831)	(0.323727)
CSRIndex	**0.141049*** **	–	**0.072629*** **	–	**0.091859 ·**	–
	(0.027051)	–	(0.016976)	–	(0.049056)	–
LCSRIndex	**0.086626***	**0.221540*** **	Dropped	0.055376	Dropped	**0.094352 ·**
	(0.036105)	(0.026726)		(0.055136)		(0.050870)
LCSR_R	–	–	–	–	–	–
	–	–	–	–	–	–
LReporting	–	–	–	–	–	–
	–	–	–	–	–	–
n	–	–	45	45	45	45
T	–	–	1--5	1--5	2--6	1--5
N	198	199	199	199	238	200
Adjusted R^2	0.42593	0.3503	0.14583	0.075973	0.066508	0.06259
F-statistic	F(3,194)=49.7293, p-value: < 2.22e-16	F(2,196)=54.0951, p-value: < 2.22e-16	F(2,152)=17.9339, p-value: 1.0171e-07	F(2,152)=8.39427, p-value: 0.00034838	F(2,42)=-11.9426, p-value: 1	F(2,42)=-12.2931, p-value: 1

Table 2.39 Followers Net Profit Estimation Results

Dependent Variable: Net Profit	Followers Net Profit Pooled OLS IV Estimations (1a)				Followers Net Profit One-way Fixed Effects Within IV Estimations (1b)				Followers Net Profit Between IV Estimations (1c)			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	4.39e+09**	4.20e+09*	4.39e+09**	3.28e+09 ·	–	–	–	–	-4.04e+09	-2.91e+08	-4.46e+09	-2.91e+08
	(1.52e+09)	(1.68e+09)	(1.52e+09)	(1.77e+09)	–	–	–	–	(3.264e+09)	(9.60e+08)	(3.37e+09)	(9.60e+08)
Asset1	1.34e-02***	–	1.34e-02***	–	4.64e-03 ·	–	4.64e-03 ·	–	1.18e-2***	–	1.15e-2***	–
	(1.33e-03)	–	(1.33e-03)	–	(2.66e-03)	–	(2.659e-03)	–	(2.65e-03)	–	(2.94e-03)	–
TR	–	7.85e-02***	–	8.39e-02***	–	4.14e-02***	–	2.93e-02***	–	4.58e-2***	–	4.58e-2***
	–	(1.39e-02)	–	(1.64e-02)	–	(8.76e-03)	–	(6.84e-03)	–	(6.81e-03)	–	(6.81e-03)
CSRIndex	Dropped	-2.09e+8**	–	–	Dropped	-1.27e+08*	–	–	1.66e+08 ·	Dropped	–	–
		(7.14e+07)	–	–		(5.91e+07)	–	–	(9.23e+07)		–	–
LCSRIndex	-3.45e+08**	Dropped	-3.45e+08**	-3.24e+08 ·	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped	2.12e+08 ·	NS
	(1.25e+08)		(1.25e+08)	(1.73e+08)							(1.08e+08)	
LCSR_R	6.13e+8***	-3.90e+8 ·	6.13e+8***	-3.09e+08	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped
	(1.18e+08)	(2.10e+08)	(1.18e+08)	(2.150)								
LReporting	-1.28e+10***	1.64e+10*	-1.28e+10***	1.70e+10*	-2.87e+09*	-2.59e+09	-2.87e+09*	-4.28e+09**	Dropped	Dropped	Dropped	Dropped
	(3.09e+09)	(7.15e+09)	(3.09e+09)	(7.91e+09)	(1.32e+09)	(1.57e+09)	(1.32e+09)	(1.38e+09)				
n	–	–	–	–	32	32	32	32	32	33	32	33
T	–	–	–	–	3--5	3--5	3--5	3--5	3--6	4--7	3--5	4--7
N	137	138	137	138	137	138	137	138	168	223	137	223
Adjusted R^2	0.54018	0.51915	0.54018	0.50269	0.040438	0.14219	0.040438	0.11606	0.53948	0.55798	0.53558	0.55798
F-statistic	F(4,132)=42.1094, p-value: < 2.22e-16	F(4,133)=38.824, p-value: < 2.22e-16	F(4,132)=42.1094, p-value: < 2.22e-16	F(4,133)=36.2514, p-value: < 2.22e-16	F(2,103)=2.92748, p-value: 0.058001	F(3,103)=8.07976 , p-value: 6.9374e-05	F(2,103)=2.92748, p-value: 0.058001	F(2,104)=9.46575, p-value: 0.00016721	F(2,29)=21.1474, p-value: 2.1648e-06	F(1,31)=45.3498, p-value: 1.5483e-07	F(2,29)=20.5637, p-value: 2.7505e-06	F(1,31)=45.3498, p-value: 1.5483e-07

Table 2.40 Followers TR Estimation Results

Dependent Variable: lnTotalRevenue	Followers TR Pooled OLS IV Estimations (2a)				Followers TR One-way Fixed Effects Within IV Estimations (2b)				Followers TR Between IV Estimations (2c)			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**35.584*** **	3.812	**24.196*** **	3.812	–	–	–	–	**30.591 ·**	4.348	**30.591·**	4.348
	(4.752)	(2.309)	(2.484)	(2.309)	–	–	–	–	(15.766)	(4.033)	(15.766)	(4.033)
lnAsset1	**-0.513***	–	0.016	–	0.475	–	**0.904*** **	–	-0.426	–	-0.426	–
	(0.197)	–	(0.100)	–	(0.495)	–	(0.235)	–	(0.737)	–	(0.737)	–
lnTC	–	**0.812*** **	–	**0.812*** **	–	**1.744*** **	–	**1.887*** **	–	**0.733** **	–	**0.733** **
	–	(0.106)	–	(0.106)	–	(0.187)	–	(0.186)	–	(0.213)	–	(0.213)
CSRIndex	**0.077*** **	Dropped	–	–	**0.050** **	**0.038** **	–	–	Dropped	Dropped	–	–
	(0.016)		–	–	(0.016)	(0.012)	–	–			–	–
LCSRIndex	**0.080 ·**	**0.058 ·**	Dropped	**0.058 ·**	-0.026	**-0.047*** **	Dropped	**-0.037** **	Dropped	Dropped	Dropped	Dropped
	(0.044)	(0.035)		(0.035)	(0.019)	(0.014)		(0.013)				
LCSR_R	**0.083** **	-0.036	**0.118*** **	-0.036	Dropped	Dropped	Dropped	Dropped	0.174	Dropped	0.174	Dropped
	(0.026)	(0.031)	(0.016)	(0.031)					(0.114)		(0.114)	
LReporting	**-8.053*** **	NS	**-4.288*** **	Dropped	Dropped	-0.011	Dropped	Dropped	Dropped	3.497	Dropped	3.497
	(1.565)		(0.832)			(0.007)				(2.884)		(2.884)
n	–	–	–	–	29	26	32	24	32	27	32	27
T	–	–	–	–	3--5	2--5	3--5	3--5	3--5	3--5	3--5	3--5
N	137	112	137	112	126	108	137	104	137	127	137	127
Adjusted R^2	0.5825	0.75618	0.52471	0.75618	0.15399	0.54635	0.094649	0.54183	0.15065	0.58704	0.15065	0.58704
F-statistic	F(5,131)= 40.8384, p-value: < 2.22e-16	F(3,108)=1 30.808, p-value: < 2.22e-16	F(3,133)=5 2.1465, p-value: < 2.22e-16	F(3,108)=1 30.808, p-value: < 2.22e-16	F(3,94)=8. 14965, p-value: 7.0277e-05	F(4,78)=60 .577, p-value: < 2.22e-16	F(1,104)=1 4.8139, p-value: 0.0002051	F(2,78)=1 01.51, p-value: < 2.22e-16	F(2,29)=-10.6061 on 2 and 29 DF, p-value: 1	F(2,24)= 17.2074, p-value: 2.3134e-05	F(2,29)=-10.6061, p-value: 1	F(2,24)=1 7.2074, p-value: 2.3134e-05

Table 2.41 Followers ROA Estimation Results

Dependent Variable: ROA	Followers ROA Pooled OLS IV Estimations (3a)		Followers ROA One-way Fixed Effects Within IV Estimations (3b)		Followers ROA Between IV Estimations (3c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**-0.9638738*** **	**-0.9638738*** **	–	–	0.1733904	0.1733904
	(0.2491809)	(0.2491809)	–	–	-0.1283645	-0.1283645
lnAsset1	**0.0460945*** **	**0.0460945*** **	**0.2763996*** **	**0.2317630*** **	-0.0057830	-0.0057830
	(0.0111909)	(0.0111909)	(0.0366571)	(0.0317880)	(0.0050701)	(0.0050701)
CSRIndex	Dropped	–	**-0.0023513 ·**	–	Dropped	–
		–	(0.0012940)	–		–
LCSRIndex	**-0.0092192*** **	**-0.0092192*** **	**-0.0061015*** **	**-0.0067615*** **	Dropped	Dropped
	(0.0026805)	(0.0026805)	(0.0014459)	(0.0010514)		
LCSR_R	**0.0041216* **	**0.0041216* **	Dropped	Dropped	Dropped	Dropped
	(0.0020076)	(0.0020076)				
LReporting	Dropped	NS	Dropped	Dropped	Dropped	Dropped
n	–	–	25	32	33	33
T	–	–	2--5	3--5	3--6	3--6
N	111	111	104	137	191	191
Adjusted R^2	0.15821	0.15821	0.42822	0.25599	0.037835	0.037835
F-statistic	F(3,107)=7.00305, p-value: 0.00024039	F(3,107)=7.00305, p-value: 0.00024039	F(3,76)=18.9728, p-value: 2.782e-09	F(2,103)=26.5884, p-value: 4.8962e-10	F(1,31)=1.30096, p-value: 0.26277	F(1,31)=1.30096, p-value: 0.26277

Table 2.42 Followers TC Estimation Results

Dependent Variable: lnTotalOperatingCost	Followers TC Pooled OLS IV Estimations (4a)		Followers TC One-way Fixed Effects Within IV Estimations (4b)		Followers TC Between IV Estimations (4c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**29.926800*** **	**28.413571*** **	–	–	**31.919919***	**31.919919***
	(2.151931)	(2.213674)	–	–	(14.024600)	(14.024600)
lnAsset1	**-0.244691** **	-0.141563	0.1619907	0.3734225	-0.448917	-0.448917
	(0.090959)	(0.090314)	(0.2467521)	(0.2290366)	(0.650778)	(0.650778)
CSRIndex	**0.047273*** **	–	**0.0245816** **	–	Dropped	
	(0.013609)	–	(0.0091313)	–		
LCSRIndex	Dropped	Dropped	Dropped	Dropped	0.136516	0.136516
					(0.087828)	(0.087828)
LCSR_R	**0.101189*** **	**0.135231*** **	Dropped	**0.0100617 ·**	Dropped	Dropped
	(0.016906)	(0.014471)		(0.0054642)		
LReporting	**-5.078261*** **	**-5.298670*** **	Dropped	Dropped	Dropped	Dropped
	(0.751600)	(0.786693)				
n	–	–	27	27	27	27
T	–	–	2--5	2--5	2--5	2--5
N	111	111	111	111	111	111
Adjusted R^2	0.61541	0.5822	0.17544	0.15001	0.19859	0.19859
F-statistic	F(4,106)=48.0295, p-value: < 2.22e-16	F93,107)=54.3916, p-value: < 2.22e-16	F(2,82)=12.7699, p-value: 1.486e-05	F(2,82)=10.4465, p-value: 9.0895e-05	F(2,24)=-6.55941, p-value: 1	F(2,24)=-6.55941, p-value: 1

Table 2.43 The Uncommitted Net Profit Estimation Results

Dependent Variable: Net Profit	The Uncommitted Net Profit Pooled OLS IV Estimations (1a)				The Uncommitted Net Profit Between IV Estimations (1c)			
	I	II	III	IV	I	II	III	IV
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**4.0699e+09*** **	**4.4816e+09·**	**4.3696e+09*** **	**6.2409e+09***	3.2916e+09	**1.0479e+09** **	3.2916e+09	**1.0479e+09** **
	(9.9011e+08)	(2.6135e+09)	(9.8360e+08)	(2.4246e+09)	(2.4091e+09)	(3.3362e+08)	(2.4091e+09)	(3.3362e+08)
Asset1	**1.6223e-02** **	–	**0.019379*** **	–	**3.3807e-02·**	–	**3.3807e-02·**	–
	(5.6325e-03)	–	(5.3859e-03)	–	(1.7310e-02)	–	(1.7310e-02)	–
TR	–	7.5992e-03	–	**1.3503e-02***	–	3.8300e-03	–	3.8300e-03
	–	(6.2951e-03)	–	(5.3226e-03)	–	(6.0846e-03)	–	(6.0846e-03)
CSRIndex	**2.5738e+08·**	**5.8540e+08·**	–	–	Dropped	Dropped	–	–
	(1.4580e+08)	(3.3969e+08)	–	–			–	–
LCSRIndex	**-6.0067e+08*** **	**-9.7391e+08** **	**-3.7520e+08*** **	**-5.6745e+08***	-3.0779e+08	Dropped	-3.0779e+08	Dropped
	(1.5858e+08)	(3.5755e+08)	(9.4779e+07)	(2.7082e+08)	(2.3171e+08)		(2.3171e+08)	
LCSR_R	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–
LReporting	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–
n	–	–	–	–	31	31	31	31
T	–	–	–	–	3--5	4--7	3--5	4--7
N	129	129	129	129	129	207	129	207
Adjusted R^2	0.23646	0.068639	0.21994	0.047626	0.047808	0.012609	0.047808	0.012609
F-statistic	F(3,125)=13.4496, p-value: 1.158e-07	F(3,125)=3.17649, p-value: 0.026503	F(2,126)=18.309, p-value: 1.0465e-07	F(2,126)=3.22934, p-value: 0.042882	F(2,28)=-7.3658, p-value: 1	F(1,29)=0.396219, p-value: 0.53398	F(2,28)=-7.3658, p-value: 1	F(1,29)=0.396219, p-value: 0.53398

Table 2.44 The Uncommitted TR Estimation Results

Dependent Variable: lnTotalRevenue	The Uncommitted TR Pooled OLS IV Estimations (2a)				The Uncommitted TR Between IV Estimations (2c)			
	I	II	III	IV	I	II	III	IV
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**7.859363*** **	**10.37208*** **	**6.663770*** **	**8.15858*** **	2.70182	2.563864	2.70182	2.563864
	(1.645488)	(1.97750)	(1.767434)	(1.99735)	(6.42439)	(2.200243)	(6.42439)	(2.200243)
lnAsset1	**0.556070*** **	–	**0.607195*** **	–	**0.80611** **	–	**0.80611** **	–
	(0.080155)	–	(0.086320)	–	(0.26856)	–	(0.26856)	–
lnTotalOperatingCost	–	**0.46538*** **	–	**0.57546*** **	–	**0.894565*** **	–	**0.894565*** **
	–	(0.10394)	–	(0.10560)	–	(0.091292)	–	(0.091292)
CSRIndex	**0.562115*** **	**0.52545*** **	–	–	Dropped	Dropped	–	–
	(0.115509)	(0.14989)	–	–			–	–
LCSRIndex	**-0.289708***	-0.29372	**0.301519*** **	**0.21763·**	0.21953	Dropped	0.21953	Dropped
	(0.144487)	(0.18002)	(0.084956)	(0.11245)	(0.16976)		(0.16976)	
LCSR_R	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–
LReporting	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–
n	–	–	–	–	31	23	31	23
T	–	–	–	–	3--5	2--7	3--5	2--7
N	129	86	129	86	129	113	129	113
Adjusted R^2	0.55689	0.54493	0.48265	0.4896	0.26717	0.74919	0.26717	0.74919
F-statistic	F(3,125)=56.307, p-value: < 2.22e-16	F(3,82)=36.4567, p-value: 4.5151e-15	F(2,126)=61.541, p-value: < 2.22e-16	F(2,83)=42.7292, p-value: 1.747e-13	F(2,28)=-6.31686, p-value: 1	F(1,21)=96.02, p-value: 2.7615e-09	F(2,28)=-6.31686, p-value: 1	F(1,21)=96.02, p-value: 2.7615e-09

Table 2.45 The Uncommitted ROA Estimation Results

Dependent Variable: ROA	The Uncommitted ROA Pooled OLS IV Estimations (3a)		The Uncommitted ROA Between IV Estimations (3c)	
	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate
(Intercept)	**0.3191498***	**0.2862817***	0.0232248	0.0232248
	(0.1379314)	(0.1372202)	(0.1889822)	(0.1889822)
lnAsset1	-0.0062977	-0.0048922	0.0012318	0.0012318
	(0.0067189)	(0.0067017)	(0.0079832)	(0.0079832)
CSRIndex	0.0154531	–	Dropped	–
	(0.0096824)	–		–
LCSRIndex	**-0.0284437***	**-0.0121902·**	Dropped	Dropped
	(0.0121115)	(0.0065958)		
LCSR_R	–	–	–	–
	–	–	–	–
LReporting	–	–	–	–
	–	–	–	–
n	–	–	31	31
T	–	–	3--6	3--6
N	129	129	177	177
Adjusted R^2	0.072549	0.054716	0.00076736	0.00076736
F-statistic	F(3,125)=3.37207, p-value: 0.020662	F(2,126)=3.73859, p-value: 0.026467	F(1,29)=0.0238078, p-value: 0.87844	F(1,29)=0.0238078, p-value: 0.87844

Table 2.46 The Uncommitted TC Estimation Results

Dependent Variable: lnTotalOperatingCost	The Uncommitted TC Pooled OLS IV Estimations (4a)		The Uncommitted TC Between IV Estimations (4c)	
	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate
(Intercept)	**7.189137*** **	**6.815064** **	2.99430	-5.05684
	(1.869143)	(2.135302)	(3.07836)	(11.37363)
lnAsset1	**0.542707*** **	**0.549081*** **	**0.88146*** **	**1.11172* **
	(0.091553)	(0.105665)	(0.12848)	(0.41063)
CSRIndex	**0.382718*** **	–	Dropped	–
	(0.066263)	–		–
LCSRIndex	Dropped	**0.426922*** **	Dropped	0.25803
		(0.093218)		(0.24453)
LCSR_R	–	–	–	–
	–	–	–	–
LReporting	–	–	–	–
	–	–	–	–
n	–	–	23	23
T	–	–	2--6	2--5
N	101	86	106	86
Adjusted R^2	0.61197	0.56039	0.63137	0.25568
F-statistic	F(2,98)=83.6841, p-value: < 2.22e-16	F(2,83)=57.4606, p-value: < 2.22e-16	F(1,21)=47.0715, p-value: 8.8075e-07	F(2,20)=-5.27322, p-value: 1

2.5 Empirical Analysis of CSR Subindices, CSR Reporting and Financial Performance

To further investigate the impacts of four CSR subindices performance on firms' financial performance, we also evaluate four sets of models as we did for CSR Index in section 2.4 for CSR subindices. To examine the signaling effect of each CSR subindex performance, we include the interaction term of each CSR subindex and *LReporting* dummy. Besides the signaling effect from the public, we expect that there might be a delayed return from lagged social CSR performance and lagged environmental CSR performance because social benevolence like community supporting program or employee relations program may receive a delayed return from the benefited groups and energy efficiency program may take some time to exhibit its resource saving effect. So we include *LSocialCSR* and *LEnvironmentalCSR* as well.

We construct IV's for each variable of interest in similar ways by using same category average CSR subindex score of firms in similar size in the sample, and other IV's as we used before. To save space, the tables of CSR subindex IV's profiles are not listed here. They can be provided at the demand to the author.

After IV's for each variable of interest is constructed, we checked the Pearson's product-moment correlation among variables of interest from the reduced form equations for all three types of models (pooled OLS, one-way fixed effects within and between models). The results showed that high Pearson's product-moment correlation ($\rho > 0.99$) exist among current year's CSR subindex scores and among lagged CSR subindex scores for full sample and leaders in pooled OLS and between models.

Technically speaking, this implied that some variables are redundant so that we need to drop the redundant variables. However, dropping variables may be problematic for two reasons. First, since for full sample and leaders' pooled OLS and between models, all current year's CSR subindex scores are pairwise highly linearly correlated and all lagged CSR subindex scores are also pairwise highly linearly correlated, we can only keep one current year's CSR subindex scorre and one lagged CSR subindex score by dropping "redundant" variables and there is no persuasive evidence to keep a particular CSR subindex score while drop others. Second, dropping too many highly correlated variables may cause serious bias of the estimate.

Economically speaking, four CSR subindices are definitely defined differently and the high correlations among CSR subindices reflect behavioral consistency of firms' CSR performance in four dimensions.

After balancing the large standard error caused by high collinearity correlations and the bias caused by dropping variables, we choose to keep all current CSR subindex scores and lagged CSR subindex scores. And we use backward elimination to derive final selected models. The limitations of our model specifications are discussed in section 2.6. Out of a parallel comparison purpose with empirical analysis of CSR index and lagged CSR index in section 2.5, we also evaluate the model specifications which only include lagged CSR subindex scores and their interaction terms. The results are presented in Table 2.47 to Table 2.62.

The estimation results indicate that the links between CSR subindces and financial performance are much more complicated than what we expected. The strength and the direction of the link may depend on a firm's CSR reporting records type, how a firm practices CSR, and time horizon. For full sample, we found both CSR management performance and social CSR performance (both current year and last year's) have positive effects on TR. And current year social CSR performance exhibits the largest positive impact on full sample TR among four CSR subindces. While the estimation results on full sample net profit and ROA show that market CSR performance and social CSR performance have positive effects and lagged market CSR performance has larger impacts on full sample net profit. For Leaders, we found positive effects of lagged CSR management performance and current year social CSR performance on net profit, TR and ROA. And current year social CSR performance exhibits the largest positive impact on Leaders' net profit, TR, and ROA among four CSR subindces. For Followers, we found that social CSR performance (both current year and last year's) and lagged reported environmental CSR performance have positive effects on TR. And social CSR performance (both current year and last year's) exhibits the largest positive impact on Followers' TR among four CSR subindces. While the estimation results on Followers net profit and ROA show that lagged reported CSR management performance and lagged reported market CSR performance have positive effects and market CSR performance has larger impacts on Followers' net profit and ROA. For The Uncommitted, we only found positive effect of current year social CSR performance on net profit, TR and ROA.

Overall, social CSR performance has the most consistent positive effects on profitability among full sample and all types and also four CSR subindices. While lagged market CSR performance has larger impacts on full sample net profit and CSR management performance also has a positive effect on full sample TR. Besides, Leaders' management CSR performance has stronger link with financial performance while Followers' market CSR performance has stronger link with financial performance. The link between environmental CSR performance and financial performance is very limited and in general negative, and we only found positive impact of environmental CSR on Followers' TR, considering that we were not able to find proper IV's for *LEnvironmentalCSR* for Leaders and no IV's for *EnvironmentalCSR* and *LEnvironmentalCSR* for The Uncommitted.

2.5.1 CSR Management Subindex and Financial Performance

2.5.1.1 Current Year CSR Performance and Financial Performance

There are consistent evidences that better current year CSR management performance has an effect to reduce TC on full sample (weakly by pooled OLS IV estimation in Table 2.50 column (4a).I) and three types (by pooled OLS IV estimation in Table 2.54 column (4a).I, Table 2.58 column (4a).I and Table 2.62 column (4a).I). Relating to the subindeices under CSR management in Table , this TC reducing effect might be due to improved CSR management efficiency (CSR-1.3, CSR-1.4, CSR-1.5, CSR-1.6 and CSR-1.14 in Table 2.1), better identification of key CSR issues (CSR-1.2 in Table 2.1) and key stakeholders (CSR-1.7 in Table 2.1), better response to stakeholders' expectation (CSR-1.8 and CSR-1.9 in Table 2.1).

Also, better current year CSR management performance increases TR on full sample (by pooled OLS IV estimation in Table 2.48 column (2a).I, One-way within IV estimation in column (2b).I and between IV estimation in column (2c).I). This TR increasing effect might come from the improved stakeholder relationship which is built up by better CSR management. However, we found that better current year CSR management performance has an effect to reduce the TR of Leaders (by pooled OLS IV estimation in Table 2.52 column (2a).I). This revenue reducing effect may be because that Leaders reallocate their resources to improve CSR management. Some resources which were used for business operating are now reallocated to support better CSR management and this effect may outmatches TR increasing effect caused by improved stakeholder relationship for Leaders.

Unfortunately, we were not able to find consistent net profit or ROA increasing effect by current year CSR management. Instead, we found weak net profit reducing effect on full sample (by pooled OLS IV estimation in Table 2.47 column (1a).I), ROA reducing effect on full sample and Leaders (by pooled OLS IV estimation in Table 2.49 column (3a).I and Table 2.53 column (3a).I), but net profit increasing effect on full sample (by One-way within IV estimation in Table 2.47 column (1b).I) and ROA increasing effect on Followers (by One-way within IV estimation in Table 2.57 column (3b).I). This mixing result on net profit and ROA may be due to two reasons. First, there are both revenue increasing aspects and revenue reducing aspects in CSR management sub-indices. So the total effect of CSR management on net profit/ROA may depend on how the firm practices CSR management. Second, some TC data are missing because of unavailability of data. Some firms didn't list out the total operating cost directly in their accounting reports. Some firms' accounting reports' structures, like firms who publish their accounting reports in Hong Kong Stock Exchange, are not comparable with other firms who publish their accounting reports in China Foreign Exchange Trade System & National Interbank Funding Center and they didn't list out the total operating cost as well. Some firm groups' accounting reports are not available so that their financial data were read from their CSR reports. Therefore, we only have 395 observations for TC pooled OLS models while we have 527 observations for net profit, TR and ROA pooled OLS models.

2.5.1.2 Lagged Reported CSR Management Performance and Financial Performance

We found that there are consistent evidences that lagged reported CSR management performance has a revenue increasing effect on full sample (by pooled OLS and one-way within IV estimation in Table 2.48 column (2a).I and column (2b).I), Leaders and Followers (by pooled OLS IV estimation in Table 2.52 column (2a).I and Table 2.56 column (2a).I). However, for The Uncommitted, their poor lagged CSR management performance has a revenue reducing effect (by pooled OLS IV and one-way within IV estimation in Table 2.60 column (2a).I and (2b).I).

On the other side, we didn't find significant effect of lagged reported CSR management performance on TC. We only found significant TC increasing effect of lagged reported CSR management performance on Leaders (by pooled OLS IV estimation in Table 2.54 column (4a).I).

We also found net profit increasing effect weakly on Leaders and significantly on Followers (by pooled IV estimation in Table 2.51 column (1a).I and Table 2.55 column (1a).I), while net profit reducing effect on The Uncommitted (by one-way within IV estimation and between IV estimation in Table 2.59 column (1b).I and (1c).I). Besides, we found ROA increasing effect on full sample (by one-way within IV estimation in Table 2.49 column (3b).I), Leaders (by pooled OLS IV estimation in Table 2.53 column (3a).I), and Followers (by one-way within IV estimation in Table 2.57 column (3b).I), while ROA reducing effect on The Uncommitted (by one-way within IV estimation in Table 2.61 column (3b).I).

In all, these findings above may primarily verify our expectation of the signaling effect of lagged reported CSR management performance. Good lagged reported CSR management performance may be a signal of CSR responsible behavior to broader stakeholders and may bring higher revenue and net profit to the firm, like Leaders and Followers. While bad lagged reported CSR management performance may be a signal of CSR irresponsible behavior to broader stakeholders and may reduce a firm’s revenue and net profit, like The Uncommitted (The Uncommitted’ lagged CSR management performance is estimated and published by CSR research institute, not The Uncommitted themselves).

2.5.2 Market CSR Subindex and Financial Performance

2.5.2.1 Current Year Market CSR Performance and Financial Performance

The effect of current year market CSR performance on financial performance is even more complicated than CSR management performance because there are more items included under market CSR subindex, for example, higher TR and net profit (CSR-2.1.2 and CSR-2.1.3 in Table 2.1), and better customer relationships (all items in CSR-2.1 in Table 2.1). Some items may have TR/net profit/ROA increasing effect while some items may have TR/net profit/ROA reducing or TC increasing effect, for example, supply chain management (all items in CSR-2.2 in Table 2.1) and R&D (all items in CSR-2.4 in Table 2.1).

Our empirical analysis suggests that better current year market CSR performance may increase the net profit on full sample (by pooled OLS IV estimation in Table 2.47 column (1a).I), Leaders (by one-way within IV estimation in Table 2.51 column (1b).I), and weakly on Followers (by pooled OLS IV estimation in Table 2.55 column (1a).I). It may also increase TR on Leaders (by one-way within IV estimation in Table 2.52 column (2b).I). And it may weakly increase ROA of Followers (by pooled OLS estimation in Table 2.57 column (1a).I).

On the other side, better current year market CSR performance may weakly reduce the net profit for full sample (by one-way within IV estimation in Table 2.47 column (1b).I) and reduce the net profit for Followers (by one-way within IV estimation in Table 2.55 column (1b).I). It may also reduce TR on full sample (by pooled OLS IV estimation and one-way within IV estimation in Table 2.48 column (2a).I and (2b).I) and Followers (by pooled OLS IV estimation and one-way within IV estimation in Table 2.55 column (2a).I and (2b.I)). And it may reduce ROA on Leaders (by pooled OLS IV estimation in Table 2.53 column (3a).I).

To further interpret these results in an economic sense, these results may imply that better current year market CSR performance may increase the net profit for full sample and net profit/ROA weakly on Followers in the long run (because one-way within estimation focuses on the short run effect and between estimation focuses on the long run effect while pooled OLS estimation is a combination of short run and long effect) while reduce the net profit for full sample and Followers in the short run. And better current year market CSR performance may increase net profit and TR for Leaders in the short run but reduce ROA in the long run. It is probably because there is a CSR catching up stage for Followers and they may not be able to receive the benefit of better market CSR performance until their market CSR performance achieves and exceeds a certain level. For Leaders, although their better market CSR performance may quickly earn net profit/TR from stakeholders, their market CSR performance has not achieved an efficient level.

The effect of current year market CSR performance on TC is quite mixed. The results suggest that better current year market CSR performance may increase TC (but less than the increase on TR) for Leaders in the short run (by one-way within IV estimation). For Followers, better current year market CSR performance may increase TC in the long run (by between IV estimation) but weakly reduce TC in the short run (by one-way within IV estimation). Since we have 26 observations of TC missing from 137 total observations for Followers, the estimation of current year market CSR performance on TC for Followers may not be very persuasive.

2.5.2.2 Lagged Reported Market CSR Performance and Financial Performance

We found that better lagged reported market CSR performance has a TR increasing effect on Leaders (by pooled OLS IV estimation and one-way within IV estimation in Table 2.52 column (2a).I and (2b).I). However, it has a TR reducing effect on full sample and Followers (by pooled OLS IV estimation and one-way within IV estimation in Table 2.48 column (2a).I and (2b).I and Table 2.56 column (2a).I and column (2b).I). This may imply that there exists positive signaling effect of lagged reported market CSR performance for Leaders while for Followers the signaling effect might be negative.

However, the results on net profit and ROA show that better lagged reported market CSR performance has a net profit and ROA increasing effect for full sample and Followers (by pooled OLS IV estimation in Table 2.47 column (1a).I, Table 2.49 column (3a).I, Table 2.55 column (1a).I and Table 2.57 column (3a).I) but has a weakly net profit reducing effect on Leaders (by pooled OLS IV estimation in Table 2.47 column (1a).1). These results suggest that there should be a contrary TC effect on full sample and Followers to counteract the TR effect of lagged reported market CSR performance on full sample and Followers. Unfortunately, we only found the evidence of TC reducing effect on full sample (by one-way within IV estimation in Table 2.50 column (4b).I) and TC increasing effect on Leaders (by one-way within IV estimation in Table 2.54 column (4b).I) but no evidence found for Followers, considering that there are missing TC observations for Followers.

Economically, the findings above may imply that the improvement of some items under market CSR performance subindex may cause a sustaining investment to maintain. For example, increasing total assets (CSR-2.1.4 in Table 2.1) may cause an increasing total operating cost in the next year, or improved customer relationship management (CSR-2.3 in Table 2.1) may cause higher operating cost to maintain it.

2.5.3 Social CSR Subindex and Financial Performance

2.5.3.1 Current Year Social CSR Performance and Financial Performance

The empirical results show quite consistent evidences that better current year social CSR performance has a TR increasing effect on full sample (by pooled OLS IV estimation in Table 2.48 column (2a).I and one-way within IV estimation in column (2b).I), Leaders and Followers (by pooled OLS IV estimation and one-way within IV estimation in Table 2.52 column (2a).I and (2b).I, Table 2.56 column (2a).I and (2b).I), and The Uncommitted (by pooled OLS IV estimation in Table 2.60 column (2a).I). Also, we found net profit increasing effect on full sample (by pooled OLS IV estimation and one-way within IV estimation in Table 2.47 column (1a).I and (3a).I), Leaders (weakly by pooled OLS IV estimation and between IV estimation in Table 2.51 column (1a).I and (3a).I), Followers (by one-way within IV estimation in Table 2.55 column (1b).I), and The Uncommitted (by pooled OLS IV estimation in Table 2.59 column (1a).I). Besides, we found consistent evidences that better current year social CSR performance has a ROA increasing effect on full sample (by pooled OLS IV estimation and one-way within IV estimation in Table 2.49 column (3a).I and (3b).I), Leaders (by pooled OLS IV estimation and one-way within IV estimation in Table 2.53 column (3a).I and (3b).I), Followers (weakly by one-way within IV estimation in Table 2.57 column (3b).I), and The Uncommitted (weakly by pooled OLS IV estimation in Table 2.61 column (3a).I).

The positive effect of current year social CSR performance might be related with employee relationship items under social CSR performance subindex, like average annual leave (CSR-3.2.7 in Table 2.1), employee training program (CSR-3.2.15 in Table 2.1), employee career development channels (CSR-3.2.17 in Table 2.1) and incentive mechanism for employee (CSR-3.2.18 in Table 2.1). Improved employee relationship may induce a higher employee morale, thus may enhance the productivity and further generate higher TR or net profit. It may also be related with the company income tax (CSR-3.1.3 in Table 2.1) because higher company income tax implies higher profitability.

On the TC side, we also found consistent evidences that better current year CSR performance may increase the TC on full sample (by pooled OLS IV estimation in Table 2.50 column (4a).I), Leaders (by pooled OLS IV estimation in Table 2.54 column (4a).I), Followers (by pooled OLS IV estimation and one-way within IV estimation in Table 2.58 column (4a).I and (4b).I), and The Uncommitted (by pooled OLS IV estimation in Table 2.62 column (4a).I).

The increasing effect on TC may be related with community relationship items under social CSR performance subindex, like supporting the education of community members (CSR-3.3.4 in Table 2.1) and donations (CSR-3.3.8 in Table 2.1). Employee relationship may also require higher investment, like financial aid to employee who have financial difficulties (CSR-3.2.11 in Table 2.1), protection to special groups (CSR-3.2.12 in Table 2.1, e.g. pregnant women), employee training program (CSR-3.2.15 in Table 2.1) and incentive mechanism for employee (CSR-3.2.18 in Table 2.1). Besides, some increased TC may be related with investment in production safety management (CSR-3.4.5 in Table 2.1).

2.5.3.2 Lagged Social CSR Performance and Financial Performance

We found that better lagged social CSR performance has an effect of increasing TR on full sample (weakly by pooled OLS IV estimation in Table 2.48 column (2a).I), Followers (by pooled OLS IV estimation and one-way within IV estimation in Table 2.56 column (2a).I and (2b).I), and The Uncommitted (by pooled OLS IV estimation in Table 2.60 column (2a).I). But it has a weakly TR reducing effect on Leaders (by pooled OLS IV estimation in Table 2.52 column (2a).I).

Meantime, we found that better lagged social CSR performance has an effect of increasing TC on full sample (weakly by pooled OLS IV estimation in **Table 2.50** column (4a).I), Followers (by pooled OLS IV estimation and one-way within IV estimation in Table 2.58 column (4a).I and (4b).I), and on The Uncommitted (by pooled OLS IV estimation in Table 2.62 column (4c).I).

For net profit, the results show that better lagged social CSR performance has an effect of increasing the net profit on full sample (by between IV estimation and weakly by pooled OLS IV estimation in Table 2.47 column (1c).I and (1a).I) and Leaders (weakly by one-way within IV estimation in Table 2.51 column (1b).I). However, it reduces the net profit of Followers (by pooled OLS IV estimation in Table 2.55 column (1a).I) and The Uncommitted (by pooled OLS IV estimation in Table 2.59 column (1a).I).

This may verify our expectation that some items in social CSR subindex may take time to generate benefit to firms and they may result in sustaining higher cost, especially when some program or system is in the establishing stage. Overall, the lagged effect of social CSR performance is more significant on full sample, Followers and The Uncommitted, but not on Leaders. It is probably because the employee relationship management, the community relationship management and production safety management of Leaders are established and more developed than other types so the lagged effect of improved social CSR performance of Leaders is not very significant.

For reported lagged social CSR performance, we didn’t find strong evidence of significant signaling effect on TR and net profit. And we didn’t find strong evidence of effect on TC as well. That may imply that the social CSR performance may only be valued by the benefited groups, like employee and community, but not all the stakeholders to the firms.

2.5.4 Environmental CSR Subindex and Financial Performance

2.5.4.1 Current Year Environmental CSR Performance and Financial Performance

We found very consistent evidences that better current year environmental CSR performance has an effect of reducing the net profit on full sample (by pooled OLS IV estimation and one-way within IV estimation in Table 2.47 column (1a).I and (1b).I), Leaders (weakly by pooled OLS IV estimation and one-way within IV estimation in Table 2.51 column (1a).I and (1b).I), and Followers (by pooled OLS IV estimation in Table 2.55 column (1a).I). Since the The Uncommitted' environmental CSR performance score tends to be very low, we could not identify proper IV's for The Uncommitted. So we didn't include environmental CSR performance related variables in The Uncommitted' models.

Also, we found that better current year environmental CSR performance has an effect of reducing TR on full sample (by pooled OLS IV estimation in Table 2.48 column (2a).I) and Leaders (by one-way within IV estimation in Table 2.52 column (2b).I). Similarly, better current year environmental CSR performance has an effect of reducing ROA on full sample (by pooled OLS IV estimation and weakly by one-way within IV estimation in Table 2.49 column (3a).I and (3b).I), Leaders (by one-way within IV estimation in Table 2.53 column (3b).I) and Followers (by one-way within IV estimation in Table 2.57 column (3b).I).

The results on TC show that better current year environmental CSR performance has an effect of increasing TC on full sample (by one-way within IV estimation in Table 2.50 column (4b).I) and Followers (by pooled OLS IV estimation in Table 2.58 column (4a).I).

The results above are consistent with common expectation that improving environmental CSR performance may result in an investment. Therefore, it may reduce the profitability in the short run.

However, it is noticeable to see that better current year environmental CSR performance has a weak effect of reducing TC on Leaders (by one-way within IV estimation). According to the structure of Income Statement adopted by most Chinese firms, TC (total operating cost) only record the cost related to the business operation. For the cost related with environmental CSR, some cost related with basic environmental management may be have been counted as operating cost by accounting standers, like cost related with environmental management system and certification (e.g. ISO 14001). While some cost related with energy conservation and pollution abatement may be recorded as non-operating expenditure. Since most Leaders may have begun to practice environmental CSR earlier than the starting time of our data set, they may have already established basic environmental management system and their environmental CSR management system may have already entered the benefit-generating stage. Therefore, their better environmental CSR performance may result in higher non-operating expenditure but a lower operating cost. For Followers, their better environmental CSR performance may mainly result in a higher cost by improved basic environmental management, so we will observe a higher TC on Followers.

2.5.4.2 Lagged Environmental CSR Performance and Financial Performance

We found that lagged environmental CSR performance has an effect of increasing TC on full sample (weakly by pooled OLS IV estimation in Table 2.50 column (4a).I) and Followers (by pooled OLS IV estimation in Table 2.58 column (4a).I). However, we also found that lagged environmental CSR performance has an effect of reducing TC on Leaders (by one-way within IV estimation in Table 2.54 column (4b).I) and Followers (by one-way within IV estimation in Table 2.58 column (4b).I).

This mixed result may imply that better last year environmental CSR performance may have a larger TC reducing effect for Leaders and Followers in the short run. However, averaging over the time in a longer period, firms who have better environmental CSR performance tend to result in higher TC compared with firms who have poorer environmental CSR performance.

It would be interesting to examine whether higher degree lagged environmental CSR performance may result in lower TC by pooled OLS IV estimation, in another sense, to examine that whether firms who have better higher degree of lagged environmental CSR performance may reduce TC compared with firms who have poorer environmental CSR performance over a longer time period. However, due to the limited time periods of our data set, this examination is not very practical.

It is also found that better lagged environmental CSR performance has an effect of reducing TR on Leaders (by one-way within IV estimation in Table 2.52 column (2b).I) and Followers (by one-way within IV estimation in Table 2.56 column (2b).I). And better lagged environmental CSR performance has an effect of reducing ROA on full sample (by pooled OLS IV estimation in Table 2.49 column (3a).I) and Followers (by pooled OLS IV estimation in Table 2.57 column (3a).I). Besides, better lagged environmental CSR performance will reduce the net profit on full sample (by pooled OLS IV estimation in Table 2.47 column (1a).I) and Leaders (by one-way within IV estimation in Table 2.51 column (1b).I). These results may be ascribed to reallocating resource to improve environmental CSR performance.

At the same time, we found that better lagged environmental CSR performance has an effect of increasing the net profit on full sample (by one-way within IV estimation in Table 2.47 column (1b).I). This result may imply that better last year environmental CSR performance may have an effect of improving the net profit in the short run on full sample. However, since we couldn't identify a proper IV for full sample for TR/TC/ROA one-way within model, we could not further verify this effect.

For lagged reported environmental CSR performance, we found that it has an effect of increasing TR on Followers (by pooled OLS IV estimation and one-way within IV estimation in Table 2.56 column (2a).I and (2b).I). This probably suggests a positive signaling effect of lagged reported environmental CSR performance on Followers in the short run.

On the other side, we found that lagged reported environmental CSR performance has an effect of increasing TC on full sample (weakly by one-way within IV estimation and between IV estimation in Table 2.50 column (4b).I and (4c).I) and Followers (by pooled OLS IV estimation and one-way within IV estimation in Table 2.58 column (4a).I and (4b).I). Since firms which report their environmental CSR performance tend to have higher environmental CSR performance scores, that implies that firms which report their CSR performance may invest more to improve their environmental CSR performance than firms which do not report their CSR performance.

When it turns to net profit/ROA, we found that better reported last year environmental CSR performance has effect of reducing ROA on full sample (by one-way within IV estimation in Table 2.49 column (3b).I) and Followers (by pooled OLS IV estimation in Table 2.57 column (3a).I). For net profit, we found that it has an effect of reducing net profit on full sample (by one-way within IV estimation in Table 2.47 column (1b).I) and Followers (by pooled OLS IV estimation and between IV estimation in Table 2.55 column (1a).I and (1c).I). However, we also found that it has an effect of increasing net profit on full sample (by pooled OLS IV estimation in Table 2.47 column (1a).I) and Followers (by one-way within IV estimation in Table 2.55 column (1b).I). This may imply that for the full sample better reported last year environmental CSR performance may increase the net profit in the long run. For Followers, it may increase the net profit in the short run. In another sense, the signaling effect may take a relatively longer period to happen on the full sample than on Followers.

Table 2.47 Full Sample Net Profit CSR Subindices Estimation Results

Dependent Variable: Net Profit	Full Sample Net Profit Pooled OLS IV Estimation (1a)		Full Sample Net Profit One-way Within IV Estimation (1b)		Full Sample Net Profit Between IV Estimation (1c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**-1.6448e+10*** **	1.3816e+09	–	–	**-8.6132e+09***	-1.3775e+10
	(4.8985e+09)	(2.6394e+09)			(4.2341e+09)	(9.0160e+09)
Asset1	**1.5642e-02*** **	**1.3929e-02*** **	**0.015882*** **	**0.016052*** **	**1.2704e-02*** **	**1.4426e-02*** **
	(8.6243e-04)	(4.1245e-04)	(4.9972e-04)	(4.8436e-04)	(7.9298e-04)	(1.6432e-03)
CSRManagment	-3.0812e+08	–	1.2475e+08	–	Dropped	–
	(2.1062e+08)		(7.8490e+07)			
LCSRManagment_R	-5.0437e+08	Dropped	Dropped	Dropped	Dropped	1.2829e+09
	(4.7612e+08)					(8.6005e+08)
MarketCSR	**8.6973e+08** **	–	-4.4667e+08	–	Dropped	–
	(3.0881e+08)		(2.9111e+08)			
LMarketCSR_R	**1.4742e+09*** **	**4.8323e+08***	**-6.9109e+08** **	**-4.8449e+08** **	Dropped	Dropped
	(3.8483e+08)	(1.9432e+08)	(2.2675e+08)	(1.7011e+08)		
SocialCSR	**8.3883e+08***	–	**4.7150e+08***	–	Dropped	–
	(3.8633e+08)		(2.3253e+08)			
LSocialCSR	8.2952e+08	Dropped	**-1.4329e+09·**	**-1.4383e+09·**	**4.1901e+08** **	Dropped
	(6.0812e+08)		(8.3096e+08)	(8.3011e+08)	(1.2567e+08)	
LSocialCSR_R	**-1.6671e+09***	Dropped	**2.9903e+09** **	**2.7246e+09** **	Dropped	Dropped
	(8.1090e+08)		(9.9357e+08)	(9.6327e+08)		
EnvironmentalCSR	**-1.3776e+09*** **	–	-3.1424e+08	–	Dropped	–
	(3.8043e+08)		(2.1727e+08)			
LEnvironmentalCSR	**-1.9011e+09***	**-6.4743e+08*** **	**4.3764e+09***	**4.1169e+09***	Dropped	3.5889e+09
	(9.4762e+08)	(1.9054e+08)	(1.9396e+09)	(1.8923e+09)		(2.4591e+09)
LEnvironmentalCSR_R	**1.2559e+09·**	2.7411e+08	**-4.1271e+09** **	**-3.9317e+09** **	Dropped	-4.4727e+09
	(7.2192e+08)	(2.0046e+08)	(1.4647e+09)	(1.4369e+09)		(2.8042e+09)
LReporting	**3.6666e+10·**	Dropped	**-4.1016e+10***	**-3.2006e+10***	Dropped	Dropped
	(2.0719e+10)		(1.6524e+10)	(1.5132e+10)		
n	–	–	119	119	119	119
T	–	–	3--5	3--5	3--5	3--5
N	525	525	525	525	525	525
Adjusted R^2	0.78685	0.78523	0.5905	0.5936	0.75671	0.59011
F-statistic	F(12,512)=178.208, p-value: < 2.22e-16	F(4,520)=497.365, p-value: < 2.22e-16	F(11,395)=130.988, p-value: < 2.22e-16	F(7,399)=203.332, p-value: < 2.22e-16	F(2,166)=199.975, p-value: < 2.22e-16	F(4,114)=35.8939, p-value: < 2.22e-16

Table 2.48 Full Sample TR CSR Subindices Estimation Results

Dependent Variable: lnTotalRevenue	Full Sample TR PLS IV Est. (2a)		Full Sample TR One-way Within IV Est. (2b)		Full Sample TR Between IV Est. (2c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**13.159244*** **	**25.665487*** **	–	–	**25.451089*** **	**31.545660*** **
	(2.567377)	(1.579666)			(5.297049)	(7.220067)
lnAsset1	**0.470081*** **	-0.111839	**-0.9379964** **	**0.38527*** **	-0.122741	-0.409010
	(0.123373)	(0.074664)	(0.3230493)	(0.11594)	(0.240659)	(0.331856)
CSRManagment	**0.027038* **	–	**0.0227145*** **	–	**0.079320** **	–
	(0.012055)		(0.0064596)		(0.026787)	
LCSRManagment_R	**0.107922** **	**0.120867** **	**0.1813545* **	Dropped	Dropped	Dropped
	(0.034198)	(0.042867)	(0.0743819)			
MarketCSR	**-0.075992* **	–	-0.0381749	–	Dropped	–
	(0.029399)		(0.0358166)			
LMarketCSR_R	**-0.087059** **	Dropped	**-0.0433010** **	Dropped	Dropped	Dropped
	(0.030572)		(0.0147485)			
SocialCSR	**0.248604*** **	–	**0.1209903*** **	–	Dropped	–
	(0.034095)		(0.0246914)			
LSocialCSR	0.032545	**0.154808*** **	Dropped	Dropped	Dropped	**0.117165** **
	(0.020277)	(0.024082)				(0.039188)
LSocialCSR_R	Dropped	**-0.107235* **	–	–	Dropped	Dropped
		(0.046709)				
EnvironmentalCSR	**-0.132907*** **	–	Dropped	–	Dropped	–
	(0.033995)					
LEnvironmentalCSR	–	Dropped	–	–	Dropped	Dropped
LEnvironmentalCSR_R	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped
LReporting	**-6.084112*** **	**-4.550050*** **	**-5.3336750*** **	**0.78891·**	Dropped	Dropped
	(0.634445)	(0.578787)	(1.4339373)	(0.42544)		
n	119	119	119	119	119	119
T	3--5	3--5	3--5	3--5	3--5	3--5
N	525	525	525	525	525	525
Adjusted R^2	0.7326	0.63268	0.27255	0.053974	0.23672	0.21647
F-statistic	F(9,515)=168.792, p-value: < 2.22e-16	F(5,519)=184.528, p-value: < 2.22e-16	F(7,399)=31.8704, p-value: < 2.22e-16	F(2,404)=15.2369, p-value: 4.1726e-07	F(2,116)=-24.0605, p-value: 1	F(2,116)=-29.44, p-value: 1

Table 2.49 Full Sample ROA CSR Subindices Estimation Results

Dependent Variable: ROA	Full Sample ROA PLS IV Est. (3a)		Full Sample ROA One-way Within IV Est. (3b)		Full Sample ROA Between IV Est. (3c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	-0.753466	-0.6267801	–	–	**0.1653334****	**0.1653334****
	(0.4744895)	(0.4512365)			(0.0519217)	(0.0519217)
lnAsset1	0.0342720	0.0302447	**-0.0602277***	**-0.0395297·**	**-0.0049506***	**-0.0049506***
	(0.0209136)	(0.0199677)	(0.0245025)	(0.0227933)	(0.0020296)	(0.0020296)
CSRManagment	**-0.0024845****	–	Dropped	–	Dropped	–
	(0.0008880)					
LCSRManagment_R	Dropped	0.0038816	**0.0089217·**	0.0071130	Dropped	Dropped
		(0.0030245)	(0.0053655)	(0.0053167)		
MarketCSR	Dropped	–	Dropped	–	Dropped	–
LMarketCSR_R	**0.0075648****	0.0040546	Dropped	Dropped	Dropped	Dropped
	(0.0025058)	(0.0024869)				
SocialCSR	**0.0077112*****	–	**0.0033503***	–	Dropped	–
	(0.0019546)		(0.0016982)			
LSocialCSR	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped
LSocialCSR_R	**-0.0069840***	**-0.0068480***	Dropped	–	Dropped	Dropped
	(0.0027495)	(0.0033287)				
EnvironmentalCSR	**-0.0052167***	–	-0.0016793	–	Dropped	–
	(0.0025683)		(0.0014084)			
LEnvironmentalCSR	**-0.0080285·**	-0.0076284	Dropped	–	Dropped	Dropped
	(0.0047943)	(0.0047581)				
LEnvironmentalCSR_R	Dropped	Dropped	**-0.0042113***	**-0.0037258***	Dropped	Dropped
			(0.0017443)	(0.0017233)		
LReporting	0.1289983	0.1281667	**-0.2097110***	-0.1344587	Dropped	Dropped
	(0.0942848)	(0.0954733)	(0.1066601)	(0.1008256)		
n	–	–	119	119	119	119
T	–	–	3--5	3--5	3--5	3--5
N	525	525	525	525	525	525
Adjusted R^2	0.084183	0.057411	0.0842	0.075768	0.047577	0.047577
F-statistic	F(8,516)=6.04201, p-value: 1.9343e-07	F(6,518)=5.33383, p-value: 2.3498e-05	F(6,400)=8.28286, p-value: 1.8074e-08	F(4,402)=11.0366, p-value: 1.6764e-08	F(1,117)=5.94961, p-value: 0.016222	F(1,117)=5.94961, p-value: 0.016222

Table 2.50 Full Sample TC CSR Subindices Estimation Results

Dependent Variable: lnTotalOperatingCost	Full Sample TC PLS IV. Est. (4a)		Full Sample TC One-way Within IV Est. (4b)		Full Sample TC Between IV Est. (4c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**43.634863*** **	**53.223032*** **	–	–	**30.070035***	**39.018416*** **
	(10.029949)	(10.934589)			(15.136297)	(8.580499)
lnAsset1	**-0.907964***	**-1.304701** **	0.152376	0.734886	-0.283418	**-0.701802·**
	(0.435965)	(0.475366)	(0.248847)	(0.450925)	(0.669377)	(0.381432)
CSRManagment	-0.020180	–	Dropped	–	Dropped	–
	(0.014684)					
LCSRManagment_R	Dropped	Dropped	Dropped	-0.136694	Dropped	Dropped
				(0.101321)		
MarketCSR	Dropped	–	Dropped	–	Dropped	–
LMarketCSR_R	Dropped	Dropped	**-0.048210·**	Dropped	Dropped	**0.119799** **
			(0.028812)			(0.038132)
SocialCSR	**0.142837*** **	–	Dropped	–	Dropped	–
	(0.023626)					
LSocialCSR	0.049120	**0.106187** **	Dropped	0.052078	Dropped	Dropped
	(0.034328)	(0.036135)		(0.039125)		
LSocialCSR_R	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped
EnvironmentalCSR	Dropped	–	**0.077439*** **	–	Dropped	–
			(0.011542)			
LEnvironmentalCSR	0.167296	**0.277190***	–	Dropped	Dropped	Dropped
	(0.113312)	(0.123462)				
LEnvironmentalCSR_R	Dropped	Dropped	0.058451	Dropped	0.080500	Dropped
			(0.047887)		(0.073937)	
LReporting	**-10.027756*** **	**-9.946542*** **	**-1.049327·**	2.044227	Dropped	Dropped
	(1.898100)	(2.073686)	(0.613318)	(1.878591)		
n	–	–	95	95	95	95
T	–	–	1--5	1--5	1--5	1--5
N	395	395	395	395	395	395
Adjusted R^2	0.62143	0.54873	0.1485	0.061785	0.20097	0.15317
F-statistic	F(6,388)=111.367, p-value: < 2.22e-16	F(4,390)=121.979, p-value: < 2.22e-16	F(5,295)=14.6431, p-value: 7.9265e-13	F(4,296)=6.64946, p-value: 3.8898e-05	F(2,92)=-15.8425, p-value: 1	F(2,92)=-28.9557, p-value: 1

Table 2.51 Leaders Net Profit CSR Subindices Estimation Results

Dependent Variable: Net Profit	Leaders Net Profit PLS IV Estimation (1a)		Leaders Net Profit One-way Within IV Estimation (1b)		Leaders Net Profit Between IV Estimation (1c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	1.4791e+09	-5.9663e+09	–	–	-2.8375e+10	-2.8421e+10
	(1.7683e+10)	(1.3658e+10)			(3.3257e+10)	(3.3493e+10)
Asset1	**1.3269e-02*** **	**1.3368e-02*** **	**1.6182e-02*** **	**1.6469e-02*** **	**1.2662e-02*** **	**1.2635e-02*** **
	(5.0174e-04)	(5.7069e-04)	(5.9980e-04)	(5.9504e-04)	(1.2525e-03)	(1.3052e-03)
CSRManagment	Dropped	–	Dropped	–	Dropped	–
LCSRManagment	1.1966e+09	Dropped	–	–	Dropped	Dropped
	(7.7513e+08)					
MarketCSR	Dropped	–	**6.4476e+08***	–	Dropped	–
			(2.7223e+08)			
LMarketCSR	-6.4884e+08	**2.3069e+09*** **	Dropped	**-6.0912e+08*** **	Dropped	Dropped
	(6.3603e+08)	(5.9994e+08)		(1.6521e+08)		
SocialCSR	1.3023e+09	–	Dropped	–	7.5580e+08	–
	(8.7396e+08)				(6.8600e+08)	
LSocialCSR	Dropped	**-1.4787e+09***	3.5124e+08	**4.1332e+08***	Dropped	8.0786e+08
		(5.8575e+08)	(2.5764e+08)	(1.9436e+08)		(7.2516e+08)
EnvironmentalCSR	-1.6590e+09	–	-5.1059e+08	–	Dropped	–
	(1.0551e+09)		(3.5380e+08)			
LEnvironmentalCSR	Dropped	**-6.0190e+08·**	**-7.8689e+08*** *	Dropped	Dropped	Dropped
		(3.2159e+08)	(2.3551e+08)			
LReporting	–	–	–	–	–	–
n	–	–	54	54	56	56
T	–	–	3--5	3--5	4--6	3--5
N	260	259	252	251	317	261
Adjusted R^2	0.74307	0.75671	0.62996	0.6333	0.68657	0.69989
F-statistic	F(5,254)=161.417, p-value: < 2.22e-16	F(4,254)=214.527, p-value: < 2.22e-16	F(5,193)=178.907, p-value: < 2.22e-16	F(3,194)=293.357, p-value: < 2.22e-16	F(2,53)=68.7559, p-value: 1.8853e-15	F(2,53)=74.0023, p-value: 4.5536e-16

Table 2.52 Leaders TR CSR Subindices Estimation Results

Dependent Variable: lnTotalRevenue	Leaders TR PLS IV Est. (2a)		Leaders TR One-way Within IV Est. (2b)	
	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate
(Intercept)	**33.452405*****	**33.399872*****	–	–
	(2.369864)	(2.595230)		
lnAsset1	**-0.904281*****	**-0.737781*****	**-1.2526802*****	**0.435907****
	(0.141164)	(0.140357)	(0.1923914)	(0.135268)
CSRManagment	**-0.070969****	–	-0.0106684	–
	(0.024863)		(0.0083445)	
LCSRManagment	**0.147384***	**0.162863***	–	–
	(0.073347)	(0.080301)		
MarketCSR	Dropped	–	**0.2003256*****	–
			(0.0313975)	
LMarketCSR	0.099039	-0.080542	**0.1339210*****	Dropped
	(0.076853)	(0.071007)	(0.0281759)	
SocialCSR	**0.297508*****	–	**0.0527290***	–
	(0.049865)		(0.0259279)	
LSocialCSR	-0.142767	**0.186665·**	–	–
	(0.097257)	(0.101026)		
EnvironmentalCSR	Dropped	–	**-0.0924158****	–
			(0.0321477)	
LEnvironmentalCSR	–	–	**-0.1441859*****	**0.038570***
			(0.0379477)	(0.017892)
LReporting	–	–	–	–
n	–	–	56	56
T	–	–	3--5	3--5
N	199	199	261	261
Adjusted R^2	0.43114	0.33722	0.38265	0.080753
F-statistic	F(5,193)=30.8921, p-value: < 2.22e-16	F(3,195)=34.1061, p-value: < 2.22e-16	F(7,198)=28.788, p-value: < 2.22e-16	F(2,203)=11.7591, p-value: 1.4719e-05

Notes:
1.Since we could not identify proper IV's between models for Leaders when *lnAsset1* is used as the firm size control variable, we do not have results of TR/ROA/TC between models for Leaders.
2.We were not able to find IV's for *LEnvironmentalCSR* for Leaders for pooled OLS model when *lnAsset1* is used as the firm size control variable, therefore, we do not have estimation results for *LEnvironmentalCSR* for TR/ROA/TC pooled OLS models
3. We were not able to find IV's for *LmanagementCSR* and *LSocialCSR* for Leaders for one-way within models when *lnAsset1* is used as the firm size control variable, therefore, we do not have estimation results for *LmanagementCSR* and *LSocialCSR* for TR/ROA/TC one-way within models.

Table 2.53 Leaders ROA CSR Subindices Estimation Results

Dependent Variable: ROA	Leaders ROA PLS IV Est. (3a)		Leaders ROA One-way Within IV Est. (3b)	
	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate
(Intercept)	**0.2088983·**	0.1033820	–	–
	(0.1223791)	(0.0925930)		
lnAsset1	-0.0028491	0.0004863	**-0.0521096*** **	**-0.0387114*** **
	(0.0075516)	(0.0055391)	(0.0053256)	(0.0047174)
CSRManagment	-0.0013154	–	Dropped	–
	(0.0011204)			
LCSRManagment	**0.0073904·**	0.0057819	–	–
	(0.0038084)	(0.0036713)		
MarketCSR	**-0.0074342·**	–	Dropped	–
	(0.0043431)			
LMarketCSR	Dropped	Dropped	Dropped	-0.0014440
				(0.0010583)
SocialCSR	**0.0091713***	–	**0.0038584*** **	–
	(0.0046495)		(0.0010190)	
LSocialCSR	**-0.0088534***	**-0.0069653·**	–	–
	(0.0040348)	(0.0036720)		
EnvironmentalCSR	Dropped	–	**-0.0024852***	–
			(0.0012161)	
LEnvironmentalCSR	–	–	Dropped	0.0020648
				(0.0015000)
LReporting	–	–	–	–
n	–	–	56	56
T	–	–	3--5	3--5
N	262	261	262	261
Adjusted R^2	0.10434	0.090898	0.2712	0.21189
F-statistic	F(6,255)=5.10328, p-value: 5.7224e-05	F(3,257)=8.71241, p-value: 1.5894e-05	F(3,203)=36.4384, p-value: < 2.22e-16	F(3,202)=25.3841, p-value: 5.6027e-14

Table 2.54 Leaders TC CSR Subindices Estimation Results

Dependent Variable: lnTotalOperatingCost	Leaders TC PLS IV Est. (4a)		Leaders TC One-way Within IV Est. (4b)	
	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate
(Intercept)	**41.467208*** **	**36.74147*** **	–	–
	(3.158346)	(2.71032)		
lnAsset1	**-1.211574*** **	**-0.92372*** **	-0.458984	**0.638384*** **
	(0.191213)	(0.16362)	(0.318986)	(0.188633)
CSRManagment	**-0.052795·**	–	Dropped	–
	(0.030696)			
LCSRManagment	**0.186970*** **	0.17300	–	–
	(0.039951)	(0.10675)		
MarketCSR	-0.158373	–	**0.155975** **	–
	(0.117825)		(0.051770)	
LMarketCSR	Dropped	Dropped	**0.158970** **	0.023593
			(0.052767)	(0.018427)
SocialCSR	**0.378395** **	–	Dropped	–
	(0.127501)			
LSocialCSR	Dropped	0.12133	–	–
		(0.10755)		
EnvironmentalCSR	Dropped	–	-0.054778	–
			(0.049434)	
LEnvironmentalCSR	–	–	**-0.201510** **	Dropped
			(0.070866)	
LReporting	–	–	–	–
n	–	–	45	45
T	–	–	1--5	1--5
N	199	199	199	199
Adjusted R^2	0.43114	0.33722	0.17314	0.078753
F-statistic	F(5,193)=30.8921, p-value: < 2.22e-16	F(3,195)=34.1061, p-value: < 2.22e-16	F(5,149)=8.96391, p-value: 1.8245e-07	F(2,152)=8.73677, p-value: 0.00025608

Table 2.55 Followers Net Profit CSR Subindices Estimation Results

Dependent Variable: Net Profit						
	Followers Net Profit PLS IV Est. (1a)		Followers Net Profit One-way Within IV Est. (1b)		Followers Net Profit Between IV Est. (1c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	-5.1065e+09	1.5553e+08	–	–	-9.1853e+08	**-7.5602e+09·**
	(4.3127e+09)	(1.4080e+09)			(3.8869e+09)	(4.3805e+09)
Asset1	**1.3162e-02*****	**1.2942e-02*****	-2.2072e-03	-1.0960e-02	**1.5676e-02*****	**1.0607e-02****
	(1.3224e-03)	(1.3203e-03)	(4.0635e-03)	(6.9996e-03)	(3.6294e-03)	(3.2781e-03)
CSRManagment	Dropped	–	Dropped	–	Dropped	–
LCSRManagment_R	**9.7965e+08*****	**1.0499e+09*****	**-1.9344e+08***	**-4.0146e+08***	**7.8523e+08***	Dropped
	(2.4904e+08)	(2.3709e+08)	(8.5396e+07)	(1.6056e+08)	(3.7020e+08)	
MarketCSR	4.1402e+08	–	**-3.5884e+08***	–	Dropped	–
	(2.7733e+08)		(1.7009e+08)			
LMarketCSR_R	**1.1898e+09***	**8.4981e+08***	Dropped	Dropped	Dropped	Dropped
	(4.6309e+08)	(4.2022e+08)				
SocialCSR	Dropped	–	**1.7835e+08·**	–	Dropped	–
			(1.0436e+08)			
LSocialCSR	**-8.3637e+08****	**-7.8865e+08****	Dropped	Dropped	Dropped	**3.1971e+08***
	(2.6646e+08)	(2.6678e+08)				(1.4332e+08)
LSocialCSR_R	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped
EnvironmentalCSR	**-4.6697e+08·**	–	Dropped	–	Dropped	–
	(2.6307e+08)					
LEnvironmentalCSR	5.1205e+08	3.7811e+08	Dropped	-2.2302e+08	Dropped	Dropped
	(3.5760e+08)	(3.5099e+08)		(2.1405e+08)		
LEnvironmentalCSR_R	**-1.9056e+09****	**-1.5455e+09****	**2.0458e+08***	**4.4286e+08***	-7.5300e+08	Dropped
	(5.9875e+08)	(5.6786e+08)	(9.8834e+07)	(1.8420e+08)	(4.5697e+08)	
LReporting	Dropped	Dropped	Dropped	6.1903e+09	Dropped	Dropped
				(4.8048e+09)		
n	–	–	32	32	32	33
T	–	–	3--5	3--5	3--5	3--5
N	137	137	137	137	137	143
Adjusted R^2	0.55863	0.5568	0.10325	0.084308	0.41352	0.46649
F-statistic	F(8,128)=23.7919, p-value: < 2.22e-16	F(6,130)=30.7674, p-value: < 2.22e-16	F(5,100)=3.29504, p-value: 0.0085131	F(5,100)=2.61169, p-value: 0.029062	F(3,28)=3.40291, p-value: 0.031308	F(2,30)=11.0962, p-value: 0.00024701

Table 2.56 Followers TR CSR Subindices Estimation Results

Dependent Variable: lnTotalRevenue	Followers TR PLS IV Est. (2a)		Followers TR One-way Within IV Est. (2b)		Followers TR Between IV Est. (2c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	19.672060	**36.874040*** **	–	–	**20.992316** **	**23.003642***
	(12.777441)	(4.205294)			(6.501775)	(9.782792)
lnAsset1	0.426088	**-0.496006** **	1.537822	**0.83339***	0.038035	-0.059971
	(0.558588)	(0.165249)	(1.026376)	(0.38135)	(0.298126)	(0.441467)
CSRManagment	Dropped	Dropped	Dropped	–	Dropped	–
LCSRManagment_R	0.087764	Dropped	Dropped	Dropped	Dropped	**0.133047·**
	(0.055977)					(0.072448)
MarketCSR	**-0.254732** **	Dropped	**-0.804116*** **	–	Dropped	–
	(0.080155)		(0.202626)			
LMarketCSR_R	**-0.261578***	**0.103142*** **	**-0.085350·**	Dropped	Dropped	Dropped
	(0.125021)	(0.028926)	(0.050316)			
SocialCSR	**0.202138*** **	Dropped	**0.186172*** **	–	Dropped	–
	(0.043411)		(0.035235)			
LSocialCSR	**0.262454*** **	**0.138986*** **	**0.145908***	Dropped	**0.089307***	Dropped
	(0.069656)	(0.034909)	(0.059473)		(0.040277)	
LSocialCSR_R	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped
EnvironmentalCSR	Dropped	Dropped	Dropped	–	–	–
LEnvironmentalCSR	Dropped	Dropped	**-0.206238·**	Dropped	–	–
			(0.111963)			
LEnvironmentalCSR_R	**0.359870** **	Dropped	0.077144	Dropped	–	–
	(0.117829)		(0.067347)			
LReporting	**-18.671658*** **	**-10.055479*** **	1.097698	0.73135	Dropped	Dropped
	(4.041760)	(1.838460)	(0.847514)	(0.60415)		
n	32	32	32	32	32	32
T	3--5	3--5	2--4	2--4	3--5	3--5
N	137	137	107	107	137	137
Adjusted R^2	0.61499	0.5219	0.24989	0.092317	0.32323	0.21095
F-statistic	F(8,128)=30.8151, p-value: < 2.22e-16	F(4,132)=39.0004, p-value: < 2.22e-16	F(8,67)=5.56174, p-value: 2.1076e-05	F(2,73)=5.71189, p-value: 0.0049582	F(2,29)=0.412014, p-value: 0.66613	F(2,29)=-8.76251, p-value: 1

Table 2.57 Followers ROA CSR Subindices Estimation Results

Dependent Variable: ROA	Followers ROA PLS IV Est. (3a)		Followers ROA One-way Within IV Est. (3b)		Followers ROA Between IV Est. (3c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**-0.5998554****	**-0.6409869****	–	–	0.1732338	0.1732338
	(0.1960573)	(0.1932338)			(0.1283617)	(0.1283617)
lnAsset1	**0.0277882****	**0.0310443*****	**0.2242939****	**0.1442122***	-0.0057768	-0.0057768
	(0.0089747)	(0.0085543)	(0.0674962)	(0.0613797)	(0.0050700)	(0.0050700)
CSRManagment	Dropped	–	**0.0052717·**	–	Dropped	–
			(0.0031209)			
LCSRManagment_R	Dropped	Dropped	0.0072159	0.0070128	Dropped	Dropped
			(0.0044495)	(0.0047225)		
MarketCSR	0.0018978	–	Dropped	–	Dropped	–
	(0.0016053)					
LMarketCSR_R	**0.0044140***	**0.0045958***	**-0.0068767·**	Dropped	Dropped	Dropped
	(0.0018491)	(0.0018454)	(0.0039414)			
SocialCSR	Dropped	–	0.0099298	–	Dropped	–
			(0.0062743)			
LSocialCSR	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped
LSocialCSR_R	Dropped	Dropped	**0.0087307****	Dropped	–	–
			(0.0031545)			
EnvironmentalCSR	Dropped	–	**-0.0196092*****	–	–	–
			(0.0051836)			
LEnvironmentalCSR	**-0.0114093*****	**-0.0101283*****	Dropped	Dropped	–	–
	(0.0030438)	(0.0028487)				
LEnvironmentalCSR_R	Dropped	Dropped	**-0.0095767****	**-0.0051440*****	–	–
			(0.0033256)	(0.0014154)		
LReporting	Dropped	Dropped	**-0.1951663·**	**-0.2322757·**	Dropped	Dropped
			(0.1166872)	(0.1249209)		
n	–	–	32	32	33	33
T	–	–	2--4	2--4	3--6	3--6
N	137	137	107	107	191	191
Adjusted R^2	0.13036	0.12246	0.35775	0.30505	0.037759	0.037759
F-statistic	F(4,132)=5.16331, p-value: 0.0006764	F(3,133)=6.39941, p-value: 0.00043996	F(9,66)=10.1266, p-value: 1.3218e-09	F(4,71)=15.1039, p-value: 5.5755e-09	F(1,31)=1.29823, p-value: 0.26326	F(1,31)=1.29823, p-value: 0.26326

Table 2.58 Followers TC CSR Subindices Estimation Results

Dependent Variable: lnTotalOperatingCost	Followers TC PLS IV Est. (4a)		Followers TC One-way Within IV Est. (4b)		Followers TC Between IV Est. (4c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**55.7574788*** **	**43.326701*** **	–	–	**38.20309***	**26.591933** **
	(11.8567962)	(3.655810)			(16.81300)	(9.073433)
lnAsset1	**-1.0818000***	**-0.744116*** **	2.212968	**2.237830***	-0.80715	-0.193944
	(0.5012174)	(0.143648)	(1.546721)	(0.987256)	(0.80546)	(0.413311)
CSRManagment	**-0.0957859*** **	–	-0.072123	–	Dropped	–
	(0.0270704)		(0.047495)			
LCSRManagment_R	Dropped	Dropped	-0.122906	**-0.113697·**	Dropped	Dropped
			(0.075517)	(0.062042)		
MarketCSR	**-0.2044996** **	–	-0.232354	–	**0.18099·**	–
	(0.0670687)		(0.192012)		(0.10388)	
LMarketCSR_R	Dropped	**0.124708*** **	Dropped	Dropped	Dropped	Dropped
		(0.025737)				
SocialCSR	**0.2184242*** **	–	**0.161379·**	–	Dropped	–
	(0.0489983)		(0.080615)			
LSocialCSR	**0.1376438***	**0.156253*** **	**0.205471·**	0.034887	Dropped	**0.101618·**
	(0.0547040)	(0.030106)	(0.122394)	(0.033400)		(0.054179)
LSocialCSR_R	Dropped	Dropped	**-0.119701·**	Dropped	–	–
			(0.070645)			
EnvironmentalCSR	**0.0144060·**	–	Dropped	–	–	–
	(0.0077413)					
LEnvironmentalCSR	**0.2632187***	Dropped	**-0.334702·**	-0.059904	–	–
	(0.1121355)		(0.175812)	(0.050812)		
LEnvironmentalCSR_R	**0.1717029*** **	Dropped	**0.192797·**	Dropped	–	–
	(0.0346405)		(0.098657)			
LReporting	**-21.7087505*** **	**-12.035727*** **	**4.851991***	**4.671225***	Dropped	Dropped
	(3.5260304)	(1.738347)	(2.079442)	(2.031273)		
n	–	–	27	27	28	27
T	–	–	1--4	1--4	3--6	2--5
N	111	111	85	85	142	111
Adjusted R^2	0.63729	0.57314	0.20275	0.15054	0.19819	0.2409
F-statistic	F(9,101)=26.2336, p-value: < 2.22e-16	F(4,106)=39.7788, p-value: < 2.22e-16	F(10,48)=2.68882, p-value: 0.010639	F(5,53)=3.37368, p-value: 0.01017	F(2,25)=-8.85824, p-value: 1	F(2,24)=-3.15837, p-value: 1

Table 2.59 The Uncommitted Net Profit CSR Subindices Estimation Results

Dependent Variable: Net Profit	Indifferentist NP PLS IV Est. (1a)		The Uncommitted NP One-way Within IV Est. (1b)		The Uncommitted NP Between IV Est. (1c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	1.1741e+09	**3.0109e+09*** **	–	–	1.8853e+09	1.8853e+09
	(1.2047e+09)	(7.3169e+08)			(1.1688e+09)	(1.1688e+09)
Asset1	**5.4871e-02*** **	**2.9476e-02*** **	**-2.6683e-02** **	**-2.7720e-02** **	**4.2805e-02* **	**4.2805e-02* **
	(1.2967e-02)	(5.5405e-03)	(8.8769e-03)	(8.8628e-03)	(1.5619e-02)	(1.5619e-02)
CSRManagment	**-4.8426e+08* **	–	-8.6992e+07	–	Dropped	–
	(2.2152e+08)		(6.9951e+07)			
LCSRManagment	Dropped	Dropped	**-1.9573e+08·**	-1.4884e+08	-3.7388e+08	-3.7388e+08
			(1.0011e+08)	(9.3002e+07)	(2.2274e+08)	(2.2274e+08)
MarketCSR	–	–	–	–	–	–
LMarketCSR	–	–	–	–	–	–
SocialCSR	**3.5962e+08·**	–	–	–	–	–
	(1.8812e+08)					
LSocialCSR	**-2.6097e+08** **	**-2.8349e+08*** **	–	–	–	–
	(9.1980e+07)	(8.0965e+07)				
EnvironmentalCSR	–	–	–	–	–	–
LEnvironmentalCSR	–	–	–	–	–	–
LReporting	–	–	–	–	–	–
n	–	–	31	31	31	31
T	–	–	3--5	3--5	3--5	3--5
N	129	129	129	129	129	129
Adjusted R^2	0.22659	0.20127	0.097213	0.08772	0.10665	0.10665
F-statistic	F(4,124)=9.56118, p-value: 9.018e-07	F(2,126)=16.351, p-value: 4.8601e-07	F(3,95)=4.81587, p-value: 0.0036392	F(2,96)=6.41398, p-value: 0.0024293	F(2,28)=-5.38102, p-value: 1	F(2,28)=-5.38102, p-value: 1

Notes: Since we could not identify proper IV's for *MarketCSR*, *LMarketCSR*, *EnvironmentalCSR*, and *LEnvironmentalCSR* for all types of models for The Uncommitted, we do not have estimation results for these variables.

Table 2.60 The Uncommitted TR CSR Subindices Estimation Results

Dependent Variable: lnTotalRevenue	The Uncommitted PLS IV Est. (2a)		The Uncommitted One-way Within IV Est. (2b)		The Uncommitted Between IV Est. (2c)	
	I	II	I	II	I	II
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**6.079757****	**6.457742*****	–	–	8.37452	8.37452
	(1.856025)	(1.687314)			(5.67762)	(5.67762)
lnAsset1	**0.561821*****	**0.668579*****	0.146864	0.146864	**0.60458***	**0.60458***
	(0.079868)	(0.073397)	(0.171097)	(0.171097)	(0.25484)	(0.25484)
CSRManagment	Dropped	–	Dropped	–	Dropped	–
LCSRManagment	**-0.213849****	Dropped	**-0.088172·**	**-0.088172·**	0.24937	0.24937
	(0.079922)		(0.050962)	(0.050962)	(0.14973)	(0.14973)
MarketCSR	–	–	–	–	–	–
LMarketCSR	–	–	–	–	–	–
SocialCSR	**0.363735*****	–	–	–	–	–
	(0.072359)					
LSocialCSR	**0.207504*****	**0.180303*****	–	–	–	–
	(0.055157)	(0.036947)				
EnvironmentalCSR	–	–	–	–	–	–
LEnvironmentalCSR	–	–	–	–	–	–
LReporting	–	–	–	–	–	–
n	–	–	31	31	31	31
T	–	–	3--5	3--5	3--5	3--5
N	129	129	129	129	129	129
Adjusted R^2	0.58808	0.51964	0.028016	0.028016	0.38764	0.38764
F-statistic	F(4,124)=48.8532, p-value: < 2.22e-16	F(2,126)=71.619, p-value: < 2.22e-16	F(2,96)=1.87771, p-value: 0.15851	F(2,96)=1.87771, p-value: 0.15851	F(2,28)=-1.61786, p-value: 1	F(2,28)=-1.61786, p-value: 1

Table 2.61 The Uncommitted ROA CSR Subindices Estimation Results

Dependent Variable: ROA	The Uncommitted&Pussyfooters ROA PLS IV Est. (3a)		The Uncommitted&Pussyfooters ROA One-way Within IV Est. (3b)		The Uncommitted&Pussyfooters ROA Between IV Est. (3c)	
	I	I.2	I	I.2	I	I.2
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	0.2255904	**0.3080334***	–	–	0.0232554	-0.13242
	(0.1575480)	(0.1370278)			(0.1889811)	(0.3191339)
lnAsset1	-0.0111003	-0.0091833	**-0.1112309*** **	**-0.1115029*** **	0.0012305	0.009479
	(0.0068719)	(0.0059606)	(0.0107521)	(0.0107699)	(0.0079832)	(0.0143241)
CSRManagment	-0.0118074	–	-0.0028116	–	Dropped	–
	(0.0083220)		(0.0024074)			
LCSRManagment	Dropped	Dropped	**-0.0061567·**	-0.0046579	Dropped	-0.0079733
			(0.0034494)	(0.0032079)		(0.0084160)
MarketCSR	–	–	–	–	–	–
LMarketCSR	–	–	–	–	–	–
SocialCSR	0.0192384	–	–	–	–	–
	(0.0136636)					
LSocialCSR	-0.0040690	-0.0040570	–	–	–	–
	(0.0034194)	(0.0030005)				
EnvironmentalCSR	–	–	–	–	–	–
LEnvironmentalCSR	–	–	–	–	–	–
LReporting	–	–	–	–	–	–
n	–	–	31	31	31	31
T	–	–	3--5	3--5	3--6	3--5
N	129	129	129	129	177	129
Adjusted R^2	0.05769	0.04327	0.39653	0.39578	0.000766	0.019415
F-statistic	F(4,124)=1.97929, p-value: 0.10174	F(2,126)=2.92029, p-value: 0.057577	F(3,95)=36.943, p-value: 6.5146e-16	F(2,96)=54.5258, p-value: < 2.22e-16	F(1,29)=0.0237581, p-value: 0.87857	F(2,28)=-7.0706, p-value: 1

Table 2.62 The Uncommitted TC CSR Subindices Estimations Results

Dependent Variable: lnTotalOperatingCost	The Uncommitted TC PLS IV Est. (4a)		The Uncommitted TC One-way Within IV Est. (4b)		The Uncommitted TC Between IV Est. (4c)	
	I	I.2	I	I.2	I	I.2
Variables	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
(Intercept)	**5.544305***	**5.000500***	–	–	5.82577	5.82577
	(2.198774)	(2.042495)			(5.89579)	(5.89579)
lnAsset1	**0.520715*** **	**0.726141*** **	0.15641	0.151284	**0.71962***	**0.71962***
	(0.098667)	(0.087584)	(0.23606)	(0.236996)	(0.25473)	(0.25473)
CSRManagment	**-0.267740***	–	Dropped	–	Dropped	–
	(0.110808)					
LCSRManagment	Dropped	Dropped	Dropped	-0.060758	0.21793	0.21793
				(0.080882)	(0.14003)	(0.14003)
MarketCSR	–	–	–	–	–	–
LMarketCSR	–	–	–	–	–	–
SocialCSR	**0.645733*** **	–	–	–	–	–
	(0.188658)					
LSocialCSR	**0.111947***	**0.192496*** **	–	–	–	–
	(0.045660)	(0.039816)				
EnvironmentalCSR	–	–	–	–	–	–
LEnvironmentalCSR	–	–	–	–	–	–
LReporting	–	–	–	–	–	–
n	–	–	23	23	23	23
T	–	–	2--5	2--5	2--5	2--5
N	86	86	86	86	86	86
Adjusted R^2	0.61816	0.5695	0.005069	0.011443	0.37897	0.37897
F-statistic	F(4,81)=38.6712, p-value: < 2.22e-16	F(2,83)=59.7406, p-value: < 2.22e-16	F(1,62)=0.439017, p-value: 0.51005	F(2,61)=0.500113, p-value: 0.60893	F(2,20)=-0.156494, p-value: 1	F(2,20)=-0.156494, p-value: 1

2.6 Limitations and Conclusions

In this paper, we did a first empirical study of CSR performance, CSR reporting and financial performance based on panel data of top firms from China right after CSR regulation to present (from year 2007 to year 2013).

We found that both current year CSR performance and lagged CSR performance have impacts on firms' financial performance. And we found that the impacts of lagged unreported CSR performance are different from lagged reported CSR performance on net profit, total revenue (TR), ROA, and total operating cost (TC). We also found that the impacts of lagged reported CSR performance in the short run are different from impacts in the long run. In the short run, the impacts of lagged reported CSR performance on profitability tend to be negative. However, in the long run, the impacts of lagged reported CSR performance on profitability tend to be positive. These findings are very likely suggesting a signaling effect of lagged reported CSR performance to firms who report their CSR performance and the signaling effect may take time to happen. In another word, it requires firms to keep publishing their CSR performance reports for a while to get the signaling effect benefit. And in the long run, better lagged CSR performance tends to increase TC.

Particularly, we found a conditional impact pattern of lagged reported CSR performance on net profit, TR and TC by pooled OLS IV estimations. The conditional impact pattern is that when lagged reported CSR performance is beyond a critical level the impact of lagged reported CSR performance on profitability is positive, while when lagged reported CSR performance is below this critical level the impact of lagged reported CSR performance on profitability is negative. The critical level is around 30 pts based on a 100 pts CSR performance index from our empirical analysis.

We differentiated firms into three types: Leaders, Followers, and The Uncommitted, based on their CSR reporting records and conduct partitioned regressions for each group. For Leaders, who initiated CSR reporting before or since 2008 and keep publishing CSR reports every year, we found a positive signaling effect of lagged CSR performance in the long run although better lagged CSR performance will also result in higher TC in the long run. Overall, better lagged CSR performance may increase the net profit for Leaders in the long run while reduce the net profit in the short run. For Followers, who initiated CSR reporting after 2008 and keep publishing CSR reports every year, we found a conditional impact patter of lagged reported CSR performance on net profit, TR and TC as we found on full sample regressions by pooled OLS IV estimations. And the critical level for Followers is around 50 pts based on a 100 pts CSR performance index. In the long run, we found a weak TR increasing effect, a net profit increasing effect and a weak TC increasing effect of better lagged reported CSR performance on Followers. For The Uncommitted who never publish CSR report or only publish CSR reports once or twice discontinuously between 2008 and 2013, we found negative effect of lagged CSR performance on net profit, TR and ROA and we didn't found significant effect of lagged CSR performance on TC. These results may suggest that although The Uncommitted almost never publish CSR reports and there seems no way for stakeholders to acquire direct information from The Uncommitted firms to determine their moral evaluation types, adverse selection by stakeholders may happen by judging from firms' silence in no CSR reporting and third party evaluation of The Uncommitted firms' CSR performance.

In general, the results suggest that current year CSR performance tends to have a positive impact on firms' profitability. This link may be ascribed to two explanations. First, it might be due to the construction of market CSR performance subindex itself which includes evaluating a firm's net profit and total revenue. Second, it may be due to improved stakeholder relationship or production efficiency induced by some items in CSR management performance subindex and social CSR performance subindex.

We further investigated the links between four aspects of CSR performance and firms' financial performance. The estimation results suggest that the links between CSR subindces and financial performance are much more complicated than what we expected. The strength and the direction of the link may depend on a firm's CSR reporting records type, how a firm practices CSR, and time horizon. Overall, social CSR performance has the most consistent positive effects on profitability among full sample and all types and also four CSR subindices. While lagged market CSR performance has larger impacts on full sample net profit and CSR management performance also has a positive effect on full sample TR. Besides, Leaders' management CSR performance has stronger link with financial performance while Followers' market CSR performance has stronger link with financial performance. The link between environmental CSR performance and financial performance is very limited and in general negative, considering that we were not able to include lagged environmental CSR performance variables in partitioned regressions for Leaders and The Uncommitted since we could not find proper IV's for these variables for both of them.

It is also needed to mention that there exist high correlations among CSR sub-indices variables (based on both Pearson product-moment correlation and variance inflation factor method) even if we've used IV for all of the CSR sub-indices variables. The VIF (variance inflation factor) rule of thumb is not helpful for us to decide which CSR sub-indices variable to drop since there is high Pearson product-moment correlation among all pair-wise CSR sub-indices variables. We choose to keep all CSR sub-indices variables since they are variables of interest and to avoid the bias caused by dropping variables. However, keeping all CSR sub-indices variables may cause a problem of larger variance to the estimates and some variables of interest may become insignificant.

For future studies, there are three directions worth exploring.

First, it would be interesting to study dynamic models on how the critical value of conditional impacts of lagged reported CSR performance evolves over the time, which may portray the evolution of signaling effects over the time, conditioning on overall CSR performance. The critical value may reflect the social expectation of the CSR performance level of a responsible firm. However, to study dynamic models, it requires more time periods which are beyond the capability of our current panel data set.

Second, the function of CSR reports as valid signals lies heavily on the trustworthiness of CSR reports considering their self-publishing feature. In job market signaling model (Spence, 1972), a critical prerequisite is that education can truthfully reflect a worker's ability as an authority-report. In CSR reports mechanism, a key condition is that CSR reports truthfully reflect CSR performance of a firm. Thus, the quality of CSR reports is crucial for it becomes trustable self-report signals. It would be worth to explore both theoretically and empirically how the quality of self-report signals would influence the equilibrium. Currently, limited quantitative measurement of CSR reports has been developed. It would be valuable to explore this issue when effective quantitative measurements of CSR reports are developed in future.

Third, it would be helpful to further investigate in detail how firms practice each CSR sub-index aspect to help us understand firms' CSR practice more deeply and make the conclusion of the impacts of CSR sub-indices on financial performance more persuasive.

Chapter 3
An Evaluation of Effects of Global Corporate Social Responsibility Reporting Regulation on Sustainable Development

3.1 Introduction

The energy security, the accelerating global warming and the continuing rise of world air pollution at an alarming rate have gained widely attention in recent years. It is estimated that global proved oil reserves in 2016 would only be sufficient to meet 50.6 years of global production at 2016 levels (BP, 2017). The year 2016 was the warmest on record in all major global surface temperature datasets since 1850, with Carbon dioxide (CO2) reached new highs in the atmosphere and global sea levels reached new record highs as well (WMO, 2016). Globally, it is estimated that 92% of the world's population reside in areas exceeding the World Health Organization's (WHO) air quality guidelines (an annual mean of 10 $\mu g/m^3$) (G. Shaddick et al., 2018) and the global population-weighted annual average PM 2.5 concentrations were 3-fold higher than WHO guideline (A. van Donkelaar et al, 2016), which dramatically increases the risk of heart disease, lung cancer and other chronic and acute respiratory diseases.

Greenhouse gas emissions and air pollution are important both to policy makers and to the world sustainable development. However, as a new policy tool to address above sustainable development issues, no evaluation of the effectiveness of global CSR regulation has been done yet.

In this chapter, I provide the first systematic evaluation of the impact of global CSR regulation on sustainable development, including the impact on energy intensity, CO_2 emissions, and $PM_{2.5}$ pollution levels. I conducted my investigation by analyzing a global panel dataset of 25 countries between 2000 and 2014. To examine the impact of CSR on energy intensity, I followed Fisher-Vanden, Jefferson, Liu and Tao (2004) and used a reduced form model to investigate whether CSR regulation may urge firms to use energy more efficiently or prudently and further reduce a nation's energy intensity. Since I use macro level time series data, panel unit root test and panel cointegration analysis are used to explore the relations. To examine the impact of CSR regulation on CO_2 emissions, I started from Kaya identity (Yamaji, Matsuhashi, Nagata & Kaya, 1991), which gives an exact decomposition of CO_2 emissions into four factors, and then focused on examining the impact of CSR regulation on the key factor of carbon intensity of energy by using panel cointegration analysis. To examine the impact of CSR regulation on $PM_{2.5}$ pollution level, I used a dynamic panel model and adopted a recently developed econometric method, panel fully aggregated estimator (PFAE) by using X-differencing procedure proposed by Han, Phillips, and Sul (2014) which has strong asymptotic and finite sample performance characteristics that dominate other procedures such as bias corrected least squares (LSDVC), generalized method of moments (GMM), and system GMM methods.

For energy intensity, I find that 3-year lag of the inventory of environmental CSR (CSR3) reporting policies has a significant positive impact on energy intensity. This might be due to the reason that all CSR reporting policies on pollution abatement and pollution control are classified into the category of environmental CSR policies. More environmental CSR policies on pollution control may have a significant effect on increasing the cost to producers to meet the requirements or expected standards in the short run. However, it is likely that the cost on pollution control or abatement may be balanced over a longer time period and the negative effect on firms' energy efficiency may disappear in the long run.

Besides, I also find that the environmental policy stringency index (EPS), R&D, and the relative price of aggregate energy price (AEPoP) have significant effects on reducing energy intensity. However, both EPS and AEPoP are estimated to first increase the energy intensity and then reduce the energy intensity. A detailed discussion on how to interpretation this composite impact pattern is provided.

For impacts on CO_2 emissions, the result suggests that there is no evidence that CSR policies have any significant impact on reducing CO_2 emissions of a country. However, the result indicates that the renewable energy consumption rate, 6-year lag of EPS and 4-year lag of the number of CO_2 emissions abatement technology patents have significant impacts on reducing carbon intensity of energy of a country.

For impacts on $PM_{2.5}$ pollution level, it is found that both the current period and 3-yer lag of inventory of general sustainability CRS reporting regulation policies (CSR1) have significant impacts on reducing $PM_{2.5}$ pollution levels. The 95% C.I.'s of elasticity of annual mean $PM_{2.5}$ exposure with respect to the inventory of current period CSR1 is [0.036%, 0.166%]. And the 95% C.I.'s of elasticity of annual mean $PM_{2.5}$ exposure with respect to the inventory of 3-year lag of CSR1 is [0.040%, 0.178%]. The inventory of 3-year lag of environmental CSR reporting regulation policies (CSR3) is also estimated to have a negative impact on $PM_{2.5}$ pollution levels. The 95% C.I.'s of elasticity of annual mean $PM_{2.5}$ exposure with respect to the inventory of 3-year lag of CSR3 is [0.008%, 0.074%].

Also, I found that EPS has a significant impact on reducing the $PM_{2.5}$ pollution level. However, total CO_2 emissions and the CO_2 emissions from solid fuel combustion have significant impacts on increasing the $PM_{2.5}$ pollution level. Particularly, an interesting result is obtained for the number of ISO14001 certificates (*ISO14001*). It is estimated that the level form of *ISO14001* has a significant positive impact on *PM2.5* while the first difference of *ISO14001* has a significant negative impact on *PM2.5*. The positive correlation might reflect an inverse causality that the increasing number of *ISO14001* certificates is driven by $PM_{2.5}$ pollution level. Higher $PM_{2.5}$ pollution level may cause more public concern on air quality which may provide firms more incentives to seek ISO14001 certificates to stand out in the market. Since the monitoring system of ISO 14001 certificates is based on a five-year review, due to the moral hazard problem, it seems that only firms which newly obtain ISO14001 certificates bring a significant impact on reducing $PM_{2.5}$ pollution level.

In section 3.2, a brief review on CSR regulation and sustainable development will be provided. In section 3.3, section 3.4, section 3.5 and section 3.6, the literature review, methodology, the data description, and results for energy intensity, CO_2 emissions, and $PM_{2.5}$ pollution level are provided in each section separately. In section 3.7, conclusions and policy implication are drawn.

3.2 CSR Reporting Regulation and Sustainable Development

The sustainable development is the primary goal of CSR reporting regulation. Up to 2015, 73.22% of global CSR reporting regulation instruments are related with firms' environmental CSR performance and 38.25% are related with general sustainability (Carrots&Sticks, 2016). In *G4 Sustainability Reporting Guidelines* (GRI, 2015), which has been mentioned, recommended, or required by 40 countries and regions' governments in their total 70 CSR reporting regulation instruments (*GRI referred in policy &regulation*, GRI), sustainability is suggested to be the central framework of a firm's CSR report. The impacts on inputs (such as energy) and outputs (such as emissions) are suggested to be indicators of a firm's environmental sustainability performance in *G4 Sustainability Reporting Guidelines* (G4). Particularly, detailed guidelines on reporting on energy consumption within and outside the organization, energy intensity, reduction on energy consumption, reduction on energy requirements of products and services, direct GHG emissions, energy indirect GHG emissions[9], GHG emissions intensity, reduction of GHG emissions, NO_X, SO_X, and other significant air emissions including particulate matter (PM) are included in G4.

3.3 Energy Intensity

3.3.1 Literature review on empirical analysis of energy intensity

The energy intensity is one of the commonly used ways to measure the energy efficiency of a nation's economy. According to the International Energy Agency (IEA), "Energy efficiency is a way of managing and restraining the growth in energy consumption. Something is more energy efficient if it delivers more services for the same energy input, or the services for less energy input (IEA, 2011)". Thus, the energy intensity is calculated as units of energy used per unit of GDP.

The commonly used approach in empirical analysis of energy intensity is the index decomposition analysis (IDA), a technique which has been increasing used since the late 1970s. It was not long after the 1973/1974 world oil crisis that energy researchers began to look for ways to quantify the impact of structural shift in industry production on total energy demand to have a better understanding of the change in energy usage. They developed simple decomposition techniques to separate the impact associated with industrial activity composition, i.e. structural effect, and the impact associated with changes in sectoral energy intensity, i.e. intensity effect (Ang & Zhang, 2000).

Specifically, the IDA on aggregate energy intensity is as follows. Assume that the aggregate energy consumption is the sum of consumption in m sectors. Define the following variables for year t:

E_t =Total industrial energy consumption

$E_{i,t}$ =Energy consumption in industrial sector i

Y_t =Total industrial production

$Y_{i,t}$ =Production of industrial sector i

$S_{i,t}$ =Production share of sector i (=$Y_{i,t}/Y_t$)

[9] Energy indirect emissions are emissions from the generation of purchased electricity, heating, cooling, and steam consumed within the organization (G4, pg.57).

I_t =Aggregate energy intensity (=E_t/Y_t)

$I_{i,t}$ =Energy intensity of sector i (=$E_{i,t}/Y_{i,t}$)

The aggregate energy intensity is then expressed as a summation of the sectoral data:

$$I_t = \sum_i S_{i,t} I_{i,t}$$

The aggregate energy intensity change from I_0 to I_T can be expressed in two ways:

$$D_{tot} = \frac{I_T}{I_0} = D_{str} D_{int} \quad (multiplicative\ decomposition)$$

$$\Delta I_{tot} = I_T - I_0 = \Delta I_{str} + \Delta I_{int} \ (additive\ decomposition)$$

To proceed, there are two basic decomposition schemes: Laspeyres index method and Divisia index method. The Laspeyres index method follows the method of Laspeyres price and quantity indices. It isolates the impact of a variable through letting this specific variable change while holding other variables at their base year values. The formulae of Laspeyres based multiplicative decomposition are (Ang & Zhang, 2000):

$$D_{str} = \sum_i S_{i,T} I_{i,0} / \sum_i S_{i,0} I_{i,0}$$

$$D_{str} = \sum_i S_{i,0} I_{i,T} / \sum_i S_{i,0} I_{i,0}$$

$$D_{rsd} = D_{tot} / (D_{str} D_{int})$$

where residual term D_{rsd} denotes the part of D_{tot}which is left unexplained. Similarly, the formulae of Laspeyres based additive decomposition are:

$$\Delta I_{str} = \sum_i S_{i,T} I_{i,0} - \sum_i S_{i,0} I_{i,0}$$

$$\Delta I_{int} = \sum_i S_{i,0} I_{i,T} - \sum_i S_{i,0} I_{i,0}$$

$$\Delta I_{rsd} = \Delta I_{tot} - \Delta I_{str} - \Delta I_{int}$$

The Divisia index method is an integral-based index introduced by Divisia (Divisia, 1925). It first differentiates I_t with respect to t and yields

$$I'_t = \sum_i I_{i,t} S'_{i,t} + \sum_i I'_{i,t} S_{i,t}$$

To acquire the multiplicative decomposition, dividing both sides of the equation above by I_t and integrating both sides from year 0 to year T yields (Ang, 1994):

$$\ln(I_T/I_0) = \int_0^T \left(\sum_i \frac{I_{i,t} S'_{i,t}}{I_t}\right) dt + \int_0^T \left(\sum_i \frac{I'_{i,t} S_{i,t}}{I_t}\right) dt$$

Let $\omega_i = E_{i,t}/E_t$, then the multiplicative decomposition can be expressed as (Ang & Zhang, 2000):

$$D_{str} = exp\left\{\int_0^T \sum_i \omega_i[dln(S_{i,t})/\,dt]\right\}$$

$$D_{int} = exp\left\{\int_0^T \sum_i \omega_i[dln(I_{i,t})/\,dt]\right\}$$

The additive decomposition of Divisa index method integrates $I'_{i,t}$ and can be expressed as (Ang & Zhang, 2000):

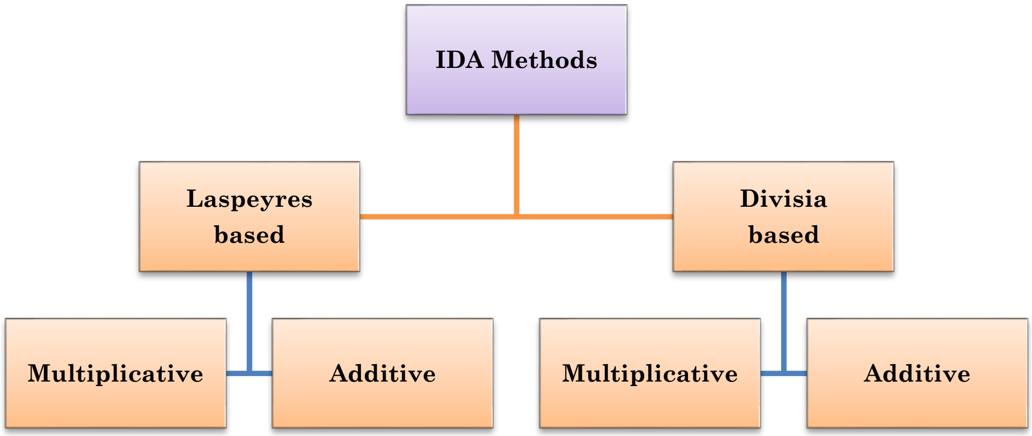
$$\Delta I_{str} = \sum_i \tau_i \ln(\frac{S_{i,T}}{S_{i,0}})$$

$$\Delta I_{int} = \sum_i \tau_i \ln(\frac{I_{i,T}}{I_{i,0}})$$

where $\tau_i = E_{i,t}/Y_t$. In empirical studies, there are different ways to approximate the weight function ω_i and τ_i by using discrete data. The arithmetic mean Divisia index method simply takes the average of the base year weight and the end year weight to approximate, e.g. $\omega_i = (\omega_{i,0} + \omega_{i,T})/2$ (Ang & Zhang, 2000). While adaptive weighting Divisia index method allows the weight ω_i and τ_i to change from year to year as output and energy consumption change (Greening, Davis, Schipper, & Khurshch, 1997). And there are other weight approximation methods as well. In practice, the arithmetic mean Divisia index with a rolling base year has been applied to the United States (Department of Energy, 1995).

Since the late 1970s, the IDA has been extensively used in energy and energy-related environmental analysis and different decomposition methods have been developed continuously. By 2000, a survey of IDA in energy and environmental studies (Ang & Zhang, 2000) documented 124 studies which used IDA. By 2015, there are more than 500 archival journal articles (in English) on IDA (Ang, 2016). An early work by Greening, Davis, Schipper, & Khurshch (1997) compared six different decomposition methods of aggregate energy intensity. They found that the adaptive weighting Divisia index method, in either a fixed year or a rolling year specification, is most robust, exhibiting the smallest residual term with the leas variation. Figure 3.1 summarizes a general framework of IDA.

Figure 3.1 A General Framework of IDA Methods



Although the IDA methods have the merit of decomposing the aggregate energy intensity into the structural effect and the intensity effect, it has the limitation to further link the factors which might have impacts on energy consumption with energy intensity. Recently, some empirical studies began to introduce econometric analysis into the empirical energy intensity analysis. Fisher-Vanden, Jefferson, Liu & Tao (2004) used a reduced form model from cost minimization and explained successfully why the energy intensity in China has fallen almost continuously since the onset of economic reform in the late 1970s. They found that rising relative energy prices, R&D expenditures, and the ownership reform in the enterprise sector, as well as shifts in China's industrial structure, are principle drivers of China's declining energy intensity. The merit of their method is that they provide a clear theoretical foundation for what efficiency determinants should be included in the empirical analysis and their results are consistent with the theoretic prediction. In addition, their method is flexible which allows incorporating new factors, such as CSR reporting regulation, in examining the associated factors on energy intensity. Metcalf (2008) regressed the energy intensity, which was measured by the ratio of total energy consumption to personal income[10], on a set of economic and weather variables to analyze the determinants of the energy intensity of 48 U.S. states between 1970 and 2001. He found that rising per capita income and higher energy prices have important roles in lowering energy intensity.

[10] Metcalf (2008) didn't use GDP due to a structural break in 1997 in U.S. GDP data.

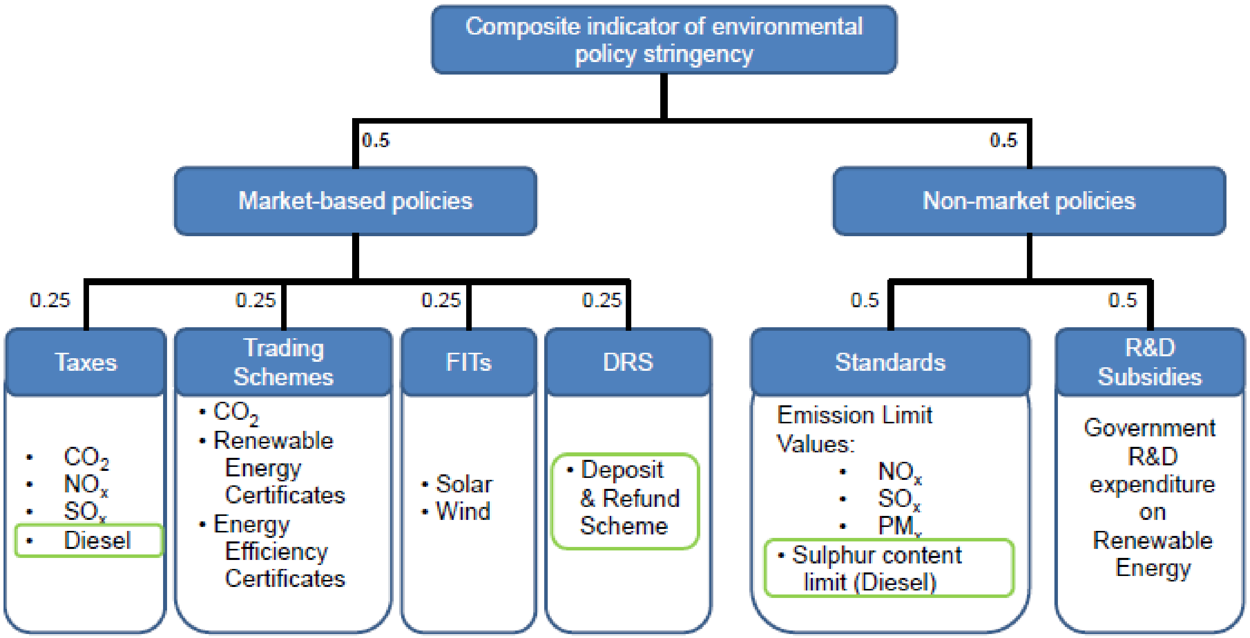
3.3.2 Methodology

The empirical model on energy intensity is derived following Fisher-Vanden, Jefferson, Liu & Tao (2004). To examine the impact of CSR reporting regulation on energy intensity, I assume that a firm may use the energy more efficiently or prudently due to the CSR reporting regulation. This impact is equivalent to "increase" the price of energy input. To avoid the endogeneity problem, I've also included factors of instruments of environmental policy related with energy and environmental policy stringency. The impact of these environmental policies can be viewed as explicit or implicit changes to the energy price. Thus, I assume a Cobb-Douglas cost function derived from cost minimization as:

$$C(P_K, P_L, P_E, P_M, Q) = \rho A^{-1} P_K^{\alpha_K} P_L^{\alpha_L} (CSR^{\gamma_1} EPS^{\gamma_2} P_E)^{\alpha_E} P_M^{\alpha_M} Q \quad (1)$$

where Q is the quantity of output, $P_K$is the price of capital input, $P_L$is the price of labor input, P_E is the aggregate energy price, *CSR* is the number of the inventory of general sustainability or environmental CSR reporting regulation instruments, *EPS* is the environmental policy stringency index, $P_M$is the price of materials input, $\alpha_x$is the elasticity of cost with respect to input price *X* (*X*=*K, L, E, M*) and $\sum_x \alpha_x = 1$, A is the total productivity factor (TPF), and ρ is a constant which only contains α_x. The environmental policy index (*EPS*) is a composite policy index developed by OECD. It is by far the first internationally comparable measures of the stringency of environmental policies over a relatively long time horizon. *EPS* is defined by explicit or implicit, cost of polluting or environmentally harmful behavior (Botta and Koźluk, 2014), which is measured by evaluated stringency scores of both market-based policies, including taxes, trading schemes, feed in tariff for wind and solar, deposit & refund scheme, and non-market policies, including emissions limit standards and R&D subsidies on renewable energy. The structure of *EPS* indicator is shown in Figure. The details of the construction of *EPS* indicator can be referred to Figure 3.2 from Botta and Koźluk (2014).

Figure 3.2 Structure of economy-wide indicator: environmental policy stringency index (EPS)



Source: Figure 4 in Botta and Koźluk (2014).

In fact, this cost function could be derived from cost minimization with a Cobb-Douglas production function $\mathrm{Q} = AK^{\alpha_K}L^{\alpha_L}E^{\alpha_E}M^{\alpha_M}$ and a linear cost structure of $\mathrm{C} = P_K K + P_L L + \tilde{P}_E E + P_M M$, where $\tilde{P}_E = CSR^{\gamma_1}EPS^{\gamma_2}P_E$ is the composite energy price which has taken policy factors into consideration. According to a recent comprehensive literature review of economy-level determinants of TPF by Isaksson (2007), creation of knowledge proxied by R&D is identified as the most important determinant of an economy's TPF. Albrizio et al. (2014) study the effects of environmental policy stringency on productivity growth for 19 OECD countries over the 1990-2010 period by using EPS as a proxy. They find that one year ahead of EPS change has a negative on productivity growth while 2-year lag and 3-year lag of EPS changes have a positive effect on productivity growth. Therefore, for the baseline model, A is specified as

$$\mathrm{A} = \exp\left(\theta_0 + \theta_1 lnRDE + \sum_{k=-1}^{j} \theta_{2k} EPS_{t-k}\right) \tag{2}$$

where RDE is the aggregate R&D expenditure.

By Shephard's Lemma, the factor demanded for an input is equal to the derivative of the cost function with respect to the input price. Therefore, the factor demand for energy is:

$$\mathrm{E} = \frac{\alpha_E \rho A^{-1} P_K^{\alpha_K} P_L^{\alpha_L} \tilde{P}_E^{\alpha_E} P_M^{\alpha_M} Q}{P_E} \tag{3}$$

Let the output price

$$P_Q = P_K^{\alpha_K} P_L^{\alpha_L} \tilde{P}_E^{\alpha_E} P_M^{\alpha_M} \tag{4}$$

The factor demand for energy can be simplified to be:

$$\mathrm{E} = \frac{\alpha_E \rho A^{-1} P_Q Q}{\tilde{P}_E} \tag{5}$$

Then, we can obtain an equation of energy intensity as:

$$\frac{E}{Q} = \frac{\alpha_E \rho A^{-1} P_Q}{\tilde{P}_E} \tag{6}$$

By substituting for A specified before and taking the log for both sides, we have the following reduced form model for energy intensity for panel data:

$$\ln\left(\frac{E}{Q}\right)_{it} = \theta_1 lnRDE_{it} + \beta_1 \ln\left(\frac{P_E}{P_Q}\right)_{it} + \beta_2 CSR_{it} + \sum_{k=-1}^{j} \beta_{3k} EPS_{t-k} + \alpha_i + T_t + \varepsilon_{it} \tag{7}$$

where α_i is the fixed individual effect, $\gamma_i t$ is an individual specific time trend, T_t is the common time dummy which captures the common time shock, ε_{it} is the error term. Since CSR policies may have lead and lag effects as EPS as well, we extend the reduced model to allow lag structures for CSR policies as well. The augmented model is as follows:

$$\ln\left(\frac{E}{Q}\right)_{it} = \theta_1 lnRDE_{it} + \beta_1 \ln\left(\frac{P_E}{P_Q}\right)_{it} + \sum_{k=-1}^{m} \beta_{2k} CSR_{it-k} + \sum_{k=-1}^{j} \beta_{3k} EPS_{it-k} + \alpha_i + T_t + \varepsilon_{it} \tag{8}$$

Due to the relative short time length we have in the panel data, we limit the max lag structure to be 3-year lag. To be more concise, we use $AEPoP_{it}$ instead of $\left(\frac{P_E}{P_Q}\right)_{it}$ hereafter.

3.3.3 Data

The data of energy intensity of primary energy, R&D, and GDP is collected from World Bank. I also refer to *2016 Global R&D Funding Forecast* (*R&D Magazine*, Winter 2016) for the most recent years' R&D data which is not included in World Bank's data.

The CSR reporting regulation data is collected from Carrots&Sticks website.

The environmental policy stringency index (EPS) data is also collected from OECD.Stat. For some countries, EPS data is missing for 2013 and 2014. I use the EPS value in 2012 as estimated value of EPS in 2013 and 2014 for these countries.

The aggregate energy price is constructed by using total producer energy prices index by country from OECD.Stat, real energy prices by country including heavy fuel oil prices for industry, natural gas prices for industry, and steam coal prices for industry from *Key World Energy Statistics* (IEA, 2003, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014) and Zambia Data Portal hosted by Zambia Central Statistical Office, and the energy consumption amount by country from *BP Statistical Review of World Energy 2017* underpinning data (BP, 2017). First, for each country, I calculate the weighted sum of oil prices, gas prices and coal prices weighting by the consumption amount for a certain year. Second, I use total producer energy prices index to recover aggregate energy prices over 2000-2014 in 2010 US $. The motivation of doing such recovery is out of the consideration that the producer energy prices index might be a more accurate reflection of the aggregate energy price faced by producers than a weighted sum of energy prices. For countries whose total producer energy prices index is not available, I use weighted sum of energy prices for all years. For countries whose real energy prices are not available, I use energy market prices from which a country mostly imports from. The energy market prices are also from *BP Statistical Review of World Energy 2017* underpinning data (BP, 2017). In a rare case of China, the real energy prices are taken from China Energy Databook version 9.0 from Lawrence Berkeley National Laboratory Energy Analysis & Environmental Impacts Division China Energy Group.

The output price P_Q is approximated by price level of real consumption of households and the government at current PPPs (in mil. 2011US$) from Penn World Table 9.0.

The descriptive statistics are provided in Table 3.1. The descriptive graphs of energy intensity in logarithm of countries in the sample are provided in Figure 3.3. Most countries exhibit a decreasing trend in the energy intensity over the time.

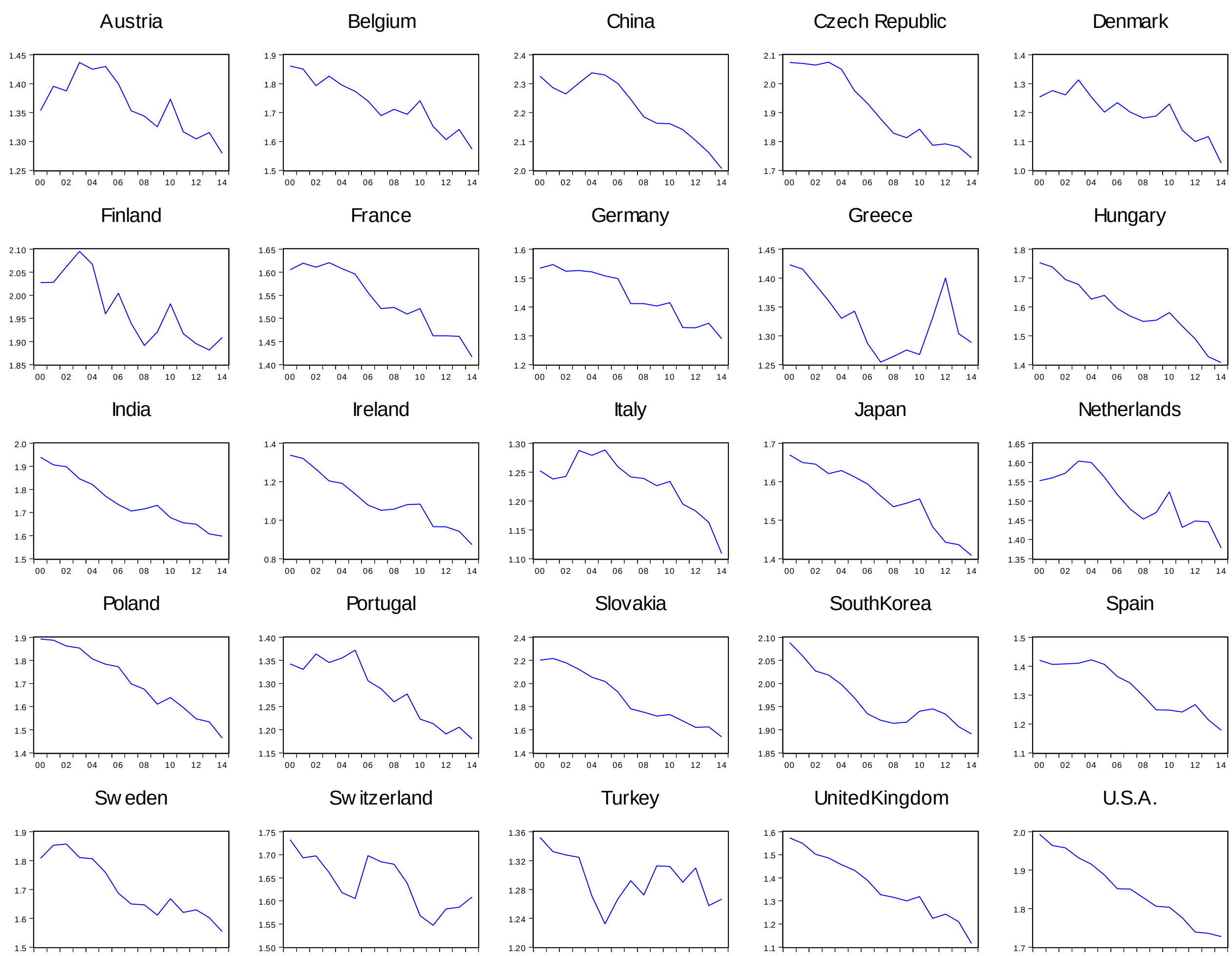
Table 3.1 Descriptive statistics of variables in the panel data set

Variable	Mean	S.D.	Min	Max
(E/Q)	5.07	1.60	2.39	10.36
RDE	3.93e+12	8.12e+12	2.30e+10	4.46e+13
AEPoP	413.66	210.02	81.36	1049.78
CSR1	0.74	1.19	0	7
CSR3	1.93	2.37	0	12
EPS	2.24	0.83	0.52	4.13

Note:

1. All variables in the level forms.
2. The aggregate energy price is a weighted average of prices of heavy fuel oil ($/tonne), natural gas for industry ($/10^7kcal GCV), and steam coal for industry ($/tonne) in 2010 US$. Thus, *AEPoP* is not a percentage.

Figure 3.3 The graphs of energy intensity in logarithm of countries in the sample



3.3.4 Results

After matching the data, a panel data set of 25 most developed countries and main developing countries over 2000 to 2014 is formed. The list of 25 countries in the sample is provided in Table 3.2.

Table 3.2 The list of 25 countries in the sample

Austria	Finland	India	Poland	Sweden
Belgium	France	Ireland	Portugal	Switzerland
China	Germany	Italy	Slovakia	Turkey
Czech Republic	Greece	Japan	South Korea	United Kingdom
Denmark	Hungary	Netherlands	Spain	U.S.A.

Since we are using macro time series data, we conduct panel unit root tests first to check whether series are stationary or not before we estimate the model.

3.3.4.1 Panel Unit Root Tests

Theoretically, panel unit root tests are extensions of unit root tests on a single series to multiple series in panel data. However, there are important differences. Depending on what assumptions are made on the autoregressive coefficients, panel unit root tests can be classified into two categories. Consider a following AR(1) process for panel data:

$$y_{it} = \rho_i y_{it-1} + X_{it}\beta_{it} + \epsilon_{it} \tag{9}$$

where $i = 1, 2, \ldots, N$ denotes the cross-section units; $t = 1, 2, \ldots, T$ denotes time periods; X_{it} are exogeneous variables in the model which may include fixed effects or individual trends; ρ_i are autoregressive coefficients and ϵ_{it} are assumed to be mutually independent idiosyncratic disturbances. If $|\rho_i| < 1$, y_{it} is considered to be weakly stationary. If $|\rho_i| = 1$, then y_{it} will contain a persistent trend which is non-stationary and is said to have a unit root.

In the literature, there are two different assumptions on ρ_i. One assumption assumes that $\rho_i = \rho$ for all i. In another word, it assumes that multiple series in the panel data are *homogenous* and follow the same autoregressive process. Under this assumption, there are

t-ratio based tests including Levin, Lin and Chu (2002) and Breitung (2000), and residual based test like Hadri (2000). The feature of these tests is that they pool the cross-section units data together and calculate one test statistic based on the pooled data. The other assumption assumes allows ρ_i to vary across cross-section units. In another word, it allows that multiple series in the panel data are *heterogenous* and follow different autoregressive processes. Under this assumption, there are t-ratio based test like Im, Pesaran, and Shin (2003), and p-values based tests like Maddala and Wu (1999) and Choi (2001). The feature of these tests is that they first calculate an individual test statistic for each cross-section unit separately and then use the average statistic or the distribution function of individual statistics to conduct the panel unit root test.

In our case, since different countries are at different economic development stages and have different institutions and economic environment which may moderate the value of the autoregressive coefficient, it is more natural to assume that ρ_i to vary across cross-section units. Therefore, we select Im, Pesaran, and Shin (2003) t-ratio based test, to conduct the panel unit root test. We first explore the descriptive graphs of each series to see whether there is an apparent trend. The graphs are listed in the Appendix B.1. There are apparent trends in energy intensity, R&D, CSR1, CSR3, and EPS for most countries in the panel. No apparent trend is found for AEPoP. The IPS (2003) unit root tests are done by using EViews 10. The results are reported in Table 3.3. The results indicate that we fail to reject the H_0: All of the series are $I(1)$, i.e. $\rho_i = 1 \; \forall i$, for energy intensity, CSR1 and CSR3 without trend. Although H_0 for EPS is rejected at significant level of 5%, by further checking the individual ADF test results for each country, only 4 countries (Finland, Hungary, South Korea, and Sweden) reject the hypothesis that $\rho_i = 1$ at the significant level of 5%. In another word, all other 21 countries fail to reject the hypothesis that $\rho_i = 1$ in individual ADF tests. Thus, we still take EPS without trend as $I(1)$. For R&D, we also further checked the individual ADF test results for each country. The individual ADF test results show that only 3 countries (Germany, Hungary, and Spain) reject the hypothesis that $\rho_i = 1$ at the significant level of 5%. Therefore, we take R&D without trend as $I(1)$. Similarly, for 25 series of AEPoP in the panel, we only find 3 countries (Germany, Italy, and Netherlands) reject the hypothesis that $\rho_i = 1$ at the significant level of 5%. Thus, we take AEPoP without trend as $I(1)$ as well.

In the situation with the trend, for energy intensity, the individual ADF test results show that one country (Belgium) rejects the hypothesis that $\rho_i = 1$ at the significant level of 5% and 4 countries (Belgium, Germany, Poland and UK) reject the hypothesis that $\rho_i = 1$ at the significant level of 10%. For CSR3, the individual ADF test results show that two countries (Denmark and Italy) rejects the hypothesis that $\rho_i = 1$ at the significant level of 5%. For AEPoP with trend, 3 countries (Ireland, Netherlands, and South Korea) rejects the hypothesis that $\rho_i = 1$ at the significant level of 5% in the individual ADF tests. Since the evidence to reject *I*(0) is quite weak, we still take energy intensity, CSR3 and AEPoP with trend as *I*(1).

The first differences of all series without trend reject H_0 at the significant level of 1%. Thus, all series are stationary in the first differences form.

Table 3.3 IPS (2003) Panel unit root tests for 25 countries, 2000-2014.

Variables	IPS(2003) H_0: All of the series are *I*(1) H_1: At least one of the series is *I*(0)	
	Without Trend	With Trend
ln*(E/Q)*	5.872 (0-2)	-2.383 (0-2)**
△ln*(E/Q)*	-11.094 (0-1)***	-8.797 (0-1)***
ln*RDE*	-2.919 (0-2)**	2.609 (0-2)
△ln*RDE*	-7.659 (0-1)***	-8.794 (0-1)***
ln*CSR1*	3.295(0-2)	0.909(0-1)
△ln*CSR1*	9.023(0-1)***	6.949(0-1)***
ln*CSR3*	2.012(0-2)	-1.317(0-2)·
△ln*CSR3*	10.546(0-2)***	8.106(0-1)***
ln*AEPoP*	-2.316 (0-2)*	-1.378 (0-2)·
△ln*AEPoP*	-10.668 (0-2)***	-8.316 (0-1)***
ln*EPS*	-1.984 (0-2)*	-0.118 (0-2)
△ln*EPS*	-12.440 (0-2)***	-10.880 (0-1)***

Notes:

1. "***", significant at 0.001; "**", significant at 0.01; "*", significant at 0.05; "·" significant at 0.1.

2. The automatic lag length selection based on SIC is specified in the parentheses.

3. The panel unit root tests for ln*CSR1* (with or without trend) and △ln*CSR1* (without trend) are based on 14 cross-section units' time series. 11 countries are dropped because CSR1 is zero or constant in all periods, or zero in the first 12-14 periods: Belgium, Czech Republic, Greece, Hungary, Ireland, Poland, Slovakia, South Korea, Switzerland, Turkey and U.S.A. The panel unit root test for △ln*CSR1* with trend is based on 15 cross-section units, including U.S.A.

Table 3.3 (cont.)

4. The panel unit root tests for ln*CSR3* (with or without trend) and △ln*CSR3* (without trend) are based on 18 cross-section units' time series. 7 countries are dropped because CSR3 is zero or constant in all periods, or zero in the first 12 periods: Belgium, Czech Republic, Hungary, Ireland, Poland, Slovakia, and Switzerland. The panel unit root test for △ln*CSR3* with trend is based on 19 cross-section units, including Ireland.

3.3.4.2 Panel Cointegration Tests

Since all of variables are $I(1)$, there is a pitfall of spurious regression as pointed out in Granger and Newbold (1974) if we estimate level model directly. A common approach used is taking first differences of variables to adjust $I(1)$ series into $I(0)$ to estimate the model.

However, we have only 15 periods data in our panel, which is short for time series analysis based on first differences. Another difficulty in using differenced data is when the explanatory variables do not vary much over time. In this situation, we miss too much information by using differenced data. After Engle and Granger (1987) gave a formal treatment of cointegration, cointegration models using variables in level form becomes more common. The idea is that: if y_t is an $I(1)$ series and $\boldsymbol{x}_t$ is an $I(1)$ vector in which all elements are $I(1)$ series, and there exists a vector $\boldsymbol{\alpha}$, such that $y_t - \boldsymbol{\alpha x}_t$ is an $I(0)$ process, then y_t and $\boldsymbol{x}_t$ are said to be cointegrated with cointegration vector $(1, \boldsymbol{\alpha})$. In another word, the vector $(1, \boldsymbol{\alpha})$ depicts the long run equilibrium relationship between y_t and $\boldsymbol{x}_t$. And an advantage of using cointegration estimation procedure is that we do not need to specify dynamics until the vector error correction model (VECM) has been estimated (Engle and Granger, 1987, p.260).

Following the procedure developed by Engle and Granger (1987), we begin with testing and estimating a panel cointegration model as follows:

$$ln\left(\frac{E}{Q}\right)_{it} = \alpha_i + \gamma_i t + \beta_{1i} ln\mathrm{RDE}_{it} + \beta_{2i} ln\mathrm{CSR}_{it} + \beta_{3i} ln\mathrm{EPS}_{it} + \beta_{4i} ln\mathrm{AEPoP}_{it} + \epsilon_{it} \qquad (10)$$

where $i = 1, 2, \ldots, N$ denotes the cross-section units; $t = 1, 2, \ldots, T$ denotes time periods; β_{1i} to β_{4i} denotes the cointegrating coefficients that may vary across panels; α_{it} is the country-specific fixed effect; γ_i is the country-specific linear time trend; ϵ_{it} is the error term; CSR_{it} represents either $CSR1_{it}$ or $CSR3_{it}$. Due to the same reason above, we assume heterogeneous cointegration vectors for the panel, i.e. β_{1i}, β_{2i}, β_{3i}, and β_{4i} are country specific.

The first step is to conduct panel cointegration tests for cointegration model (10). If $ln\left(\frac{E}{Q}\right)_{it}$ is cointegrated with the other four $I(1)$ series $ln\text{RDE}_{it}$, $ln\text{CSR}_{it}$, $ln\text{EPS}_{it}$, and $ln\text{AEPoP}_{it}$, it is justified to estimate the cointegration model (10) by using level form variables.

In general, to test the null hypothesis of no cointegration, Pedroni (1999, 2004) will first fit the model (11) by using OLS and obtain the estimated residual:

$$y_{it} = \beta_{\text{i}}\boldsymbol{X}_{it} + \gamma_i\boldsymbol{Z}_{it} + \epsilon_{it} \tag{11}$$

where y_{it} is an $I(1)$ process, $\boldsymbol{X}_{it}$ is an $I(1)$ vector, $\boldsymbol{Z}_{it}$ contains panel-specific means (fixed effect), panel-specific time trends or nothing. Then, the unit root test is conducted by fitting the DF regression model of estimated residuals $\hat{e}_{it}$ for ϵ_{it} as follows:

$$\hat{e}_{it} = \rho_i\hat{e}_{it-1} + v_{it} \tag{12}$$

where ρ_i is the AR parameter and v_{it} is the error term.

Pedroni (1999, 2004) derives seven residual-based panel cointegration test statistics which allow panel-specific cointegration vectors as we specified above. Among them, four test statistics (within dimension approach) assume the same-AR for residuals: panel υ-statistic, panel ρ-statistic (panel modified PP t-statistic), panel PP t-statistic (panel non-parametric t-statistic), panel ADF t-statistic. The other three test statistics (between dimension approach) assume panel-specific-AR for residuals: group ρ-statistic (group modified PP t-statistic), group PP t-statistic (panel non-parametric t-statistic), group ADF t-statistic. The panel υ-statistic is constructed as a ratio of variances. The numerator is the size of the residual variance from the cointegrating regression of y_{it} on $\boldsymbol{X}_{it}$. The denominator is the size of the conditional variance based on the projection of Δy_{it} onto $\Delta\boldsymbol{X}_{it}$. If there is no cointegration, the variance ratio should stabilize asymptotically. If there is cointegration, the variance ratio should diverge. The panel ρ-statistic is based on DF regression and test whether $\rho_i - 1 = 0$. Both panel υ-statistic and panel ρ-statistic do not control for serial correlation in residuals v_{it}. Both panel PP t-statistic and panel ADF t-statistic control for the serial correlation in residuals v_{it}. The panel PP t-statistic uses Newey-west nonparametric adjustments while panel ADF t-statistic uses additional lags of first difference of residuals $\hat{e}_{it}$ to control for serial correlations in v_{it}.

However, a prerequisite to conduct Pedroni (1999, 2004) cointegration test is that the covariates are not cointegrated among themselves. Assume that there are m covariates in $I(1)$ vector $\boldsymbol{x}_t$. Let $\boldsymbol{x}_t(n)$ denotes a vector of first n elements and $\boldsymbol{x}_t(m-n)$ denotes a vector of the rest (m-n) elements so that $\boldsymbol{x}_t = (\boldsymbol{x}_t(n), \boldsymbol{x}_t(m-n))$, where $1 < n \leq m$-2. If n elements in $\boldsymbol{x}_t(n)$ are cointegrated with a cointegrating vector $\boldsymbol{\alpha}$, then $\boldsymbol{\alpha}\boldsymbol{x}_t(n)$ will be an $I(0)$ process. It is always true that the sum of an $I(0)$ and $I(1)$ will be $I(1)$. If y_t is not cointegrated with these n elements in $\boldsymbol{x}_t(n)$ but cointegrated with the rest elements in $\boldsymbol{x}_t(m-n)$, when we first fit the model (11) by OLS in the test, we may still be able to find a vector $\boldsymbol{\beta} = (\boldsymbol{\alpha}, \boldsymbol{\gamma})$ so that $y_t - \boldsymbol{\beta}\boldsymbol{x}_t$ is an $I(0)$ process. In another word, we may wrongly conclude that y_t and $\boldsymbol{x}_t$ are cointegrated even if they are not.

Therefore, we need to conduct pairwise cointegration tests among covariates before we conduct the cointegration tests between the dependent variable and covariates. Since the cointegration test is not symmetric, the pairwise cointegration tests should go two-way. Thus, for each pair of covariates, there are two cointegration results. The results are reported in

Table 3.4. The tests are done by using EViews 10. Since the panel v-statistic does not require modeling on $\hat{e}_{it}$ and does not accommodate serial correlation and the panel ρ-statistic does not accommodate serial correlation as well, we mainly rely on test Panel/Group PP statistic and Panel/Group ADF statistic to draw conclusions. The results indicate that cointegration exists for any pair of covariates.

Table 3.4 The pairwise Padroni (1999, 2004) cointegration tests among covariates for energy intensity models

	Dependent Variables (Without Trend)				
	lnRDE	lnCSR1	lnCSR3	lnEPS	lnAEPoP
lnRDE	-	No	(4)·	(3)**, (4)***, (6)***, (7)***	No
lnCSR1	(7)·	-	-	(3)*, (4)*, (7)·	(2)**, (3)***, (4)***, (6)**, (7)***
lnCSR3	(4)*, (7)*	-	-	(3)**, (4)**, (6)*, (7)**	(2)**, (3)***, (4)***, (6)***, (7)***
lnEPS	(4)*, (6)***, (7)***	No	No	-	(3)*, (4)**, (6)**, (7)***
lnAEPoP	No	No	No	(3)*, (4)**, (6)*, (7)***	-

Table 3.4 (cont.)

	Dependent Variables (With Trend)				
	lnRDE	lnCSR1	lnCSR3	lnEPS	lnAEPoP
lnRDE	-	(1)**, (3)*, (4)**, (6)***, (7)***	(1)**, (3)***, (4)***, (6)***, (7)***	(3)***, (4)***, (6)***, (7)***	(1)·, (2)·, (3)***, (4)***, (6)***, (7)***
lnCSR1	(1)***, (4)·, (7)*	-	-	(4)**, (7)*	(3)***, (4)***, (6)**, (7)***
lnCSR3	(1)***	-	-	(4)**, (7)*	(3)***, (4)***, (6)***, (7)***
lnEPS	(1)***, (4)***, (7)***	(1)*, (4)**, (7)**	(1)**, (3)*, (4)**, (6)**, (7)***	-	(3)***, (4)***, (6)***, (7)***
lnAEPoP	(1)***, (7)***	(1)*, (3)**, (4)***, (6)**, (7)**	(1)**, (3)***, (4)***, (6)***, (7)***	(1)*, (4)**, (6)**, (7)***	-

Notes:

1. "***", significant at 0.001; "**", significant at 0.01; "*", significant at 0.05; "·" significant at 0.1.
2. Variables in columns are dependent variables.
3. Number (1) to (7) denotes seven different panel cointegration test statistics from Pedroni (1999, 2004) tests without trend:

   (1). Panel v-Statistic

   (2). Panel rho-Statistic

   (3). Panel PP-Statistic

   (4). Panel ADF-Statistic

   (5). Group rho-Statistic

   (6). Group PP-Statistic

   (7). Group ADF-Statistic

   "No" means no statistic is significant.
4. Since 9 countries' *CSR1* takes 0 for all the periods, the panel cointegration test involving *CSR1* is based on 16 countries: Austria, China, Denmark, Finland, France, Germany, India, Italy, Japan, Netherlands, Portugal, Spain, Sweden, Turkey, UK, U.S.A.
5. Since 6 countries' *CSR3* takes 0 for all the periods, the panel cointegration test involving *CSR3* is based on 19 countries: Austria, China, Denmark, Finland, France, Germany, Greece, India, Ireland, Italy, Japan, Netherlands, Portugal, South Korea, Spain, Sweden, Turkey, UK, U.S.A.
6. The lag length in ADF is automatically selected based on SIC.

Based on above cointegration tests among covariates, we change our cointegration testing strategy to testing and estimating cointegration between energy intensity and CSR policies, EPS, R&D and AEPoP separately, with policy issues go first in the order.

A. Energy intensity and CSR policies

Our cointegration testing strategy for energy intensity and CSR policies is to conduct cointegration tests between energy intensity and one-year lead of CSR policies, same period CSR policies, one-year lag of CSR policies, two-year lag of CSR polices, and 3-year lag of CSR policies separately. The reason for us to do so is that including more than one CSR policies series will cause covariates to be cointegrated since the series of CSR polices is an $I(1)$ process. Thus, we test different lead and lag of CSR policies separately to locate a stationary long run equilibrium relationship between energy intensity and any lead or lag of CSR policies.

The testing results are reported in Appendix B.2 Table B- 1 and Table B- 2. The results show that five statistics among seven statistics: Panel v-Statistic, Panel/Group PP-Statistic, and Panel/Group ADF-Statistic reject the null hypothesis H_0: no cointegration at significant level from 1% to 0.1%. Thus, all lead, same period and lag of CSR policies are justified to be included in a model involving energy intensity and CSR policies in level forms.

Given the existence of cointegration, we use the fully modified OLS (FMOLS) developed by Pedroni (2000) for cointegrated panels which accounts for the heterogeneity in the fixed effects to estimate the long run equilibrium relation. FMOLS is originally suggested by Phillips and Hansen (1990). The motivation to develop FMOLS estimation procedure is that the widely believed properties of the joint dependence of most aggregate time series and non-stationarity invalidate the routine application of many standard statistical procedures (Phillips and Hansen, 1990). For example, in the dynamic cointegrated panels of aggregate time series, it is widely believed that there are endogenous feedback effects from regressors to the independent variables. To be more precisely, consider a data generating system as follows:

$$y_t = \beta X_t + \gamma D_t + u_{1t} \tag{13}$$

$$\Delta X_t = u_{2t} \tag{14}$$

where y_t and X_t are $I(1)$ processes, D_t is the deterministic trend regressor, u_{1t} and u_{2t} are the error terms. It is widely believed that $\text{cov}(u_{1t}, u_{2t}) \neq 0$. Thus, strict exogeneity assumption of regressors is not acceptable by most standards and the conventional OLS estimator for the cointegration vector is asymptotically biased (Pedroni, 2000). FMOLS employs a semi-parametric correction to eliminate the endogeneity problem caused by the long run correlation between the cointegrating equation and stochastic regressors innovations. It also makes a correction to eliminate the serial correlation. Pedroni (2000) shows that the FMOLS estimator is asymptotically unbiased and allows for standard Wald tests. Due to the same reason as we explained when conducting panel cointegration tests, we only include one CSR policy series each time in estimating the long run equilibrium relation specified as follows:

$$ln\left(\frac{E}{Q}\right)_{it} = \alpha_i + \gamma_i t + \beta ln\text{CSR}_{it-k} + \epsilon_{it} \tag{15}$$

where $k = -1, 0, 1, 2, 3$. To allow for heterogeneity among countries, we use heterogenous first-stage long-run coefficients β_i in FMOLS procedure. Among all FMOLS estimates, only 3-year lag of environmental CSR policies has a statistically significant positive long run equilibrium relation with energy intensity. The complete FMOLS results can be referred to Appendix B.2 Table B- 3 and Table B- 4. The FMOLS results for 3-year lag of environmental CSR policies are presented in Table 3.5.

The estimate indicates that with 1% increase the number of 3-year lag of environmental CSR (CSR3) policies, the energy intensity is estimated to increase by [0.00127%, 0.0694%] (90% C.I.). This might be due to the reason that all CSR reporting policies on pollution abatement and pollution control are classified into the category of environmental CSR policies. More environmental CSR policies on pollution control may have a significant effect on increasing the cost to producers to meet the requirements or expected standards in the short run. However, it is likely that the cost on pollution control or abatement may be balanced over a longer time period and the negative effect on firms' energy efficiency may disappear in the long run.

Table 3.5 Energy intensity and CSR policies long run equilibrium relation FMOLS estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3(-3)	0.035348*	0.020586	1.717115	0.0881
T	11			
n	18			
N	198			
Adjusted R^2	0.993028			

Notes:

1. To allow for heterogeneity in response to CSR policies among countries, we use heterogenous first-stage long-run coefficients to estimate FMOLS model.
2. Since 7 countries' CSR3 takes 0 for all the periods, the FMOLS estimation using three-year lag of CSR3 are based on 18 countries: Austria, China, Denmark, Finland, France, Germany, Greece, India, Italy, Japan, Netherlands, Portugal, South Korea, Spain, Sweden, Turkey, UK, U.S.A.

To verify the long run equilibrium relation that we identified for CSR3 and energy intensity, we further estimate a vector error correction model (VECM) for energy intensity and 3-year lag of CSR3 as suggested by Engle and Granger (1987). First, we obtained the estimated residuals from model (15). Second, using the lagged residuals from model (15) as the error correction term (ECT), a dynamic VECM is estimated by using seemingly unrelated regressions (SUR) for model (16a) and model (16b). The VECM results are reported in Table 3.8.

$$\Delta\ln\left(\frac{E}{Q}\right)_{it} = \alpha_{1j} + \theta_{11}\Delta\ln\left(\frac{E}{Q}\right)_{it-1} + \theta_{12}\Delta lnCSR3_{i(t-3)-1} + \lambda_1\epsilon_{it-1} + u_{1it} \qquad (16a)$$

$$\Delta\ln CSR3_{it-3} = \alpha_{2j} + \theta_{21}\Delta\ln\left(\frac{E}{Q}\right)_{it-1} + \theta_{22}\Delta lnCSR3_{i(t-3)-1} + \lambda_2\epsilon_{it-1} + u_{2it} \qquad (16b)$$

Table 3.6 The VECM results for energy intensity and CSR3

	$\Delta\ln(E/Q)_t$	$\Delta\ln CSR3_{t-3}$
ECT	-1.136***	-0.127
	(0.102)	(0.511)
$\Delta\ln(E/Q)_{t-1}$	0.254**	0.062
	(0.076)	(0.381)
$\Delta\ln CSR3_{(t-3)-1}$	-0.020	-0.047
	(0.016)	(0.082)
C	-0.015***	0.054***
	(0.003)	(0.013)

Note:

1. Due to the short time length in our panel data, we limit the lag length in VECM to be 1.
2. The VECM is estimated using seemingly unrelated regression method.

The coefficient of ECT in $\Delta\ln(E/Q)_t$ model is -1.136 at significant level of 0.1%, indicating that energy intensity will converge to its long run equilibrium relation with 3-year lag of CSR3 at a very fast speed. On the other hand, the coefficient of ECT in $\Delta\ln CSR3_{t-3}$ model is not significant, indicating that there is no long run Granger causality from energy intensity to 3-year lag of CSR3. Besides, we find that the change of one-year lag of energy intensity has a significant positive impact on the change of current period energy intensity, indicating that there is a short run Granger causality from one-year lag of energy intensity to current period of energy intensity.

B. Energy intensity and EPS

Following the same testing and estimation strategy as we used for CSR policies, we first conduct panel cointegration tests between energy intensity and the lead, same period, 1-year lag, 2-year lag, and 3-year lag of EPS. Similar to CSR policies, the results show that five statistics among seven statistics: Panel v-Statistic, Panel/Group PP-Statistic, and Panel/Group ADF-Statistic reject the null hypothesis H_0: no cointegration at significant level from 5% to 0.1%. Thus, all lead, same period and lag of EPS are justified to be included in a model involving energy intensity and EPS in level forms. A long run equilibrium relation between energy intensity and EPS is specified as follows:

$$ln\left(\frac{E}{Q}\right)_{it} = \alpha_i + \gamma_i t + \beta ln\text{EPS}_{it-k} + \epsilon_{it} \tag{17}$$

where $k = -1, 0, 1, 2, 3$. Again, we use FMOLS procedure to estimate model (17). Among all FMOLS estimates, both 2-year lag of EPS and 3-year lag of EPS have statistically significant negative long run equilibrium relations with energy intensity. The complete FMOLS results can be referred to in Appendix B.2 Table B- 4. The FMOLS results for 2-year lag and 3-year lag of EPS are presented in Table 3.7. The estimate indicates that with 1% increase of 2-year lag of EPS index, the energy intensity is estimated to drop by [0.00165%, 0.0523%] (95% C.I.). And with 1% increase of 3-year lag of EPS index, the energy intensity is estimated to drop by [0.0127%, 0.0686%] (95% C.I.). This finding is consistent with Albrizio et al (2014) which finds that changes in 2-year lag of EPS and 3-year lag of EPS have significant positive effect on macro level productivity growth. This might be due to the reason that more stringent environmental policies measured by EPS may have an immediate effect on reducing the energy consumption, but not the energy efficiency. However, more stringent environmental policies may induce producers to make investments on emission reducing technology or energy efficiency improvement technology to meet standards or reduce the cost incurred by paying environmental taxes and purchasing emission credits. These technology progress may result in a drop of energy intensity with 2 to 3 years' lag.

Table 3.7 Energy intensity and EPS long run equilibrium relation FMOLS estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS (-2)	-0.02697*	0.012857	-2.097729	0.0369
T	12			
n	25			
N	300			
Adjusted R^2	0.989291			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-3)	-0.040657**	0.014185	-2.866309	0.0045
T	11			
n	25			
N	275			
Adjusted R^2	0.989299			

Note: To allow for heterogeneity in response to EPS index among countries, we use heterogenous first-stage long-run coefficients to estimate FMOLS model.

To verify the dynamics we identified for EPS, we further estimate a vector error correction model (VECM) for energy intensity and 2-year lag of EPS as suggested by Engle and Granger (1987). First, we obtained the estimated residuals from model (17). Second, using the lagged residuals from model (17) as the error correction term (ECT), a dynamic VECM is estimated by using seemingly unrelated regressions (SUR) for model (18a) and model (18b). The VECM results are reported in Table 3.8.

$$\Delta\ln\left(\frac{E}{Q}\right)_{it} = \alpha_{1j} + \theta_{11}\Delta\ln\left(\frac{E}{Q}\right)_{it-1} + \theta_{12}\Delta lnEPS_{i(t-2)-1} + \lambda_1\epsilon_{it-1} + u_{1it} \quad (18a)$$

$$\Delta\ln EPS_{it-2} = \alpha_{2j} + \theta_{21}\Delta\ln\left(\frac{E}{Q}\right)_{it-1} + \theta_{22}\Delta lnEPS_{i(t-2)-1} + \lambda_2\epsilon_{it-1} + u_{2it} \quad (18b)$$

Table 3.8 The VECM results for energy intensity and EPS

	$\Delta\ln(E/Q)_t$	$\Delta\ln EPS_{t-2}$
ECT	-0.894***	0.203
	(0.0679)	(0.405)
$\Delta\ln(E/Q)_{t-1}$	0.271***	0.0176
	(0.0544)	(0.325)
$\Delta\ln EPS_{(t-2)-1}$	-0.0177·	-0.0649
	(0.0103)	(0.0612)
C	-0.0143***	0.0707***
	(0.00199)	(0.0119)

Note:

1. Due to the short time length in our panel data, we limit the lag length in VECM to be 1.

2. The VECM is estimated using seemingly unrelated regression method.

The coefficient of ECT in $\Delta\ln(E/Q)_t$ model is -0.894 at significant level of 0.1%, indicating that energy intensity will converge to its long run equilibrium relation with 2-year lag of EPS at a fast speed. The $\Delta\ln EPS_{(t-2)-1}$ is estimated to have a significant negative impact on $\Delta\ln(E/Q)_t$ at 10% significant level, implying that $\ln EPS_{t-3}$ has a significant negative impact on $\ln(E/Q)_t$, which is consistent with what we find for 3-year lag of EPS by FMOLS models.

C. Energy intensity and R&D

Similarly, we use the same procedure to analyze the long run equilibrium relation between energy intensity and R&D. We start with testing and estimating cointegration between energy intensity and the same period R&D. The testing results are reported in Table 3.9. The results show that five statistics among seven statistics: Panel v-Statistic, Panel/Group PP-Statistic, and Panel/Group ADF-Statistic reject the null hypothesis H_0: no cointegration at significant level of 0.1%.

Table 3.9 The panel cointegration tests between energy intensity and R&D

Panel Cointegration Test: use same period of R&D			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	3.672846***	Group rho-Statistic	2.287087
Panel rho-Statistic	0.626708	Group PP-Statistic	-5.269243***
Panel PP-Statistic	-3.713146***	Group ADF-Statistic	-6.347495***
Panel ADF-Statistic	-5.706593***		

Then we estimate FMOLS for a stationary relation between energy intensity and R&D specified in model (19). The FMOLS results are presented in Table 3.10. The results suggest that 1% increase in the same period R&D has a significant impact on reducing energy intensity by [0.000284%, 0.0581%] (90% C.I.). This result is consistent with a panel analysis for 2500 firms from 1997-1999 in China by Fisher-Vanden, Jefferson, Liu and Tao (2004) which finds that the 1% increases in firm's R&D expenditure reduces energy intensity by around 0.05% to 0.1%. Since aggregate R&D expenditure also includes expenditure which is not directly with production, it suggests that our estimate is a reasonable estimate which is closer but smaller than the elasticity of firm R&D expenditure on energy intensity.

$$ln\left(\frac{E}{Q}\right)_{it} = \alpha_i + \gamma_i t + \beta ln\text{RDE}_{it} + \epsilon_{it} \quad (19)$$

Table 3.10 The FMOLS results for energy intensity and R&D

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnRDE	-0.031534*	0.014763	-2.136085	0.0335
T	14			
n	25			
N	350			
Adjusted R^2	0.988605			

Note: We use heterogenous first-stage long-run coefficients to estimate this FMOLS model.

Given that we've located a long run equilibrium relation, we continue to estimate a VECM to further identify dynamics between R&D and energy intensity. The VECM is specified by model (20a) and (20b). The results of VECM is reported in Table 3.11. The ECT in model (20a) has a significant negative coefficient of -1.158 at the significant level of 1%, indicating that energy intensity will converge to the long-run equilibrium relationship with R&D at a relatively fast speed. The change of 1-year lag of R&D has a significant negative impact on energy intensity while the change of 2-year lag of R&D has a significant positive impact the change of energy intensity. A possible explanation to this result might be due to the complexity of R&D projects. Some R&D projects may be short-term and low implementation cost projects and can generate a return within one or two years. However, some R&D projects may be long-term and high implementation cost projects and may request a further facility investment to realize the technology upgradation, which may cause GDP to drop in 2-year lag. It is likely that the long term and high implementation cost R&D projects may have a significant negative impact on energy intensity over a longer period. However, due to the limitation of our data, we could not examine higher-order dynamics beyond 3-year lag.

It is notable that the ECT is significant and positive in the estimated equation (20b) by VECM. This result indicates that there is no long run granger causality from energy intensity to R&D. However, when the gap between energy intensity and R&D becomes large in period t-1, the R&D must rise in period t to correct the disequilibrium error of the previous period. This result further confirms that there is only one cointegrating relation from R&D to energy intensity. The changes of 1-year lag R&D and 3-year lag R&D are estimated to have positive impacts on the change of current period R&D. This is possibly due to two reasons: first, the short run force which drives the increase of R&D may persist for one year; second, some R&D projects renew the funding periodically, like 3-year period.

$$\Delta\ln\left(\frac{E}{Q}\right)_{it} = \alpha_{1j} + \sum_{k=1}^{3}\theta_{11}\Delta\ln\left(\frac{E}{Q}\right)_{it-k} + \sum_{k=1}^{3}\theta_{12}\Delta lnRDE_{it-k} + \lambda_1\epsilon_{it-1} + u_{1it} \qquad (20a)$$

$$\Delta\ln RDE_{it} = \alpha_{2j} + \sum_{k=1}^{3}\theta_{21}\Delta\ln\left(\frac{E}{Q}\right)_{it-k} + \sum_{k=1}^{3}\theta_{22}\Delta lnRDE_{it-k} + \lambda_2\epsilon_{it-1} + u_{2it} \qquad (20b)$$

Table 3.11 The VECM results for energy intensity and R&D

	$\Delta\ln(E/Q)_t$	$\Delta\ln RDE_t$
ECT	-1.158***	0.568*
	(0.074)	(0.263)
$\Delta\ln(E/Q)_{t-1}$	0.485***	-0.137
	(0.056)	(0.199)
$\Delta\ln(E/Q)_{t-2}$	0.350***	-0.144
	(0.050)	(0.179)
$\Delta\ln(E/Q)_{t-3}$	0.323***	-0.090
	(0.047)	(0.168)
$\Delta\ln RDE_{t-1}$	-0.030·	0.314***
	(0.016)	(0.056)
$\Delta\ln RDE_{t-2}$	0.074***	-0.001
	(0.016)	(0.058)
$\Delta\ln RDE_{t-3}$	-0.023	0.211**
	(0.016)	(0.057)
C	0.0008	0.011
	(0.003)	(0.010)

Note: The VECM is estimated using seemingly unrelated regression method.

D. Energy intensity and aggregate energy price (AEPoP)

Lastly, we investigate the cointegrating relation between energy intensity and AEPoP. We follow the same panel cointegration testing and estimating procedure we used above. Since the aggregate energy price elasticity of energy demand may be inelastic in the short run while elastic in the long run, we extend to test and estimate cointegrating relation between energy intensity and AEPoP up to 8-year lag. The testing results are reported in Appendix B.2 Table B- 7.

For nine $lnAEPoP_{it-k}$ $(k = 0, 1, 2, 3, 4, 5, 6, 7, 8)$ series, the testing results show that five statistics among seven statistics: Panel υ-Statistic, Panel/Group PP-Statistic, and Panel/Group ADF-Statistic reject the null hypothesis H_0: no cointegration at significant level 0.1%. Thus, all nine $lnAEPoP_{it-k}$ $(k = 0, 1, 2, 3, 4, 5, 6, 7, 8)$ series are justified to be included in a model involving energy intensity and AEPoP in level forms. A long run equilibrium relation between energy intensity and AEPoP is specified as follows:

$$ln\left(\frac{E}{Q}\right)_{it} = \alpha_i + \gamma_i t + \beta ln\text{AEPoP}_{it-k} + \epsilon_{it} \qquad (21)$$

where $k = 0, 1, 2, 3, 4, 5, 6,7$ 8. Again, we use FMOLS procedure to estimate each model. Among all FMOLS estimates, 2-year lag and 4-year lag of AEPoP have significant positive impacts on energy intensity while 6-year lag, 7-year lag and 8-year lag of AEPoP have significant negative impacts on energy intensity. The complete FMOLS results can be referred to in Appendix B.2 Table B- 8. The FMOLS results for 2-year lag, 4-year lag, 6-year lag, 7-year lag and 8-year lag of AEPoP are presented in Table 3.12.

To explain these results, we need to look into the measurement of energy intensity level of primary energy we used in more details. According to World Bank, Sustainable Energy for All (SE4ALL) database, energy intensity of primary energy is defined by the total primary energy supply divided by GDP. The main sources of primary energy include: petroleum, natural gas, coal, renewable energy, and nuclear electric power. Primary energy supply is different from and higher than final energy consumption, depending on the energy generation efficiency, transformation efficiency, delivery efficiency and non-energy use. Therefore, there is also another energy intensity measurement called energy intensity level of final energy to measure the final energy usage efficiency. And there is an indicator called final to primary energy ratio (%) to capture the efficiency of using the primary energy. From the perspective of how much natural resources are used for a country's production of total output, energy intensity level of primary energy is a better indicator and more common to be used than the energy intensity of final energy.

Based on the understanding of this measurement issue explained above, the positive impact of 2-year lag and 4-year lag of AEPoP on primary energy intensity may reflect the positive energy price elasticity of primary energy supply. That is, higher aggregate energy price elicits higher primary energy supply in the short run, where there might be an overproduction problem. On the other side, the energy price elasticity of energy demand is relatively inelastic in the short run, while negative and elastic in the long run. This is because the energy usage pattern usually depends on the energy devices used by the end-users, which are relatively stable in the short run but upgradable in the long run. Therefore, the significant negative impacts of 6-year lag, 7-year lag and 8-year lag of AEPoP on primary energy intensity may reflect the negative the energy price elasticity of energy demand. Overall, the accumulative absolute values of the price elasticity of energy demand are higher than the accumulative absolute values of price elasticity of primary energy supply. Therefore, in the long run, higher AEPoP may finally result in a decrease of primary energy intensity.

Our finding is different from the panel analysis for 2500 firms from 1997-1999 in China by Fisher-Vanden, Jefferson, Liu and Tao (2004). In their study, they use firm level energy intensity, which can be viewed as the energy intensity of final energy by individual firm. They find that current year price of aggregate energy/ price of output has a significant negative impact on firm's energy intensity of final energy use. The elasticity is estimated to by around -0.368. Our results show that the energy price elasticity of aggregate energy demand suggested by FMOLS estimates is around -0.086 using 6-year lag of AEPoP, around -0.075 using 7-year lag of AEPoP, and around -0.047 using 8-year lag of AEPoP, which are reasonable compared to Fisher-Vanden, Jefferson, Liu and Tao (2004) considering the macro level feature and the rough measurement of aggregate energy price. Compared with the policy intervention like EPS, the response from energy intensity to the energy price change will take a longer period to reach the long run equilibrium.

Table 3.12 The Energy intensity and AEPoP long run equilibrium relation FMOLS estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-2)	0.019174·	0.011618	1.650301	0.1001
T	12			
n	25			
N	300			
Adjusted R^2	0.989042			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-4)	0.030693*	0.01229	2.497459	0.0133
T	10			
n	25			
N	250			
Adjusted R^2	0.9893			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-6)	-0.085724***	0.015532	-5.519091	0.0000
T	8			
n	25			
N	200			
Adjusted R^2	0.991138			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-7)	-0.074997***	0.015124	-4.958725	0.0000
T	7			
n	25			
N	175			
Adjusted R^2	0.990088			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-8)	-0.046691**	0.014080	-3.316193	0.0013
T	6			
n	25			
N	150			
Adjusted R^2	0.989987			

Note: We use heterogenous first-stage long-run coefficients to estimate this FMOLS model.

Given the equilibrium relation we found for 2-year lag of AEPoP and energy intensity, we also estimate a panel vector error correction model (VECM) for AEPoP to perform the short-run and long-run Granger-causality tests. After a balance between the potential to examine dynamics as fully as possible and the relative short time length of our panel data, we use up to 4-period lag in the VECM to allow it to include 6-year lag of AEPoP. The results of VECM are reported in Table 3.13.

The results show that the ECT in the model of $\Delta\ln(E/Q)_t$ is significant and negative, indicating that there is long-run Granger-causality from 2-year lag of AEPoP to energy intensity. However, the coefficient of ECT is -0.167 significant at 0.1% level, suggesting a relative slow speed in converging to the long-run equilibrium. We find that the change of 6-year lag of AEPoP has a significant negative impact on energy intensity, which is consistent with what we found from FMOLS estimates. On the other side, the ECT in the model of $\Delta\ln AEPoP_{t-2}$ is also significant and negative. This result indicates that when the gap between energy intensity of primary energy supply and the 2-year lag of AEPoP becomes larger the 2-year lag of AEPoP will drop to reduce the gap, which verifies the cointegrating relation between the energy intensity and 2-year lag of AEPoP.

Table 3.13 The VECM results for energy intensity and AEPoP

	$\Delta\ln(E/Q)_t$	$\Delta\ln AEPoP_{t-2}$
ECT	-0.167***	-0.572*
	(0.0498)	(0.270)
$\Delta\ln(E/Q)_{t-1}$	-0.0339	0.0661
	(0.0716)	(0.388)
$\Delta\ln(E/Q)_{t-2}$	-0.00409	0.485
	(0.0718)	(0.389)
$\Delta\ln(E/Q)_{t-3}$	0.104	0.135
	(0.0687)	(0.373)
$\Delta\ln(E/Q)_{t-4}$	-0.0864	0.586
	(0.0707)	(0.383)
$\Delta\ln AEPoP_{t-3}$	-0.0166	-0.347***
	(0.0129)	(0.0670)
$\Delta\ln AEPoP_{t-4}$	0.0221	-0.0148
	(0.0151)	(0.0821)
$\Delta\ln AEPoP_{t-5}$	0.00694	-0.0742
	(0.0158)	(0.0855)
$\Delta\ln AEPoP_{t-6}$	-0.0460*	-0.154
	(0.0187)	(0.101)
C	-0.0242***	0.0522*
	(0.00371)	(0.0201)

Note: The VECM is estimated using seemingly unrelated regression method.

3.3.5 Robustness check

To check the robustness of the cointegrating relations we identified using FMOLS models, we also use dynamic OLS (DOLS) to re-estimate each cointegrating relation we've identified.

The DOLS is firstly advanced by Saikkonen (1992) and Stock and Watson (1993) and then extended to panel data setting by Kao and Chiang (2000), Mark and Sul (1999, 2003), and Pedroni (2001). It augments the panel cointegrating regression equation with cross-section specific lags and leads of ΔX_{it} to eliminate the asymptotic endogenity and serial correlation.

The estimation results are reported in Appendix B.3 Table B- 8 and Table B- 9. All estimates by DOLS are consistent with estimates by FMOLS. We implement two types of DOLS models: (1). DOLS based on SIC criterion to select the number of lead and lag included in the model; (2). DOLS with fixed 1 lead and 1 lag.

The results from DOLS estimates based on SIC criterion indicate that several cointegrating relations become less significant, including 3-year lag of EPS, 2-year lag of AEPoP and 8-year lag of AEPoP. However, the results from DOLS with fixed 1 lead and 1 lag indicate that all estimates are consistent with FMOLS estimates and even more significant, except for 4-year lag of AEPoP. Unfortunately, we are unable to obtain estimates for 7-year lag of AEPoP and 8-year lag of AEPoP using fixed l lead and 1 lag of DOLS due to the problem of not enough period included to estimate the DOLS model.

3.4 CO_2 Emissions

3.4.1 Literature review on empirical analysis on CO_2 emissions

Currently, there are two approaches in studying greenhouse gas emissions.

The first approach is the factor analysis and Index Decomposition Analysis (IDA) by decomposing CO_2 emissions into several factors or indexes. A simply factor analysis can be given by Kaya identity (Yamaji, K., Matsuhashi, R., Nagata, Y., Kaya, Y., 1991). The Kaya identity expresses the total CO_2 emissions (F) as a product of four driving factors:

$$\mathrm{F} = \mathrm{P}\left(\frac{G}{P}\right)\left(\frac{E}{G}\right)\left(\frac{F}{E}\right) = Pgef \tag{22}$$

where P is the total population, G is GDP, E is total primary energy consumption, $g=G/P$ is the per-capital GDP, $e=E/G$ is the energy intensity of GDP, and $f=F/E$ is the carbon intensity of energy. The merit of Kaya identity factor analysis is that it gives an exact decomposition of CO_2 emissions without residual. Raupach M.R. et al (2007) used Kaya identity to analyze global and regional drivers of accelerating CO_2 emissions. They found that global emissions growth since 2000 was driven by a cessation or reversal of earlier declining trends in the energy intensity of gross domestic product (GDP) (energy/GDP) and the carbon intensity of energy (emissions/energy), coupled with continuing increases in population and per-capita GDP. Similarly, IDA method first decomposes total CO_2 emissions (F) into n factors $(x_1, \dots, x_n)$ to be $\mathrm{F} = x_1 x_2 \dots x_n$ and then expresses the change in F as

$$\Delta \mathrm{F} = F^T - F^0 = \Delta F_{x_1} + \Delta F_{x_2} + \cdots + \Delta F_{x_n} \tag{23}$$

or

$$\mathrm{D} = \frac{F^T}{F^0} = D_{X_1} D_{x_2} \dots D_{x_n} \tag{24}$$

Up to 2015, there are more than 500 archival journal articles (in English) on IDA (Ang, B.W., 2016).

The second approach is to use econometric models to examine the effect of environmental policy or mechanism on greenhouse gas (GHG) emissions. For example, He, Huang, & Tarp (2014) used dynamic panel data model to evaluate the effectiveness of Clean Development Mechanism (CDM) on emission reduction. For another example, Kasim (2017) used Discontinuity Based Ordinary Least Squares (DB-OLS) to examine the effect of an environmental disclosure policy on air quality in New South Wales (NSW), Australia.

3.4.2 Methodology

To give an exact factor analysis of effects of CSR reporting regulation on CO_2 emissions, I adopted Kaya identity factor analysis method following Raupach M.R. et al (2007).

From Kaya identity, we have an equation as follows:

$$\frac{F}{P} = \frac{G}{P}\frac{E}{G}\frac{F}{E} \tag{25}$$

where GHG emissions per capita (F/P) is decomposed into three factors: GDP per capita (G/P), energy intensity of GDP (E/G), and carbon intensity of energy (F/E). From this decomposition, it is easy to see that CSR reporting regulation may influence CO_2 emissions per capita through two factors: energy intensity and carbon intensity of energy. Since we have analyzed the effect of CSR reporting regulation on energy intensity in Section 3.3, I will only focus on examining the effect of CSR reporting regulation on carbon intensity of energy.

To further decompose F/E, we need to further examine the sources of CO_2 emissions. It is estimated that the global CO_2 emission flux from fossil fuel combustion and industrial processes between 2000-2004 includes contributions from seven sources: (Raupach M.R. et al, 2007)

$$\mathrm{F} = \underset{\approx 35\%}{F_{Solid}} + \underset{\approx 36\%}{F_{Liquid}} + \underset{\approx 20\%}{F_{Gas}} + \underset{<1\%}{F_{Flare}} + \underset{\approx 3\%}{F_{Cement}} + \underset{<1\%}{F_{NonFuelHC}} + \underset{\approx 4\%}{F_{Bunkers}} \tag{26}$$

We can see that the main source of CO_2 emission is the combustion of fossil fuel. To the contrary, the consumption of renewable energy, including wind energy, solar thermal energy, solar photovoltaic (PV), solar thermal-PV hybrids, geothermal energy, marine energy, and hydro energy, contributes very little GHG emissions. Thus, we can make following assumptions:

$$F_R = aE_R \tag{27}$$

$$F_F = bE_F \tag{28}$$

where F_R is the CO_2 emissions from renewable energy consumption, E_R is the amount of renewable energy consumption, a is a constant, F_F is the CO_2 emissions from fossil fuel combustion and nuclear energy generation, E_F is the amount of fossil fuel consumption and nuclear energy consumption, b is also a constant. And it is reasonable to assume that $E_R + E_F = E$ and $a<b$. Further, assume that the CO_2 emission which has been reduced by CO_2 emission reduction equipment is $\rho_{ER}F$, where ρ_{ER} is the percentage of F which has been reduced by CO_2 emission reduction technologies. Then, we can express F/E as:

$$\frac{F}{E} = \frac{F_R + F_F - \rho_{ER}F}{E}$$

$$= \frac{aE_R + bE_F - \rho_{ER}F}{E}$$

$$= a\frac{E_R}{E} + b\frac{E_F}{E} - \frac{\rho_{ER}F}{E}$$
$$= a\frac{E_R}{E} + b(1 - \frac{E_R}{E}) - \frac{\rho_{ER}F}{E}$$
$$= \frac{(a-b)}{1+\rho_{ER}}\frac{E_R}{E} + \frac{b}{1+\rho_{ER}}$$

(29)

where $\frac{E_R}{E}$ is the renewable energy consumption rate (% total energy consumption). Since $\frac{a-b}{1+\rho_{ER}} < 0$, F/E is decreasing in $\frac{E_R}{E}$. Here, we can see that CSR reporting regulation may influence F/E through two possible ways. First, it may provide incentives to firms to switch to consume renewable energy so that the renewable energy consumption ratio will be increased. Second, it may increase ρ_{ER} by providing firms incentives to be equipped with CO_2 reduction devices to reduce CO_2 emissions.

A possible empirical strategy to examine these two effects would be to estimate two empirical models. We can evaluate one empirical model on $\frac{E_R}{E}$ which all non-CSR regulation determinants of $\frac{E_R}{E}$ as well as CSR regulation factors. Similarly, we can estimate an empirical model on ρ_{ER} as well.

However, there is great difficulty in investigating causality relationship between renewable energy consumption rate and CSR reporting regulation. The main difficulty is that there are many factors which may influence the renewable energy penetration. J.P. Painuly (2001) proposed six categories of barriers which may influence the renewable energy penetration: energy market barriers, energy market distortion barriers, economic and financial barriers, institutional barriers, technical barriers, and social, cultural and behavior barriers. A well estimated empirical renewable energy consumption model would require adequate data on barriers mentioned in J.P. Painuly (2001). However, we do not have such detailed data for global countries. Instead, a few empirical studies on drivers behind renewable energy have been done by using panel cointegration technique (Sardorsky 2009a, 2009b; Apergis & Payne, 2010; Salim & Rafiq, 2012). Sardorsky (2009a, 2009b) find that per capita renewable energy consumption is driven by real GDP per capita, CO2 per capita in G7 countries and is driven by real per capita income 18 emerging countries. Apergis & Payne (2010) find that there is a long-run equilibrium relationship between real GDP, renewable energy consumption, real gross fixed capital formation, and the labor force. The Granger causality results indicate bidirectional causality between renewable energy consumption and economic growth in both the short-and long-run. Salim & Rafiq (2012) find that in the long-run the renewable energy consumption is significantly determined by income and pollutant emissions by using time series technique for each country from 1980 to 2006.

For the empirical model on ρ_{ER} , since currently there is no data on the amount of CO_2 emission reduction $\rho_{ER}F$, the empirical model on ρ_{ER} is infeasible. However, the data on ρ_{ER} possible determinants are available, including the number of patents on CO_2 emission reduction which can be a proxy of the available CO_2 emissions reduction technology, the data on CSR regulation, and *EPS*.

Therefore, we can evaluate an empirical model on F/E which keeps $\frac{E_R}{E}$ while replace ρ_{ER} by its possible determinants. Thus, a baseline empirical model on F/E is identified as follows:

$$\frac{F}{E}_{i,t} = \alpha_i + \delta_i t + \beta_{1i}\frac{E_R}{E}_{i,t} + \beta_{2i}CO2Tech_{i,t-1} + \beta_{3i}CSR_{i,t} + \beta_{4i}EPS_{i,t} + \varepsilon_{i,t} \tag{30}$$

where $\alpha_{i,t}$ is the individual effect, t is the time trend, $\frac{E_R}{E}_{i,t}$ is the renewable energy consumption rate (% of total energy consumption), $CO2Tech_{i,t-1}$ is the number of 1-year lag of CO2 emission reduction patents, $CSR_{i,t}$ is the number of CSR1 or CSR3 policies, and $EPS_{i,t}$ is the environmental policy stringency index, and $\varepsilon_{i,t}$ is the error term. To accommodates lag structures for CO_2Tech, CSR and EPS, an augmented model is specified as follows:

$$\frac{F}{E}_{i,t} = \alpha_i + \delta_i t + \beta_{1i}\frac{E_R}{E}_{i,t} + \sum_{k=1}^{j}\boldsymbol{\beta_{2i}}CO2Tech_{i,t-k} + \sum_{k=0}^{m}\boldsymbol{\beta_{3i}}CSR_{i,t-m} + \sum_{k=0}^{n}\boldsymbol{\beta_{4i}}EPS_{i,t-n} + \varepsilon_{i,t} \tag{31}$$

To be clearer, we will use CO_2/E for $\frac{F}{E}$ and RE for $\frac{E_R}{E}$ hereafter.

3.4.3 Data

The data sources on *CSR*, and *EPS* have been specified in Section 3.3.3.

The data on total CO_2 intensity of energy use and renewable energy consumption rate are collected from World Bank, which is collected from Carbon Dioxide Information Analysis Center (CDIAC), Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States. Particularly, CDIAC calculates annual anthropogenic emissions from data on fossil fuel consumption (from the United Nations Statistics Division's World Energy Data Set) and world cement manufacturing (from the U.S. Department of Interior's Geological Survey, USGS 2011). In combustion, different fossil fuels release different amounts of carbon dioxide for the same level of energy use: oil releases about 50 percent more carbon dioxide than natural gas, and coal releases about twice as much. Cement manufacturing releases about half a metric ton of carbon dioxide for each metric ton of cement produced (World Bank Data, CO_2 Intensity, Statistical Concept and Methodology).

The data on CO_2 emission reduction patents is collected from OECD.Stat. Particularly, the number of CO_2 emissions reduction patents is the sum of enabling technologies with a potential contribution to CO_2 emissions mitigation, technologies relating to oil refining and petrochemical industry, reduction of CO_2 emissions during production processes, technologies related to metal processing, reduction of CO_2 emissions, capture, storage, sequestration or disposal of CO_2, combustion technologies with mitigation potential (e.g. using fossil fuels, biomass, waste, etc.).

Finally, we got a panel data set for the CO_2 emissions model from 2000 to 2014. The descriptive statistics are provided in. The descriptive graphs of CO_2 intensity of energy use in logarithm of countries in the sample are provided in

Figure 3.4. Most countries exhibit a decreasing trend in CO_2 intensity of energy use over the period 2000-2014, except for China, India, Japan and Turkey. The descriptive graphs of renewable energy consumption rate in the sample are provided in Figure 3.5. Most countries have an increasing trend of renewable energy consumption rate over the period, except for China, India, and Turkey. The descriptive graphs of registered lag CO2 reduction technology patents are provided in Appendix B.1 Figure B- 6.

Table 3.14 Descriptive statistics of variables in the panel data set

Variable	Mean	S.D.	Min	Max
CO2/E	2.31	0.56	0.90	3.47
RE	14.22	12.34	0.69	51.79
Lag CO2Tech	31.76	74.92	0	527.36
CSR1	0.74	1.19	0	7
CSR3	1.93	2.37	0	12
EPS	2.24	0.83	0.52	4.13

Notes: All variables are in level forms.

Figure 3.4 The CO_2 intensity of energy use from 2000 to 2014

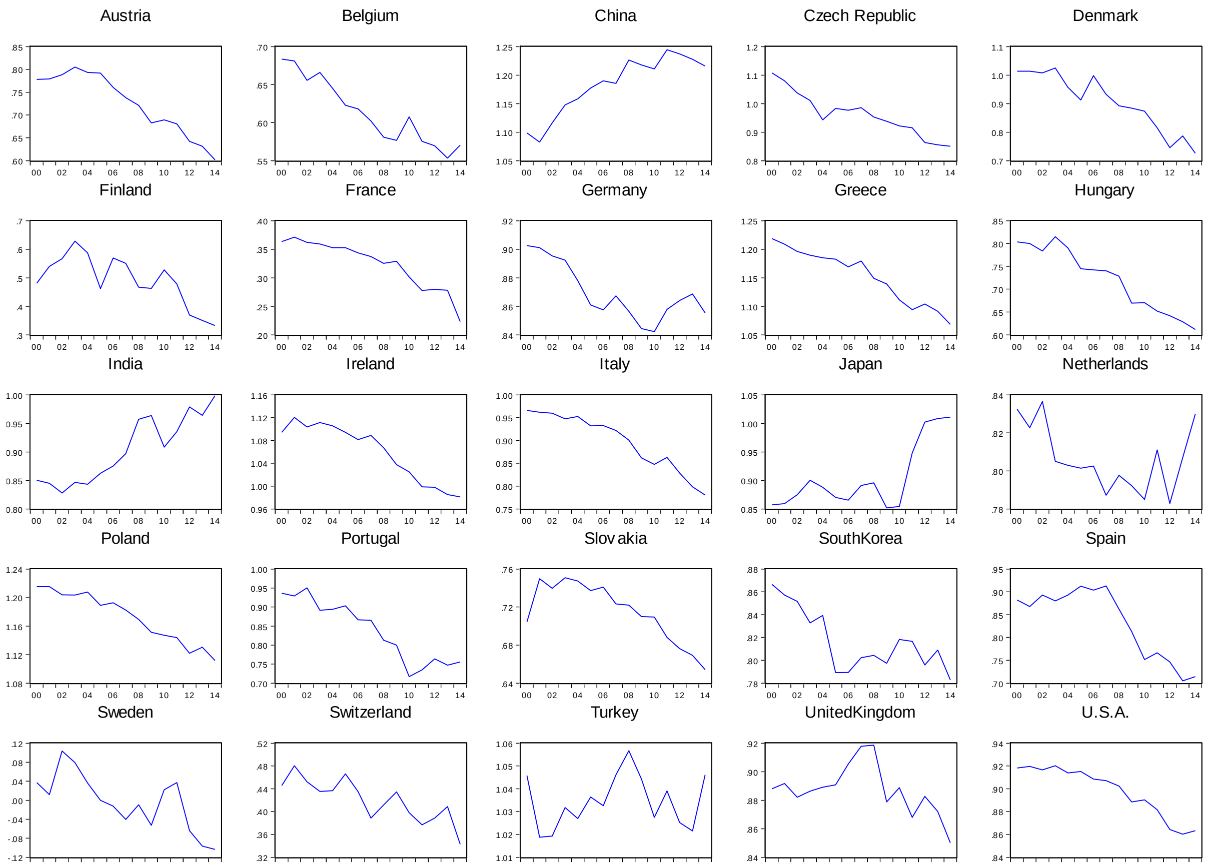
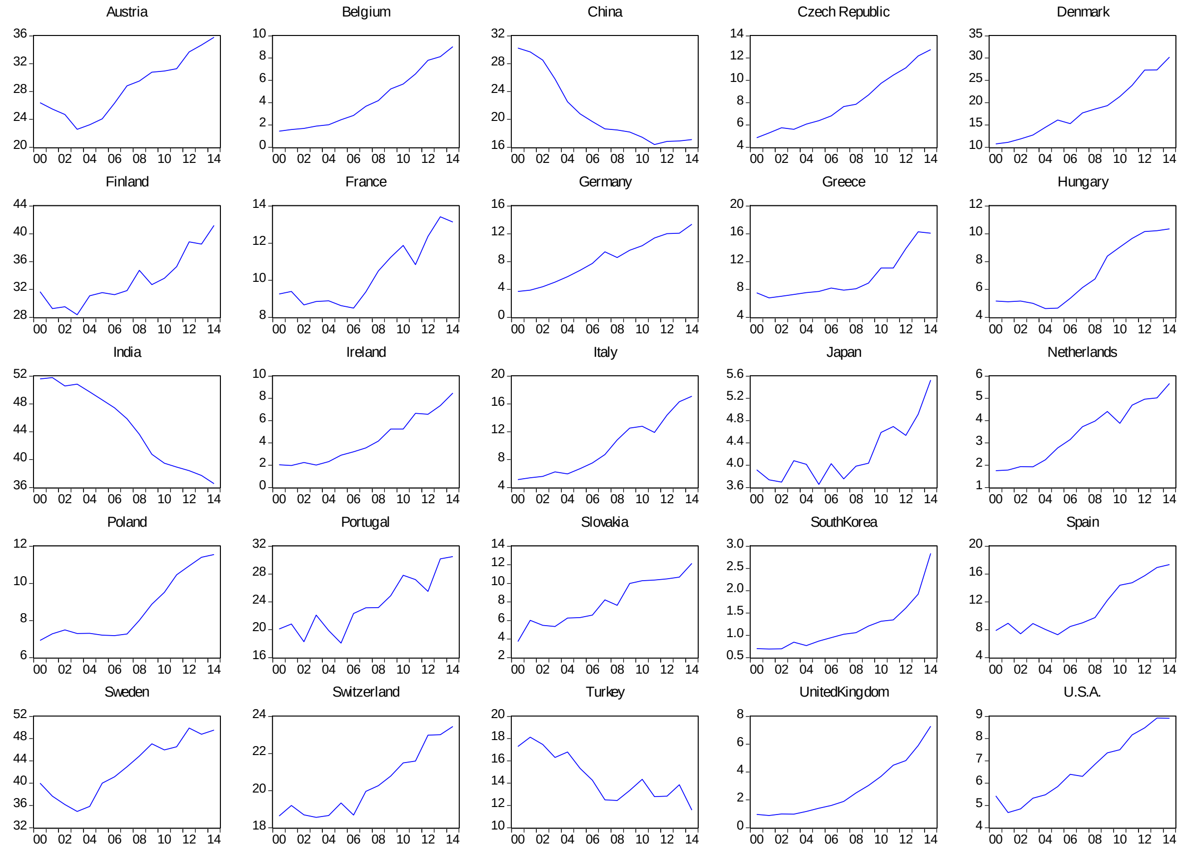


Figure 3.5 The Renewable energy consumption rate from 2000 to 2014



3.4.4 Results

Since we are using macro level annual data, we conduct panel unit root tests and panel cointegration tests to address the concern of stationarity of the data and the cointegration among variables before we estimate the model.

3.4.4.1 Panel Unit Root Tests

We conduct IPS (2003) panel unit root tests for CO_2/E, RE and lagged CO_2Tech which allows autoregressive coefficient ρ_i to vary across cross-section units. The panel unit root tests for CSR and EPS have been done in the previous section 3.3.4.1. The results are reported in Table 3.15. The IPS (2003) panel unit root test results for other series can be referred to Table 3.3. At the significant level of 0.1%, we reject the null hypothesis H_0: All of the series are $I(1)$ for series of CO_2/E and RE either with or without trend. For lagged CO_2Tech without trend, by further inspecting the intermediate ADF test results, four countries out of 25 countries reject H0: $\rho_i = 1$ at the significant level of 5% (China, Hungary, Slovakia, and Turkey). For lagged CO_2Tech with trend, by further inspecting the intermediate ADF test results, two countries out of 25 countries reject H0: $\rho_i = 1$ at the significant level of 5% (Slovakia and Turkey). Thus, we still take lagged CO_2Tech as $I(1)$ with or without trend.

Table 3.15 IPS (2003) panel unit root test 2000-2014

Variables	IPS(2003) H0: All of the series are $I(1)$ H1: At least one of the series is $I(0)$	
	Without Trend	With Trend
lnCO2/E	6.41668(0-2)	-0.64725(0-2)
△ln(CO2/E)	-12.5194(0-2)***	-13.0889(0-1)***
lnRE	7.17112(0-2)	-2.82134(0-2)**
△lnRE	-11.0439(0-2)***	-8.34216(0-1)***
Lag lnCO2Tech	2.64928(0-1)**	2.78243(0-2)**
△Lag lnCO2Tech	-14.6444(0-2)***	-9.99721(0-1)***

Notes:

1. "***", significant at 0.001; "**", significant at 0.01; "*", significant at 0.05; "·" significant at 0.1.

2. The automatic lag length selection based on SIC is specified in the parentheses.

3.4.4.2 Panel Cointegration Tests

We first conduct two-way pairwise Pedroni (1999, 2004) panel cointegration tests among potential dependent $I(1)$ series RE, CSR1, CSR3, EPS, and lagged CO_2Tech before we include all these $I(1)$ series into the FMOLS model. The results of panel cointegration tests are reported in Appendix B.2 Table B- 9. The pairwise testing results that cointegration exists between any pair of covariates. Based on above cointegration tests among covariates, we change our cointegration testing strategy to testing and estimating cointegration between CO_2/E and RE, CO_2Tech, CSR policies, EPS separately.

A. Carbon intensity of energy use (CO_2/E) and renewable energy consumption rate (RE)

We start with testing and estimating cointegration between carbon intensity of energy use and the same period renewable energy consumption rate. The testing results are reported in Table 3.16. The results show that four statistics among seven statistics:

Panel/Group PP-Statistic, and Panel/Group ADF-Statistic reject the null hypothesis H_0: no cointegration at significant level of 0.1%.

Then we estimate FMOLS for a stationary relation between CO_2/E and RE specified in model (32). The FMOLS results are presented in Table 3.17. The results suggest that 1% increase in the same period RE has a significant impact on reducing same period CO_2/E by [0.0804%, 0.138%] (90% C.I.).

Table 3.16 The panel cointegration tests between CO_2/E and RE

Panel Cointegration Test: use same period of RE			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	-0.250825	Group rho-Statistic	2.064911
Panel rho-Statistic	0.099887	Group PP-Statistic	-8.150056***
Panel PP-Statistic	-5.81147***	Group ADF-Statistic	-8.038688***
Panel ADF-Statistic	-6.762512***		

$$ln\left(\frac{CO2}{E}\right)_{it} = \alpha_i + \gamma_i t + \beta ln\text{RE}_{it} + \epsilon_{it} \qquad (32)$$

Table 3.17 The FMOLS results for CO_2/E and RE

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnRE	-0.109409***	0.014728	-7.428645	0.0000
T	14			
n	25			
N	350			
Adjusted R^2	0.992854			

Note:

1. "***": significant at 0.001.

2. We use heterogenous first-stage long-run coefficients to estimate this FMOLS model.

Given that we've located a long run equilibrium relation, we continue to estimate a VECM to further identify dynamics between energy intensity and RE. The results of VECM is reported in Table 3.18. The ECT in model for $\Delta\ln(CO2/E)_t$ has a significant negative coefficient of -1.068 at the significant level of 1%, indicating that CO_2/E will converge to the long-run equilibrium relationship with RE at a fast speed. The change of 2-year lag of RE is found to have a significant positive impact on CO_2/E. A possible explanation to this short-run fluctuation pattern is likely due to the possible correlation between RE and the price of fossil fuels. When RE increases, the demand for fossil fuel will decrease so that the fossil fuel price may decrease, which may induce the fossil fuel consumption to rise a little bit in the short run. The ECT in the model for $\Delta\ln RE_t$ is negative but not significant, implying that there is no Granger-causality from 1-year lag of CO_2/E to RE. Consistent with the short-run fluctuation pattern we find between 1-year lag of RE and CO_2/E, we find that the change from 1-year lag of RE does not have a significant impact on $\Delta\ln RE_t$. However, both changes from 2-year lag of RE and 3-year lag of RE have a significant positive impact on $\Delta\ln RE_t$.

Table 3.18 The VECM results for CO_2/E and RE

	$\Delta\ln(CO2/E)_t$	$\Delta\ln RE_t$
ECT	-1.068**	-0.143
	(0.080)	(0.288)
$\Delta\ln(CO2/E)_{t-1}$	0.432***	0.231
	(0.061)	(0.218)
$\Delta\ln(CO2/E)_{t-2}$	0.082	0.268
	(0.052)	(0.188)
$\Delta\ln(CO2/E)_{t-3}$	0.193***	0.052
	(0.050)	(0.180)
$\Delta\ln RE_{t-1}$	0.043*	0.098
	(0.017)	(0.061)
$\Delta\ln RE_{t-2}$	-0.007	0.275***
	(0.016)	(0.057)
$\Delta\ln RE_{t-3}$	-0.007	0.310***
	(0.015)	(0.054)
C	-0.005**	0.029***
	(0.002)	(0.006)

Note: The VECM is estimated using seemingly unrelated regression method.

B. Carbon intensity of energy use (CO_2/E) and CO_2 emission reduction technology (CO_2Tech)

We then move on to test and estimate cointegration between carbon intensity of energy use and CO_2 emission reduction technology. Since there might be a delay between CO_2 emission reduction technology innovation and the adoption of the technology, we continue searching for higher order lag of *CO_2Tech* until we find a stationary long-run equilibrium relation between x-year lag of CO_2Tech and CO_2/E. The testing results are reported in Appendix B.2 Table B- 10. The results show that for from 1-year lag of *CO_2Tech* to four-year lag of *CO_2Tech*, five statistics among seven statistics: Panel v-statistic, Panel/Group PP-Statistic, and Panel/Group ADF-Statistic reject the null hypothesis H_0: no cointegration at significant level of 0.1%.

Then we estimate equation (33) by FMOLS for 1-year lag of *CO_2Tech* to 4-year lag of *CO_2Tech*. The complete estimates results are reported in Appendix B.2. The results show that 4-year lag of CO_2Tech has a significant negative impact on $CO2/E$. The FMOLS result is presented in Table 3.19. The results suggest that 1% increase in the 4-year lag of *CO_2Tech* has a significant impact on reducing current period CO_2/E by [0.000177%, 0.010301%] (90% C.I.). This estimated effect is quite small which may imply that there is still much room to improve the effectiveness of CO_2 emission reduction technology by encouraging the adoption of the new technology. Due to the short time length of our panel data, the VECM for CO_2/E and 4-year lag of *CO_2Tech* would have too limited periods, so we do not go further to estimate the VECM.

$$ln\left(\frac{CO2}{E}\right)_{it} = \alpha_i + \gamma_i t + \beta ln\mathrm{CO2Tech}_{it-k} + \epsilon_{it} \tag{33}$$

where k=1, 2, 3, 4.

Table 3.19 The FMOLS results for CO_2/E and 4-year lag of CO_2Tech

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCO_2Tech(-4)	-0.005239·	0.003065	-1.709319	0.0888
T	11			
n	25			
N	275			
Adjusted R^2	0.993056			

Note:

1. "·": significant at 0.1.

2. We use heterogenous first-stage long-run coefficients to estimate this FMOLS model.

To further examine the dynamics, we estimate VECM for 4-year lag of CO_2Tech. The results are reported in Table 3.20. The ECT in the model for $\Delta\ln(CO2/E)_t$ is -1.278 significant at 0.1%, which indicates that there is long-run Granger causality from 4-year lag of CO_2Tech to current period of CO_2/E. The ECT is the model for $\Delta\ln CO2Tech_{t-4}$ is not significant, indicating that there is no long-run Granger causality from CO_2/E to 4-year lag of CO_2Tech. For the short-run Granger causality, all one-year lag to 3-year lag of CO_2/E have significantly positive impacts on the current period of CO_2/E. However, the changes of 5-year lag of CO_2Tech and the 6-year lag of CO_2Tech are significantly negative related. This might suggest that there are strong fluctuations in CO_2Tech series in the short run.

Table 3.20 The VECM results for CO_2/E and CO_2Tech

	$\Delta\ln(CO2/E)_t$	$\Delta\ln CO2Tech_{t-4}$
ECT	-1.278***	-1.198
	(0.084)	(2.128)
$\Delta\ln(CO2/E)_{t-1}$	0.568***	2.485·
	(0.058)	(1.465)
$\Delta\ln(CO2/E)_{t-2}$	0.188***	0.062
	(0.048)	(1.228)
$\Delta\ln(CO2/E)_{t-3}$	0.205***	0.160
	(0.048)	(1.210)
$\Delta\ln CO2Tech_{t-5}$	0.004	-0.422***
	(0.003)	(0.070)
$\Delta\ln CO2Tech_{t-6}$	0.0004	-0.155*
	(0.003)	(0.073)
$\Delta\ln CO2Tech_{t-7}$	-0.002	-0.037
	(0.003)	(0.068)
C	-0.0002	0.186
	(0.002)	(0.043)

Note:

1. The VECM is estimated using seemingly unrelated regression method.
2. Included observations are 200. Total system (balanced) observations are 400.

C. Carbon intensity of energy use (CO_2/E) and CSR policies

Since there might be a delay for the CSR policies to take effect, we extend to test and estimate cointegrating relation between CO_2/E and CSR1 or CSR3 policies up to 6-year lag of CSR1 and CSR3 policies. The complete cointegration tests results are reported in Appendix B.2 Table B-12 and Table B-13.

The results show that four to five among seven statistics: Panel v-statistic, Panel/Group PP-Statistic, and Panel/Group ADF-Statistic reject the null hypothesis H_0: no cointegration at the significant level between 0.1% to 10%. Particularly, four statistics: Panel/Group PP-Statistic, and Panel/Group ADF-Statistic reject the null hypothesis H_0 at the significant level above 1%. Therefore, all CSR1 and CSR3 series we tested are justified for a model in level form.

Then we estimate the equation (34) by FMOLS for both CSR1 and CSR3. The complete FMOLS estimation results are reported in Appendix B.2 Table B-14 and Table B-15. Unfortunately, we do not find any significant estimate for equation (31). This indicates that up to 6-year lag of CSR1 or CSR3 policies, we are unable to find any significant impact from CSR policies on CO_2/E. In another word, CSR policies may not provide enough incentives to firms to switch from using fossil fuel to using renewable energy or increase the CO_2 emission reduction rate.

$$ln\left(\frac{CO2}{E}\right)_{it} = \alpha_i + \gamma_i t + \beta ln\text{CSR}_{it-k} + \epsilon_{it} \tag{34}$$

where k=0, 1, 2, 3, 4, 5, 6.

D. Carbon intensity of energy use (CO_2/E) and EPS policies

Similarly, we conduct cointegration testing and estimation between CO_2/E and *EPS* up to 6-year lag of EPS. The complete cointegration tests results are reported in Appendix Table B-16. The results show that four to five among seven statistics: Panel v-statistic, Panel/Group PP-Statistic, and Panel/Group ADF-Statistic reject the null hypothesis H_0: no cointegration at the significant level between 0.1% to 5%. Particularly, four statistics: Panel/Group PP-Statistic, and Panel/Group ADF-Statistic reject the null hypothesis H_0 at the significant level above 1%. Therefore, all EPS series we tested are justified for a model in level form.

Then we estimate the equation (35) by FMOLS for CO_2/E and EPS. The complete FMOLS estimation results are reported in Appendix B.2 Table B-17. Among all FMOLS estimates, we find significant stationary equilibrium relations for same period EPS, 1-year lag of EPS and 6-year lag of EPS. The results on these significant relations are listed in Table 3.21.

$$ln\left(\frac{CO2}{E}\right)_{it} = \alpha_i + \gamma_i t + \beta ln\text{EPS}_{it-k} + \epsilon_{it} \quad (35)$$

where k=0, 1, 2, 3, 4, 5, 6.

Table 3.21 The FMOLS results for CO_2/E and EPS

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS	0.025068**	0.00796	3.149091	0.0018
T	14			
n	25			
N	350			
Adjusted R^2	0.991965			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-1)	0.018524*	0.00806	2.298193	0.0223
T	13			
n	25			
N	325			
Adjusted R^2	0.99258			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-6)	-0.019575*	0.009577	-2.043821	0.0427
T	8			
n	25			
N	200			
Adjusted R^2	0.993774			

Note: We use heterogenous first-stage long-run coefficients to estimate FMOLS models.

The cointegrating relation between the same period EPS, 1-year lag of EPS and CO_2/E is not necessarily a casual relationship. Rather, it might reflect an opposite casual relationship: higher current CO2/E may cause policy makers to increase the same period EPS and next period EPS. To further examine the short-run and long-run Granger-causality, we estimate VECM for same period EPS, 1-year lag of EPS and 6-year lag of EPS separately. The results are reported in Table 3.22, Table 3.23 and Table 3.24.

According to VECM results for CO_2/E and same period EPS in Table 3.22, the ECT in model for $\Delta\ln(CO2/E)_t$ and ECT in model for $\Delta\ln EPS_t$ are both negative and significant, indicating that there is long-run Granger-causality from EPS to CO_2/E and from CO_2/E to EPS as well. For the short-run dynamics, there is no evidence of short-run dynamics from EPS (from 1-year lag to 3-year lag) to CO_2/E but there are significant positive impacts from 1-year lag and 3-year lag of CO_2/E to EPS, which implies there is short-run Granger-causality from CO_2/E to EPS but no short-run Granger-causality from EPS to CO_2/E.

The VECM results for $(CO_2/E)_t$ and EPS_{t-1} in Table 3.23 show that the ECT in model for $\Delta\ln(CO2/E)_t$ is negative and significant, indicating that there is long-run Granger-causality from EPS_{t-1} to $(CO_2/E)_t$. However, the ECT in model for $\Delta\ln EPS_{t-1}$ is not significant, indicating that there is no long-run Granger-causality from $(CO_2/E)_t$ to EPS_{t-1}. Also, we do not observe short-run dynamics from $(CO_2/E)_t$ to EPS_{t-1} as well. Based on these results, it is likely that the stationary long-run equilibrium relation between $(CO_2/E)_t$ and EPS_{t-1} is not due to a casual relation but due to the persistent trend in CO_2/E series. Since $(CO_2/E)_t$ has a Granger-causality with EPS_t and there is persistent autoregressive relation between $(CO_2/E)_t$ and $(CO2/E)_{t-1}$, the stationary long-run equilibrium relation between $(CO_2/E)_t$ and EPS_{t-1} may simply a reflection of the long-run equilibrium relation between $(CO_2/E)_t$ and $EPS_{t.}$

Lastly, the VECM results for $(CO_2/E)_t$ and EPS_{t-6} in Table 3.24 show that the ECT in model for $\Delta\ln(CO2/E)_t$ is negative and significant, indicating that there is long-run Granger-causality from EPS_{t-6} to $(CO_2/E)_t$. However, the ECT in model for $\Delta\ln EPS_{t-6}$ is not significant, indicating that there is no long-run Granger-causality from $(CO_2/E)_t$ to EPS_{t-6}.

In all, we conclude that $(CO_2/E)_t$ has a Granger-causality to EPS_t. On the other side, EPS_{t-6} has a significant negative impact on $(CO_2/E)_t$. With 1% increase in EPS_{t-6}, $(CO_2/E)_t$ is reduced by [0.000649%, 0.0385%] (95% C.I.).

Table 3.22 The VECM results for CO_2/E and EPS

	$\Delta\ln(CO2/E)_t$	$\Delta\ln EPS_t$
ECT	-1.088***	-1.741***
	(0.075)	(0.395)
$\Delta\ln(CO2/E)_{t-1}$	0.461***	0.850*
	(0.057)	(0.329)
$\Delta\ln(CO2/E)_{t-2}$	0.121*	0.126
	(0.049)	(0.294)
$\Delta\ln(CO2/E)_{t-3}$	0.231***	0.774*
	(0.047)	(0.321)
$\Delta\ln EPS_{t-1}$	-0.005	-0.059
	(0.008)	(0.056)
$\Delta\ln EPS_{t-2}$	-0.005	-0.111*
	(0.008)	(0.054)
$\Delta\ln EPS_{t-3}$	-0.0006	0.011
	(0.008)	(0.054)
C	-0.001	0.069***
	(0.002)	(0.012)

Note: The VECM is estimated using seemingly unrelated regression method.

Table 3.23 The VECM results for CO_2/E and 1-year lag of EPS

	$\Delta \ln(CO2/E)_t$	$\Delta \ln EPS_{t-1}$
ECT	-1.153***	0.098
	(0.080)	(0.577)
$\Delta \ln(CO2/E)_{t-1}$	0.504***	0.403
	(0.059)	(0.429)
$\Delta \ln(CO2/E)_{t-2}$	0.114*	0.255
	(0.050)	(0.362)
$\Delta \ln(CO2/E)_{t-3}$	0.222***	0.195
	(0.048)	(0.348)
$\Delta \ln EPS_{t-2}$	-0.001	-0.071
	(0.008)	(0.060)
$\Delta \ln EPS_{t-3}$	-0.005	-0.137*
	(0.008)	(0.060)
$\Delta \ln EPS_{t-4}$	0.006	-0.002
	(0.008)	(0.059)
C	-0.002	0.073***
	(0.002)	(0.014)

Note: The VECM is estimated using seemingly unrelated regression method.

Table 3.24 The VECM results for CO_2/E and 6-year lag of EPS

	$\Delta \ln(CO2/E)_t$	$\Delta \ln EPS_{t-6}$
ECT	-1.571***	-0.436
	(0.102)	(0.966)
$\Delta \ln(CO2/E)_{t-1}$	0.638***	0.059
	(0.062)	(0.594)
$\Delta \ln(CO2/E)_{t-2}$	0.223***	0.048
	(0.055)	(0.519)
$\Delta \ln EPS_{t-7}$	0.004	-0.100
	(0.008)	(0.077)
$\Delta \ln EPS_{t-8}$	0.015·	-0.146·
	(0.008)	(0.079)
C	-0.004·	0.097***
	(0.002)	(0.019)

Note: The VECM is estimated using seemingly unrelated regression method.

3.4.5. Robustness Check

To check the robustness of the cointegrating relations we identified using FMOLS models, we also use dynamic OLS (DOLS) to re-estimate each cointegrating relation we've identified.

The estimation results are reported in Appendix B.2 Table B-18 and Table B-19. All estimates by DOLS are consistent with estimates by FMOLS. We implement two types of DOLS models: (1). DOLS based on SIC criterion to select the number of lead and lag included in the model; (2). DOLS with fixed 1 lead and 1 lag.

The results from DOLS estimates based on SIC criterion indicate that several cointegrating relations become insignificant, including 4-year lag of CO_2Tech, one-year lag of EPS and 6-year lag of EPS, although the sign of each estimate is consistent with the sign of the estimate by FMOLS. This is probably due to the reason that FMOLS procedure allows more heterogeneity than DOLS by using heterogenous first-stage long-run coefficients to estimate FMOLS models. Only the estimate for RE by DOLS with fixed 1 lead and 1 lag is consistent with FMOLS. Other estimates by DOLS with fixed 1 lead and 1 lag are insignificant and the sign for the estimate of 6-year lag of EPS even reverses. The main reason for the reverse estimate might be due to less periods included in DOLS with fixed 1 lead and 1 lag for 6-year EPS (6 periods included) than FMOLS for 6-year EPS (8 periods included).

3.5 $PM_{2.5}$ Pollution

3.5.1 Literature review on $PM_{2.5}$ pollution abatement

Basically, there are two kinds of sources of $PM_{2.5}$: primary sources and secondary sources. Primary sources include incomplete combustion, automobile emissions, industry processing, dust and cooking. Secondary sources include chemical reactions in the atmosphere (Salvador, S., Salvador, EI, 2012).

Early studies on PM focused on fundamental researches on measuring the chemical composition and formation of PM. Chow and Waston (2002) reviewed the Chemical Mass Balance (CMB) analyses in 22 studies and found that fossil fuel combustion to be a large contributor to $PM_{2.5}$ and PM_{10} concentrations, with most of the primary contributions originating from diesel-and gasoline-powered vehicle exhaust. Coal- and oil-fired power stations have also been shown to be large contributors if without effective pollution controls. For the formation of PM in urban areas, several on-site assessment researches have verified the sources of $PM_{2.5}$ in urban areas. The analysis by Lewis, Norris, Conner, & Henry (2003) using the multivariate receptor model Unmix based on a 3-yr $PM_{2.5}$ ambient aerosol data set collected in Phoenix, AZ, beginning in 1995 found five source categories: gasoline engines (33±4%), diesel engines (16±2%), secondary SO_4^{2-} (19±2%), crustal/soil (22±2%), and vegetative burning (10±2%). Lonati, Giugliano, Butelli, Romele, & Tardivo (2005) found in Milan (Italy) that the primary contribution of the traffic source, in terms of carbonaceous matter, is estimated in 6% and 11% of the total $PM_{2.5}$ mass, respectively, in the cold and warm season. The secondary organic aerosols (SOA) from traffic source contribute 30% of the total $PM_{2.5}$ mass. Pérez, Pey, Cusack, Reche, Querol, Alastuey, & Viana (2010) found in Barcelona that $PM_{2.5}$ increased during traffic rush hours, reflecting exhaust, and non-exhaust traffic emissions, and then decreased by the effect of breezes and the reduction of traffic intensity. $PM_{2.5\text{–}10}$ levels did not decrease during the day as a result of dust resuspension by traffic and wind. The number of particles showed a second peak, registered in the afternoon and parallel to O_3 levels and solar radiation intensity, that may be attributed to photochemical nucleation of precursor gases. Also, there are a series of studies which analyze the chemical composition of PM in China (e.g. Cao et al 2003; Cheng *et al* 2000; Wang *et al* 2006; Xu et al, 2004). Some Chinese scholars used $PM_{2.5}$ on-site measured samples to identify the chemical composition of $PM_{2.5}$ and potential sources to reduce emissions in Beijing and other Chinese cities (e.g. Duan *et al*, 2006; He *et al*, 2001; Huang *et al*, 2006; Song *et al*, 2006; Zhao, *et al*, 2013). Yao *et al* (2009) provides a detailed review of studies on formation and control of PM in China. Based on summarizing four studies on the source apportionment of $PM_{2.5}$ in Beijing, China, Yao *et al*. (2009) conclude that three dominant primary sources of urban $PM_{2.5}$ are: coal combustion (15%-20%), vehicle exhaust (5%-10%) and biomass burning (5%-12%).

Recently, based on previous fundamental researches on the formation and control of PM, to better assess PM's related climate and health impacts, and to provide a solid reference for policy makers to regulate primary pollution sources, great efforts have been made to quantify primary emissions of PM from various sources on global (EDGAR; Janssens-Maenhout,*et al*,, 2012; Huang Y., *et al*, 2014), regional (Klimont, Z., *et al*, 2002; Zhang,Q, *et al*, 2009), and country (U.S. EPA NEI; NAEI; MEIC; Reddy,, M. 2002; Zhang, Q., 2007; Lei, Y., 2011; Zhao, Y., 2011) scales. These studies or databases estimate PM emissions based on identifying pollution sources and activities, their corresponding emission factors (defined as mass of pollutant emitted per unit fuel consumed or material produced) and the emission reduction effects of adopted PM control technology. Globally, according to the estimation by Huang Y., *et al* (2014) for year of 2007, biomass burning, including wildfires, residential fuels, and agriculture wastes, accounted for 67.6% of total global $PM_{2.5}$ emissions. Power generation contributed 6.4% of global $PM_{2.5}$ emissions. Motor vehicles accounted for 0.8%-1.4% of global $PM_{2.5}$ emissions.

By using China's emission inventory (MEIC) as input into an environmentally extended input-output framework and applying structural decomposition analysis, Guan D. *et al.* (2014) find that three main primary sources of $PM_{2.5}$ emissions in China from 1997-2010 are: industrial processes (45%), biofuel combustion (26%) and coal combustion (25%). From an industrial sector consumption perspective, Guan D. *et al.* (2014) find that two sectors: construction (37%) and metals and machinery (18%) are the largest emission sectors in China. From a final demand consumption perspective, Guan D. *et al.* (2014) find that contributions by three categories of final demands to PM2.5 emission are: capital formation (32%-39%), household (15%-20%) and exports (9%-18%).

However, studies on $PM_{2.5}$ pollution abatement are still rare currently. Prakash and Potoski (2014) studied the efficacy of adoption of ISO 14001 on reducing the emissions of PM_{10} by analyzing a panel of 159 countries from 1991 to 2005 using a panel AR(1) model in first difference estimated by GMM (Arellano & Bond, 1991). Prakash and Potoski (2014) find that lagged PM_{10} level has a significant positive impact on current year's PM_{10} level. Besides, they find that both GDP and the lagged number of ISO 14001 certifications in the country have significant negative impacts on PM_{10} level. Another related study by Another related study by Kasim (2017) used Discontinuity Based Ordinary Least Squares (DB-OLS) to examine the effect of an environmental disclosure policy on air quality in New South Wales (NSW), Australia. Kasim (2017) found that the concentration levels were not significantly affected after the implementation of the policy. The limitation of this research is that it only examined the data between 2011 and 2013 and the DB-OLS method only allows to examine the effect of one policy, not an inventory of polices which are developed gradually.

3.5.2 Methodology

The dependent variable is $PM_{2.5}$ pollution level measured by annul mean population exposure to $PM_{2.5}$. Due to the feature that $PM_{2.5}$ pollution level is closely related with combustion and it may persistent for quite a long time due to the photochemical reactions in the atmosphere, I follow Prakash and Potoski (2014) and use a dynamic panel AR(1) model to evaluate the impact of CSR reporting regulation on $PM_{2.5}$ pollution level. For the selection of independent variables, by referring to the literature on the primary sources of $PM_{2.5}$ and Prakash and Potoski (2014), I select independent variables from five dimensions:

(*a*). Total fossil fuel combustion amount:

To control for the total fossil fuel combustion amount, I select total CO_2 emissions from fossil fuel combustion as a proxy for the total fossil fuel combustion amount. It is expected that higher fossil fuel combustion amount will result in higher $PM_{2.5}$ pollution level.

(*b*). The main primary source of $PM_{2.5}$ emissions:

Different fuel types have different PM emission levels. Among three categories of fuel types: solid fuel, liquid fuel and gaseous fuel, solid fuel has relatively higher emission factors than other two types of fuel (Huang Y., *et al*, 2014, Table S1). Therefore, given the same total fuel combustion amount, the PM emissions may vary a lot due to different shares of three fuel types combustion. To control for the main primary source of $PM_{2.5}$, I include CO_2 emissions from solid fuel combustion (% of total CO_2 emissions) as an independent variable.

(*c*). $PM_{2.5}$ related abatement policies or standards:

Under this dimension, I include three independent variables: the inventory of CSR polices, Environmental Policy Stringency Index (EPS), and the number of ISO 14001 certificates in a country. It is worthy to mention that a firm may seek ISO 14001 certificates as a meant to practice environmental CSR. Thus, the number of ISO 14001 certificates may be correlated with the inventory of CSR policies. However, since ISO 14001 is instituted by International Organization of Standardization, not by governments and CSR policies may have an impact on $PM_{2.5}$ pollution through other channels like promoting green finance, we still view these two variables as two different mechanisms.

A concern of using the number of ISO 14001 certificates is that the monitoring system of ISO 14001 is based on a five-year review. There is a moral hazard problem that once a firm obtains the ISO 14001 certificate, it may not keep making efforts to meet the standard. Thus, I consider using two different specifications of the number of ISO 14001 certificates in a country: a). the level form; b). the first difference form. The level form measures the inventory of total ISO 14001 certificates in a country. The first difference form measures the number of firms which newly obtained ISO 14001 certificates in a country.

(*d*). $PM_{2.5}$ abatement technology:

Given the same total fuel combustion amount, the PM emissions may vary greatly depending on what control technology is adopted. To control for the impact of $PM_{2.5}$ abatement technology, I use the lagged number of published applications for patents of emission abatement invention as a proxy of the $PM_{2.5}$ abatement technology development, including emission abatement patents on SOx, NOx, PM emissions.

(*e*). Other important influencing factors:

Since annul mean population exposure to $PM_{2.5}$ uses annual mean $PM_{2.5}$ concentration estimates divided by total population, I further include total population of a country as a control variable.

Our two model specifications are as follows:

(a). $PM2.5_{i,t} = \beta_i + \rho PM2.5_{i,t-1} + \beta_1 TotalCO2_{i,t} + \beta_2 Population_{i,t} + \beta_3 SolidFuelCO2_{i,t} + \beta_4 CSR_{i,t} + \beta_5 EPS_{i,t} + \beta_6 ISO14001_{i,t} + \beta_7 PM2.5Tech_{i,t-1} + \boldsymbol{T}_t + \varepsilon_{it}$ (36)

(b). $PM2.5_{i,t} = \beta_i + \rho PM2.5_{i,t-1} + \beta_1 TotalCO2_{i,t} + \beta_2 Population_{i,t} + \beta_3 SolidFuelCO2_{i,t} + \beta_4 CSR_{i,t} + \beta_5 EPS_{i,t} + \beta_6 \Delta ISO14001_{i,t} + \beta_7 PM2.5Tech_{i,t-1} + \boldsymbol{T}_t + \varepsilon_{it}$ (37)

where the subscript *i* denotes country and *t* denotes year. $PM2.5_{i,t}$ is the annul mean population exposure to $PM_{2.5}$. $TotalCO2_{i,t}$ is the total CO_2 emissions (kt) from fossil fuel combustion. $Population_{i,t}$ is the total population. $SolidFuelCO2_{i,t}$ is the CO_2 emissions (kt) from solid fuel combustion. $CSR_{i,t}$ represents the inventory of general sustainable CSR policies (CSR1) or the inventory of environmental CSR policies (CSR3). $EPS_{i,t}$ is the environmental policy stringency index. $ISO14001_{i,t}$ is the total number of ISO14001 certificates in a country. $PM2.5Tech_{i,t-1}$ is the lagged number of published applications for patents of emission abatement invention. All these variables are in log forms. β_i is the country specific fixed effect. $\boldsymbol{T}_t$ is the time fixed effect for year 2000 to year 2014. ε_{it} is the error term.

For a dynamic AR(1) model, since the lagged values of dependent variables are positively correlated with the unobservable unit specific fixed effects, it is well known that there is an incidental-parameter-induced bias for the Least Square Dummy Variable (LSDV) estimator as pointed out by Nickell (1981).

In the literature, there are three categories of approaches developed as alternatives to LSDV estimators. The first category of approaches uses differenced lagged variables as instruments (Arellano and Bond, 1991; Anderson and Hsiao, 1981, 1982; Arellano and Bover, 1995; Blundell and Bond, 1998), among which first-difference GMM estimator developed by Arellano and Bond (1991) is the most common approached in practical empirical work with dynamic panel regression. However, this method often suffers from problems of inefficiency and substantial bias, especially when there is weak instrument as pointed out by Han, Phillips, and Sul (2014). The second category of approaches are bias-corrected LSDV estimators (LSDVC) which correct for the bias of LSDV estimators based on parametric assumptions (Kiviet, 1995, 1999; Bun and Kiviet, 2003; Hahn and Kuersteiner, 2002; Bruno, 2005). The Monte Carlo evidence from Kiviet (1995), Judson and Owen (1999), and Bun and Kiviet (2003) suggest that LSDVC estimator is more efficient than LSDV estimator, first-difference 2SLS estimator (Aderson and Hsiao, 1981, 1982), first-differenced GMM estimator (Arellano and Bond, 1991), and system GMM estimator (Blundell and Bond, 1998) at the aspects of bias and root mean squared error (RMSE) for small or moderately large samples. The third category of approaches is bias-free parametric estimation (Hsiao, Pesaran, and Tahmiscioglu, 2002; Kruiniger, 2008; Han and Phillips, 2010; Han, Phillips, and Sul, 2014). Particularly, the recently developed bias-free parametric estimation method: panel fully aggregated estimator (PFAE) by Han, Phillips, and Sul (2014) is shown to have strong asymptotic and finite sample performance characteristics that dominate other procedures such as LSDVC estimators, GMM estimators, and system GMM estimators in evaluating dynamic panel models. The PFAE estimator uses a novel form of systematic differencing, called "X-differencing", which eliminates unit specific fixed effects and make full use of all the information in the data.

Therefore, I estimate equation (36) and (37) by using three estimation approaches: first-difference GMM estimator (Arellano and Bond, 1991), LSDVC estimator, and PFAE estimator (Han, Phillips, and Sul, 2014). Due to the superior characteristic of PFAE estimator over other estimators, the conclusion is mainly drawn based on PFAE estimator.

3.5.3 Data

The *PM2.5* and *PM2.5Tech* data is collected from OECD.Stat. The total population data and CO_2 emissions (kt) from solid fuel combustion data are collected from World Bank. The data of ISO 14001 certificates is collected from The ISO Survey of Management System Standard Certifications (1999-2016). The sources of other data are specified as before. After matching the data, we form a balanced panel data set of 25 countries from year 2000 to year 2014. The list of countries in the panel data set can be referred to Table 3.2.

Descriptive statistics of the data are presented in Table 3.25. All variables are in log forms. The figures of *PM2.5* for 25 countries in the panel are presented in Figure 3.6. From *PM2.5* figures, we can see that there is a lot of variations from year to year and there seems no persistent trend for most countries. A panel unit root test for *PM2.5* is provided in the next section 3.5.4 Results.

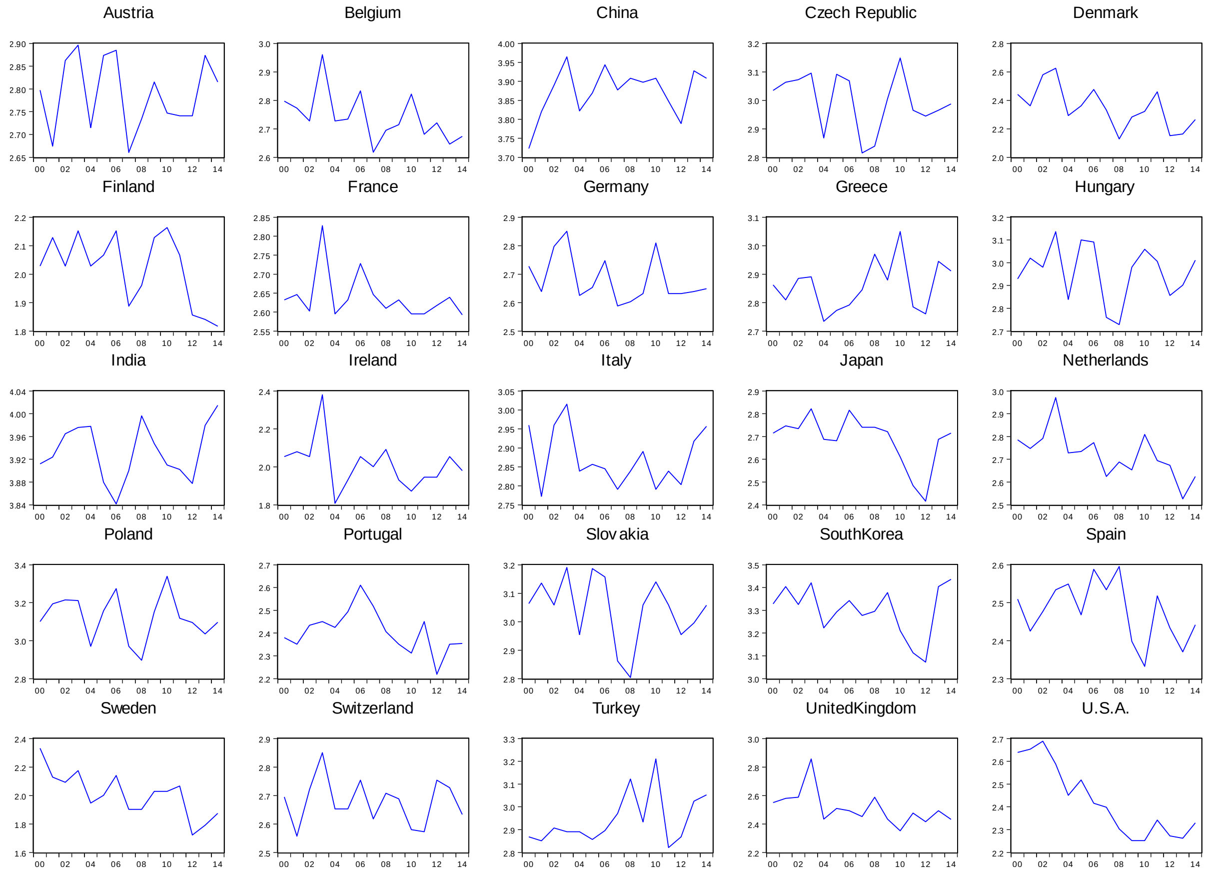
Table 3.25 Descriptive Statistics for PM2.5 Panel Data Set

Variable	Mean	S.D.	Min	Max
PM2.5	18.00	10.63	5.60	55.42
TotalCO2	219608.8	478793.4	8395.0	2818700
Population	1.40E+08	3.33E+08	3805174	1.36E+09
SolidFuelCO2	33.28	18.87	1.17	75.92
CSR1	0.74	1.19	0	7
CSR3	1.93	2.37	0	12
EPS	2.24	0.83	0.52	4.13
ISO 14001	4653.63	9463.26	20	80292
PM2.5Tech	392.55	755.61	0	2847.63

Note:

1. All variables in the level forms.
2. $PM_{2.5}$ is measured by annual mean population exposure to $PM_{2.5}$. *TotalCO2* is measured by total CO2 emissions (kt). *SolidFuelCO2* is measured by CO_2 emissions from solid fuel combustion (% of total CO_2 emissions).

Figure 3.6 The figures of $PM_{2.5}$ for 25 countries in the panel



3.5.4 Results

Since dynamic panel AR(1) model requires that the dependent variable has no unit root, I first take a IPS (2003) panel unit root test for *PM2.5*. The results are reported in Table 3.26. The null hypothesis H_0: All of the series are $I(1)$ is rejected for both level form and first difference form of *PM2.5* with or without trend at the significance level of 0.001. Thus, we conclude that there is no unit root in *PM2.5* series.

Table 3.26 IPS (2003) panel unit root test for PM2.5 series (2000-2014)

Variables	IPS (2003)	
	H_0: All of the series are $I(1)$	
	H_1: At least one of the series is $I(0)$	
	Without Trend	With Trend
lnPM2.5	-8.07558(0-2)***	-7.87034(0-2)***
△ln(PM2.5)	-15.0243(0-2)***	-12.2273(0-1)***

Notes:

1. "***", significant at 0.001; "**", significant at 0.01; "*", significant at 0.05; "·" significant at 0.1.

2. The automatic lag length selection based on SIC is specified in the parentheses.

A. Baseline models

Next, we proceed to estimate dynamic panel AR(1) model specified in equation (33) and equation (34). For a purpose of comparison, we use three estimation methods: first-difference GMM estimator (Arellano and Bond, 1991), LSDVC estimator, and PFAE estimator (Han, Phillips, and Sul, 2014). However, due to the advantage of PFAE method, we draw conclusions based on PFAE estimates. The first-difference GMM estimators are estimated by Eviews 10. The LSDVC estimators are estimated by STATA 15 using the command xtlsdvc. The PFAE estimators are estimated by R version 3.4.3. The results are reported in Table 3.27 and Table 3.28.

The PFAE estimate results suggest that the same period inventory of general sustainability CSR policies (*CSR1*) has a significant negative impact on $PM_{2.5}$ annual mean population exposure. With 1% increase in the number of *CSR1*, *PM2.5* is estimated to drop by [0.030%, 0.085%] (95% C.I.) (Table 3.27, PFAE model 2). However, we do not find any significant impact of the inventory of environmental CSR policies (*CSR3*) on *PM2.5*. One possible explanation to this result is that environmental CSR policies are more specific to focus on only one aspect of environmental issues, like waste, water quality, hazardous materials, greenhouse gas emissions and so on. Some environmental CSR policies may not be directly related with air quality. However, general sustainability CSR policies usually have a broader scope on environmental issues. The *EPS* is estimated to have a significant negative impact on *PM2.5*. With 1% increase in *EPS*, *PM2.5* is estimated to drop by [0.010%, 0.054%] (95% C.I.) (Table 3.27, PFAE model 2). An interesting result is obtained for *ISO14001*. It is estimated that the level form of *ISO14001* has a significant positive impact on *PM2.5* while the first difference of *ISO14001* has a significant negative impact on *PM2.5*. The positive correlation might reflect an inverse causality that the increasing number of *ISO14001* certificates is driven by $PM_{2.5}$ pollution level. Higher $PM_{2.5}$ pollution level may cause more public concern on air quality which may provide firms more incentives to seek ISO14001 certificates to stand out in the market. However, due to the moral hazard problem as we speculated before, only firms which newly obtain ISO14001 certificates bring a significant negative impact on $PM_{2.5}$.

As far as for some other influencing factors, we find that lagged *PM2.5* has a significant positive impact on current year *PM2.5* by both PFAE and LSDVC estimations. This result confirms the specification of a dynamic panel AR(1) model. The *TotalCO2* is estimated to have a significant positive impact on *PM2.5* by PFAE estimation, consistent with our expectation. With 1% increase in *TotalCO2*, *PM2.5* is estimated to increase by [0.008%, 0.126%] (95% C.I.) (Table 3.27, PFAE model 2). The *SolidFuelCO2* is found to have a significant positive impact on *PM2.5* (Table 3.27 PFAE Model 2 and Table 3.28 PFAE Model 2). With 1% increase in *SolidFuelCO2*, *PM2.5* is estimated to increase by [0.032%, 0.216%] (95% C.I.) (Table 3.27, PFAE model 2). Comparing with the impact of *TotalCO2* on *PM2.5*, *SolidFuelCO2* has a larger impact on *PM2.5*. We do not find significant impact of *Population* on *PM2.5*. Although *Population* is expected to have negative impact on *PM2.5* since annual mean exposure to $PM_{2.5}$ is weighted by *Population*, it may also have a positive impact on *PM2.5* due to more production and consumption activities related with higher total population. Thus, the impact of *Population* on *PM2.5* is uncertain, depending on which direction of effects dominates. The *PM2.5Tech* is found to have a significant positive impact on *PM2.5*. This result may suggest that currently the development of $PM_{2.5}$ abatement technology is still driven by $PM_{2.5}$ pollution level but has not exhibited significant impacts on reducing the overall $PM_{2.5}$ level in a country.

Table 3.27 Baseline models: dynamic panel AR(1) estimate results for PM2.5 model (using CSR1)

Variables	PM2.5					
	First-Difference GMM		LSDVC		PFAE	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
PM2.5$_{i,t-1}$	0.009	0.017	0.698***	0.707***	0.243***	0.263***
	(0.123)	(0.142)	(0.055)	(0.056)	(0.021)	(0.023)
TotalCO2	-0.610	-0.388	-0.0002	-0.015	0.080**	0.067*
	(1.200)	(0.848)	(0.113)	(0.115)	(0.026)	(0.030)
Population	-0.474	11.371	0.370	0.472	-0.045	-0.0003
	(16.462)	(27.371)	(0.878)	(0.880)	(0.082)	(0.095)
SolidFuelCO2	1.048	1.130	0.107	0.113	0.059	0.124**
	(1.312)	(1.687)	(0.160)	(0.160)	(0.041)	(0.047)
CSR1	-0.162	-0.212	-0.034	-0.033	-0.068***	-0.057***
	(0.357)	(0.445)	(0.054)	(0.055)	(0.013)	(0.014)
EPS	0.070	0.071	-0.026	-0.021	-0.025*	-0.032**
	(0.171)	(0.248)	(0.040)	(0.040)	(0.010)	(0.011)
ISO14001	0.119	–	0.009	–	0.034***	–
	(0.233)	–	(0.043)	–	(0.005)	–
△ISO14001	–	0.264	–	-0.056	–	-0.029**
	–	(0.441)	–	(0.079)	–	(0.010)
PM2.5Tech$_{i,t-1}$	-0.014	0.053	0.016	0.017	0.016***	0.021***
	(0.050)	(0.125)	(.0133)	(0.013)	(0.005)	(0.005)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
n	25	25	25	25	25	25
T	13	13	14	13	15	14
N	325	325	350	325	1950	1650
Adjusted R^2	–	–	–	–	0.4446	0.4332
Statistic	J-statistic =$\chi(4)$ =9.02	J-statistic =$\chi(4)$ =8.48			F(22,1928)=71.96	F(21,1629)=61.05
Prob of Statistic	Prob(J-statistic)= 0.060624	Prob(J-statistic)= 0.075619			p-value: < 2.2e-16	p-value: < 2.2e-16

Notes:

1. "***", significant at 0.001; "**", significant at 0.01; "*", significant at 0.05; "·" significant at 0.1.

2. All variables are in logarithm forms.

3. For first-difference GMM estimator, we use two lags of *PM2.5* from 2 to 3 as instruments. Also, we use White period instrument weighting matrix and White period standard errors & covariance (d.f. corrected).

4. For LSDVC estimator, we use system GMM method to obtain initial estimates. The Bias correction is up to order $O(\frac{1}{NT^2})$. The S.E. is obtained by using 50 times bootstrap process.

5. To save space, we do not include estimates for Year Dummies.

Table 3.28 Baseline models: dynamic panel AR(1) main estimate results for PM2.5 model (using CSR3)

Variables	PM2.5					
	First-Difference GMM		LSDVC		PFAE	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
$PM2.5_{i,t-1}$	-0.018	-0.008	0.650***	0.660***	0.251***	0.274***
	(0.134)	(0.112)	(0.057)	(0.057)	(0.021)	(0.023)
TotalCO2	0.285	-0.096	-0.011	-0.026	0.064*	0.050·
	(1.461)	(0.698)	(0.111)	(0.112)	(0.027)	(0.030)
Population	-4.265	0.463	0.327	0.435	-0.064	-0.022
	(15.402)	(19.311)	(0.883)	(0.884)	(0.084)	(0.096)
SolidFuelCO2	0.006	0.554	0.128	0.138	0.062	0.124**
	(1.569)	(1.337)	(0.157)	(0.156)	(0.042)	(0.048)
CSR3	0.071	0.005	0.020	0.018	-0.009	0.004
	(0.239)	(0.235)	(0.050)	(0.049)	(0.011)	(0.013)
EPS	0.139	0.115	-0.024	-0.018	-0.018·	-0.027*
	(0.171)	(0.157)	(0.039)	(0.038)	(0.010)	(0.011)
ISO14001	-0.058	–	0.015	–	0.033***	–
	(0.308)	–	(0.043)	–	(0.005)	–
△ISO14001	–	0.089	–	-0.065	–	-0.028**
	–	(0.330)	–	(0.076)	–	(0.010)
$PM2.5Tech_{i,t-1}$	-0.013	0.010	0.015	0.016	0.017***	0.022***
	(0.065)	(0.101)	(0.014)	(0.013)	(0.005)	(0.005)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
n	25	25	25	25	25	25
T	13	13	14	13	15	14
N	325	325	350	325	1950	1650
Adjusted R^2	–	–	–	–	0.4364	0.4275
Statistic	J-statistic $=\chi(4)$ =8.78	J-statistic $=\chi(4)$ =8.46			F(22,1928)=69.63	F(21,1629)=59.67
Prob of Statistic	Prob(J-statistic)= 0.066883	Prob(J-statistic)= 0.075981			p-value: < 2.2e-16	p-value: < 2.2e-16

Notes:

1. "***", significant at 0.001; "**", significant at 0.01; "*", significant at 0.05; "·" significant at 0.1.

2. All variables are in logarithm forms.

3. For first-difference GMM estimator, we use two lags of *PM2.5* from 2 to 3 as instruments. Also, we use White period instrument weighting matrix and White period standard errors & covariance (d.f. corrected).

4. For LSDVC estimator, we use system GMM method to obtain initial estimates. The Bias correction is up to order $O(\frac{1}{NT^2})$. The S.E. is obtained by using 50 times bootstrap process.

5. To save space, we do not include estimates for Year Dummies.

B. Models with lag structures

Since there might be time lag for CSR policies and registered $PM_{2.5}$ reduction technology patents to take effects on $PM_{2.5}$ pollution level, we further estimate models with one to four years lag structures for *CSR1*, *CSR3* and *PM2.5Tech* by using PFAE estimation method. For CSR1, we include the same period of CSR1 in all lag structure specifications since it is estimated to have a significant negative impact on PM2.5. For CSR3, we do not include the current period of CSR3 for all lag structure specifications since the estimates for CSR3 in the baseline model is not significant and inclined to be positive. For all models with lag structures, we use first difference of *ISO14001* as a control variable rather than using *ISO14001* since the first difference of *ISO14001* is estimated to be a causal factor to reduce the $PM_{2.5}$ pollution level while *ISO14001* is not based on baseline models. The estimation results on models with lag structures are reported in Table 3.29 and Table 3.30.

The results of models using CSR1 show that the current period CSR1 has a robust negative impact on $PM_{2.5}$ among all lag structure specifications. And the estimates for the current period of CSR1 are between -0.11 to -0.08, significant at 1%. The 95% C.I.'s of elasticity of annual mean $PM_{2.5}$ exposure with respect to the inventory of current period CSR1 is [0.036%, 0.166%] (Table 3.29 Model 4). Besides, we also find that 3-year lag of CSR1 has a significant negative impact on PM2.5. The 95% C.I.'s of elasticity of annual mean $PM_{2.5}$ exposure with respect to the inventory of 3-year lag of CSR1 is [0.040%, 0.178%] (Table 3.29 Model 4).

However, we also find that 2-year lag of CSR1 is estimated to have a significant positive impact on $PM_{2.5}$. There might be two possible reasons for we to find a significant positive estimate of 2-year lag of CSR1 policies. First, CSR1 policies cover a broad scope of general sustainability, including CSR governance, environmental CSR and social CSR. In practice, implementing CSR1 may result in a short-run effect of increasing $PM_{2.5}$ pollution. Second, it may be due to the need to balance the total negative impacts of CSR1 policies. In fact, the positive estimate for 2-year lag of CSR1 disappear in our robustness check, which we postpone presenting it in Section 3.5.4 Robustness Check. However, considering the total effects of CSR1 from the current period up to 4-year lag, the negative impacts of CSR1 on $PM_{2.5}$ still dominate and the total effect of CSR1 on $PM_{2.5}$ is still negative.

The results of models using CSR3 show that 3-year lag of CSR3 has a robust negative impact on $PM_{2.5}$ pollution level. The estimates are between -0.113 to -0.038 among different lag structure specifications, significant at 0.1% to 5%.

For *PM2.5Tech*, models using CSR1 suggest that 4-year lag of *PM2.5Tech* has a significant negative impact on PM2.5. The estimate is -0.012, significant at 10%. However, the estimate for 4-year lag of *PM2.5Tech* in models using CSR3 is not significant. This may suggest that the impacts of *PM2.5Tech* on reducing the $PM_{2.5}$ pollution level is still limited.

The estimates for other variables of interests in models with lag structures are consistent with estimates from baseline models as we explained above.

Table 3.29 PM2.5 models with lag structures using CSR1

Variables	PM2.5 (using CSR1)				
	PFAE				
	Model 1 (1-year lag)	Model 2 (2-year lag)	Model 3 (3-year lag)	Model 4 (3-year lag)	Model 5 (4-year lag)
$PM2.5_{i,t-1}$	0.264***	0.259***	0.277***	0.272***	0.309***
	(0.023)	(0.025)	(0.028)	(0.028)	(0.030)
TotalCO2	0.085**	0.123***	0.110**	0.119**	0.063
	(0.030)	(0.035)	(0.041)	(0.041)	(0.045)
Population	-0.022	-0.108	-0.222·	-0.168	-0.029
	(0.095)	(0.110)	(0.131)	(0.130)	(0.154)
SolidFuelCO2	0.105*	0.063	0.109·	0.118·	0.166*
	(0.048)	(0.054)	(0.062)	(0.062)	(0.069)
CSR1	-0.087**	-0.109***	-0.103**	-0.101**	-0.099**
	(0.028)	(0.030)	(0.033)	(0.033)	(0.036)
$CSR1_{i,t-1}$	0.022	-0.026	-0.033	-0.036	-0.004
	(0.028)	(0.041)	(0.044)	(0.044)	(0.048)
$CSR1_{i,t-2}$	–	0.034	0.129**	0.124**	0.085·
	–	(0.032)	(0.045)	(0.045)	(0.048)
$CSR1_{i,t-3}$	–	–	-0.107**	-0.109**	-0.149**
	–	–	(0.035)	(0.035)	(0.048)
$CSR1_{i,t-4}$	–	–	–	–	0.017
	–	–	–	–	(0.039)
EPS	-0.036**	-0.015	-0.024	-0.029*	-0.012
	(0.011)	(0.013)	(0.015)	(0.015)	(0.016)
△ISO14001	-0.028**	-0.035**	-0.042**	-0.045***	-0.018
	(0.010)	(0.012)	(0.013)	(0.013)	(0.015)
$PM2.5Tech_{i,t-1}$	0.022***	–	–	–	–
	(0.005)	–	–	–	–
$PM2.5Tech_{i,t-2}$	–	0.005	–	–	–
	–	(0.006)	–	–	–
$PM2.5Tech_{i,t-3}$	–	–	0.021***	–	–
	–	–	(0.006)	–	–
$PM2.5Tech_{i,t-4}$	–	–	–	–	-0.012·
	–	–	–	–	(0.007)
Year Dummies	Yes	Yes	Yes	Yes	Yes
n	25	25	25	25	25
T	14	13	12	12	11
N	1650	1375	1125	1125	900
Adjusted R^2	0.4342	0.4581	0.471	0.4662	0.3273
F-Statistic	F(22,1628)=58.55, p-value: < 2.2e-16	F(22,1353)=53.83, p-value: < 2.2e-16	F(22,1103)=46.53, p-value: < 2.2e-16	F(21,1104)=47.79, p-value: < 2.2e-16	F(22,878)=20.91, p-value: < 2.2e-16

Table 3.30 PM2.5 models with lag structures using CSR3

Variables	PM2.5 (using CSR3)				
	PFAE				
	Model 1 (1-year lag)	Model 2 (2-year lag)	Model 3 (3-year lag)	Model 4 (3-year lag)	Model 5 (4-year lag)
$PM2.5_{i,t-1}$	0.274***	0.275***	0.282***	0.278***	0.310***
	(0.022)	(0.025)	(0.028)	(0.028)	(0.030)
TotalCO2	0.044	0.061·	0.058	0.066·	0.019
	(0.030)	(0.034)	(0.039)	(0.040)	(0.044)
Population	-0.029	-0.058	-0.158	-0.098	0.012
	(0.095)	(0.112)	(0.132)	(0.131)	(0.154)
SolidFuelCO2	0.122*	0.111*	0.164**	0.176**	0.234***
	(0.048)	(0.054)	(0.062)	(0.063)	(0.069)
$CSR3_{i,t-1}$	0.019	–	–	–	–
	(0.014)	–	–	–	–
$CSR3_{i,t-2}$	–	-0.004	–	–	–
	–	(0.015)	–	–	–
$CS33_{i,t-3}$	–	–	-0.038*	-0.041*	-0.113***
	–	–	(0.017)	(0.017)	(0.030)
$CS31_{i,t-4}$	–	–	–	–	0.034
	–	–	–	–	(0.030)
EPS	-0.024*	-0.007	-0.022	-0.027·	-0.015
	(0.012)	(0.013)	(0.015)	(0.015)	(0.016)
△ISO14001	-0.027**	-0.041***	-0.050***	-0.053***	-0.025·
	(0.010)	(0.012)	(0.013)	(0.013)	(0.015)
$PM2.5Tech_{i,t-1}$	0.023***	–	–	–	–
	(0.005)	–	–	–	–
$PM2.5Tech_{i,t-2}$	–	0.006	–	–	–
	–	(0.006)	–	–	–
$PM2.5Tech_{i,t-3}$	–	–	0.022***	–	–
	–	–	(0.006)	–	–
$PM2.5Tech_{i,t-4}$	–	–	–	–	-0.011
	–	–	–	–	(0.007)
Year Dummies	Yes	Yes	Yes	Yes	Yes
n	25	25	25	25	25
T	14	13	12	12	11
N	1650	1375	1125	1125	900
Adjusted R^2	0.4281	0.4426	0.4569	0.4516	0.3134
F-Statistic	F(21,1629)=59.83, p-value: < 2.2e-16	F(20,1355)=55.59, p-value: < 2.2e-16	F(19,1106)=50.81, p-value: < 2.2e-16	F(18,1107)=52.46, p-value: < 2.2e-16	F(19,881)=22.63, p-value: < 2.2e-16

3.5.5 Robustness Check

Since some countries do not issue any general sustainability CSR policies or environmental CSR policies during the period over 2000 to 2014 we examined, there might be a problem of outliers in the dimension of CSR policies which may cause estimates for CSR policies to be misleading. To check the robustness of our estimates, particularly for CSR policies, we re-estimate models by using PFAE method on a smaller sample which exclude countries which the inventory of general sustainability CSR policies or environmental CSR policies is all zero for all years.

For *CSR1*, we get a smaller sample which includes 17 countries: Austria, China, Finland, France, Germany, Hungary, India, Italy, Japan, Netherlands, Portugal, Spain, Sweden, Turkey, UK, and U.S.A. In another word, 8 countries are dropped because *CSR1* is zero in all years: Belgium, Czech Republic, Greece, Ireland, Poland, Slovakia, South Korea, Switzerland.

For *CSR3*, we get a smaller sample which includes 21 countries. In another word, 4 countries are dropped because *CSR3* is zero in all years: Czech Republic, Poland, Slovakia, and Switzerland.

The results of robustness check are presented in Appendix B.3. Robustness Check Table B- 22 and Table B-23. The results show that both current period of CSR1 and 3-year lag of CSR1 have significant negative impacts on PM2.5. Instead of 3-year lag of CSR3, 4-year lag of CSR3 has a significant negative impact on PM2.5. These results are basically consistent with what we have by using the full sample. Besides, estimates for other control variables are consistent with estimates on the full sample as well.

3.6 Conclusions and Policy Implications

In this chapter, we analyzed the effects of CSR policies on energy usage efficiency measured by energy intensity, total CO_2 emissions characterized by carbon intensity of energy, and $PM_{2.5}$ pollution level of a country based on a panel data set of 25 developed and developing countries from 2000-2014.

Based on dynamic panel model estimation, we find that both the current period and 3-yer lag of inventory of general sustainability CRS reporting regulation policies (CSR1) have significant impacts on reducing $PM_{2.5}$ pollution levels. The 95% C.I.'s of elasticity of annual mean $PM_{2.5}$ exposure with respect to the inventory of current period CSR1 is [0.036%, 0.166%] (Table 3.29 Model 4). And the 95% C.I.'s of elasticity of annual mean $PM_{2.5}$

exposure with respect to the inventory of 3-year lag of CSR1 is [0.040%, 0.178%] (Table 3.29 Model 4). The inventory of 3-year lag of environmental CSR reporting regulation policies (CSR3) is also estimated to have a negative impact on $PM_{2.5}$ pollution levels. The 95% C.I.'s of elasticity of annual mean $PM_{2.5}$ exposure with respect to the inventory of 3-year lag of CSR3 is [0.008%, 0.074%] (Table 3.30 Model 4).

However, based on panel cointegration tests and cointegrating relations analysis, we do not find any significant impact of the inventory of CSR1 or environmental CSR reporting regulation instruments (CSR3) on carbon intensity of energy. Particularly, we find that 3-year lag of the inventory of CSR3 has a significant positive impact on energy intensity. This might be due to the reason that all CSR reporting policies on pollution abatement and pollution control are classified into the category of environmental CSR policies. More environmental CSR policies on pollution control may have a significant effect on increasing the cost to producers to meet the requirements or expected standards in the short run. However, it is likely that the cost on pollution control or abatement may be balanced over a longer time period and the negative effect on firms' energy efficiency may disappear in the long run.

We also find that the environmental policy stringency index (EPS) has significant impacts on reducing energy intensity, carbon intensity of energy, and $PM_{2.5}$ pollution levels. However, the impacts of EPS on energy intensity and carbon intensity differ depending on the length of lags. For energy intensity, we find that both 2-year lag and 3-year lag of EPS have significant impacts on reducing energy intensity. The estimate indicates that with 1% increase of 2-year lag of EPS, the energy intensity is estimated to drop by [0.00165%, 0.0523%] (95% C.I.). And with 1% increase of 3-year lag of EPS, the energy intensity is estimated to drop by [0.0127%, 0.0686%] (95% C.I.). For carbon intensity of energy, we find that higher carbon intensity of energy result in higher EPS in the same period. However, 6-year lag of EPS has a significant impact on reducing carbon intensity of energy. With 1% increase in EPS_{t-6}, $(CO_2/E)_t$ is reduced by [0.000649%, 0.0385%] (95% C.I.). For $PM_{2.5}$ pollution level, with 1% increase in *EPS*, *PM2.5* is estimated to drop by [0.010%, 0.054%] (95% C.I.).

Compared with the impacts of market based environmental policies and emission limit standards represented by EPS, CSR policies have relatively stronger and more significant impact on reducing $PM_{2.5}$ pollution level, much more indirect impact on energy intensity and no significant impact on carbon intensity of energy. Overall, there is no evidence that CSR policies have any impact on reducing CO_2 emissions of a country.

Besides, we find some other relating factors to a country's energy intensity, carbon intensity of energy and $PM_{2.5}$ pollution level. For energy intensity, we find that the same period aggregate R&D expenditure has a significant impact on reducing energy intensity. The relative aggregate energy price (AEPoP) has quite complicated impacts on energy intensity. It is estimated that 2-year lag and 4-year lag of AEPoP have significant impacts on increasing the energy intensity while 6-year lag, 7-year lag and 8-year lag of AEPoP have significant impacts on reducing the energy intensity. The positive impacts of AEPoP on energy intensity might be due to a combination of positive energy price elasticity of primary energy supply in the short run and inelasticity of energy demand in the short run. The negative impacts of AEPoP on energy intensity may be due to the negative elasticity of energy demand in the long run. For carbon intensity of energy, the same period renewable energy consumption rate is found to have a significant impact on reducing the carbon intensity of energy. Also, 4-year lag of the number of CO_2 emissions abatement technology is found to have a significant small impact on reducing the carbon intensity of energy. For $PM_{2.5}$ pollution level, the total CO_2 emissions and the CO_2 emissions from solid fuel combustion are found to have significant impacts on increasing $PM_{2.5}$ pollution level. An interesting result is obtained for the number of ISO14001 certificates (*ISO14001*). It is estimated that the level form of *ISO14001* has a significant positive impact on *PM2.5* while the first difference of *ISO14001* has a significant negative impact on *PM2.5*. The positive correlation might reflect an inverse causality that the increasing number of *ISO14001* certificates is driven by $PM_{2.5}$ pollution level. Higher $PM_{2.5}$ pollution level may cause more public concern on air quality which may provide firms more incentives to seek ISO14001 certificates to stand out in the market. Since the monitoring system of ISO 14001 certificates is based on a five-year review, due to the moral hazard problem, it seems that only firms which newly obtain ISO14001 certificates bring a significant impact on reducing $PM_{2.5}$ pollution level.

Currently, our measurement of CSR reporting regulation instruments is only based on the number of inventory. A better measurement of CSR reporting regulation instruments, like the stringency of CSR reporting regulation is worthy to be developed in future to have a better evaluation results on CSR reporting regulation impacts, like environmental policy stringency index developed by OECD.Stat. Another limitation of our study is the limited time periods we have in conducting panel time series analysis and panel cointegration analysis. Future studies on evaluation of CSR policies may need to further examine the robustness of our findings when more periods of CSR policies data are available. For future CSR reporting regulation, more effort on enhancing the stringency of instruments, like monitoring the CSR reports' quality, is suggested to improve the effectiveness of CSR reporting regulation.

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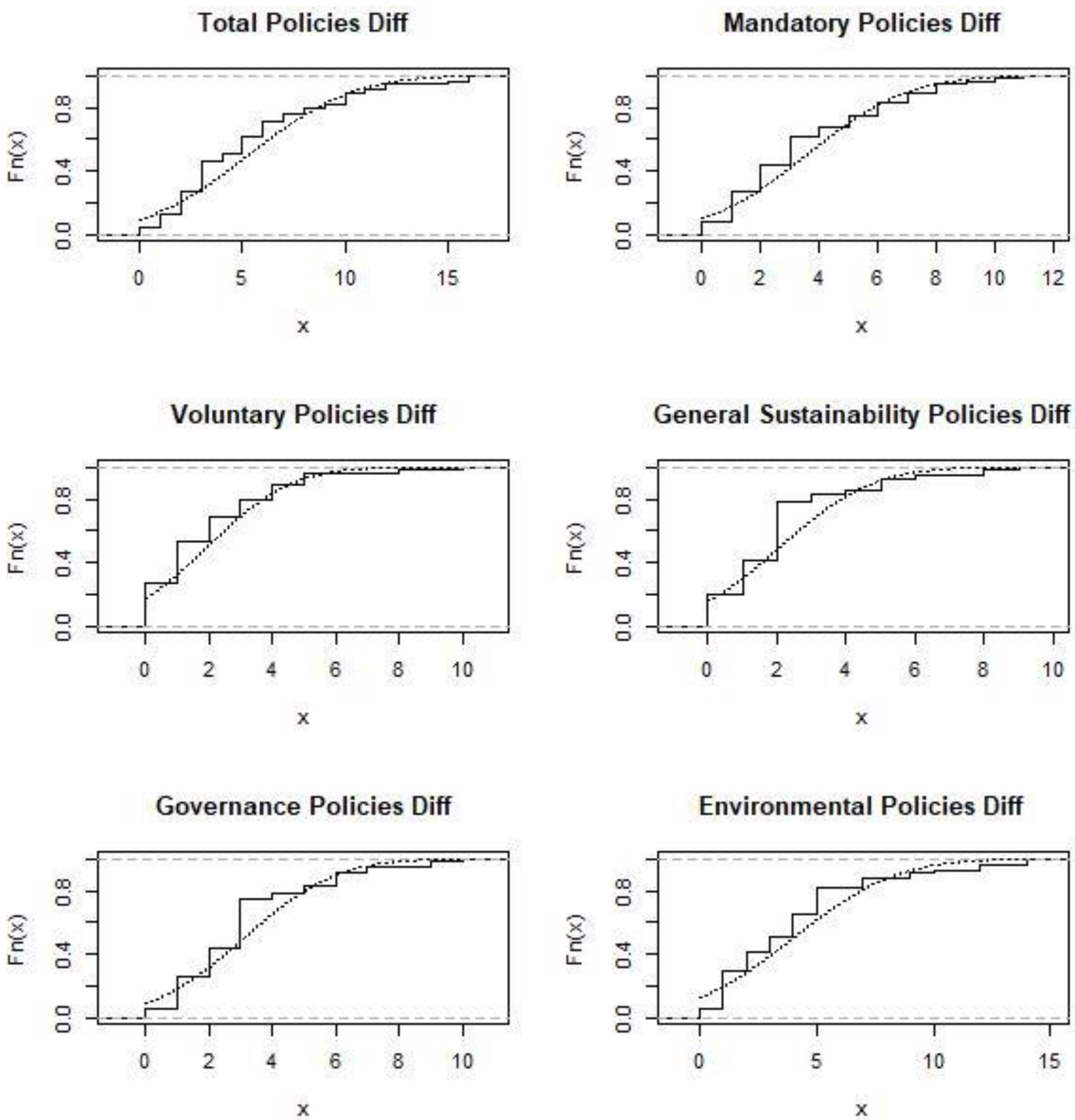
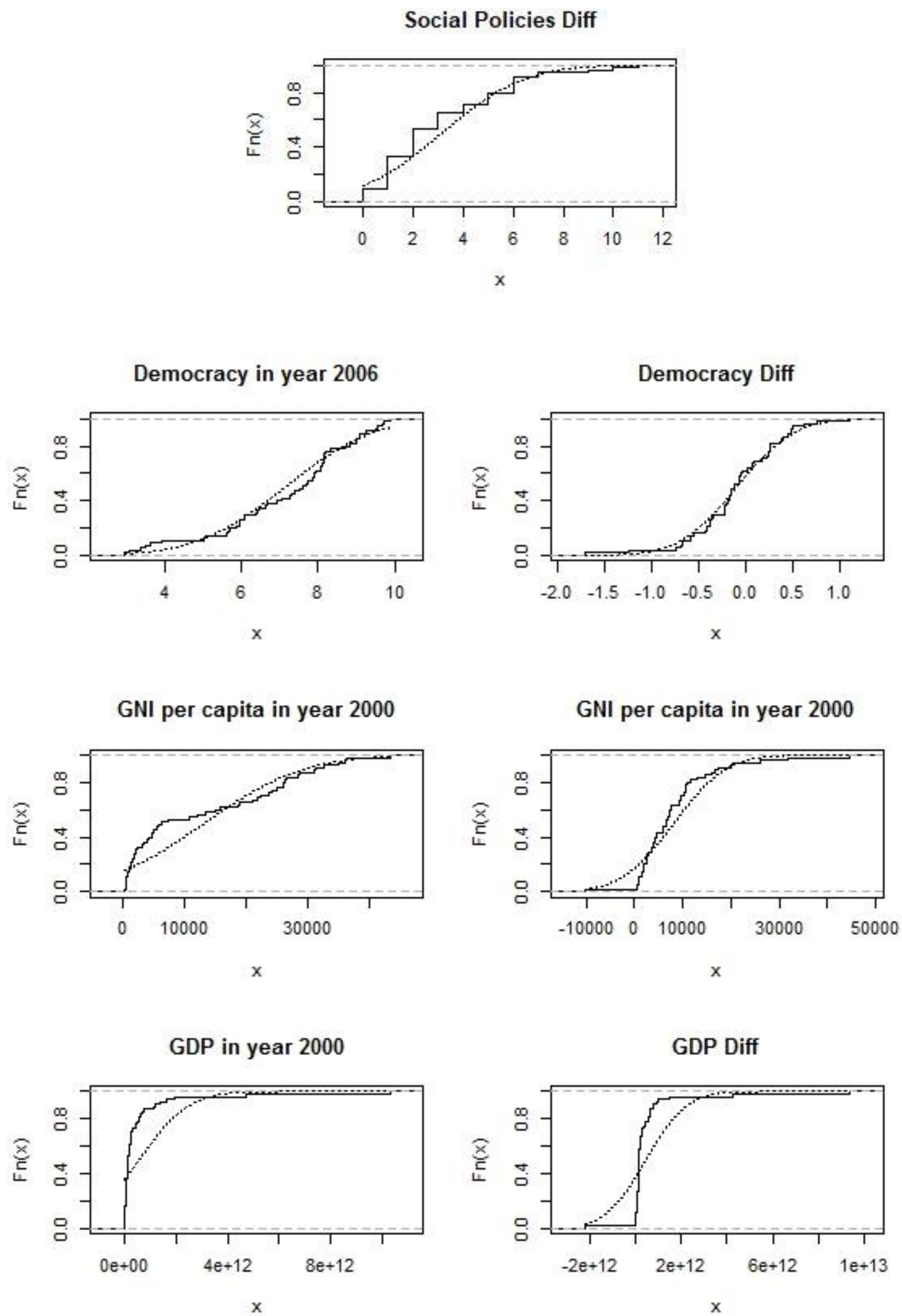
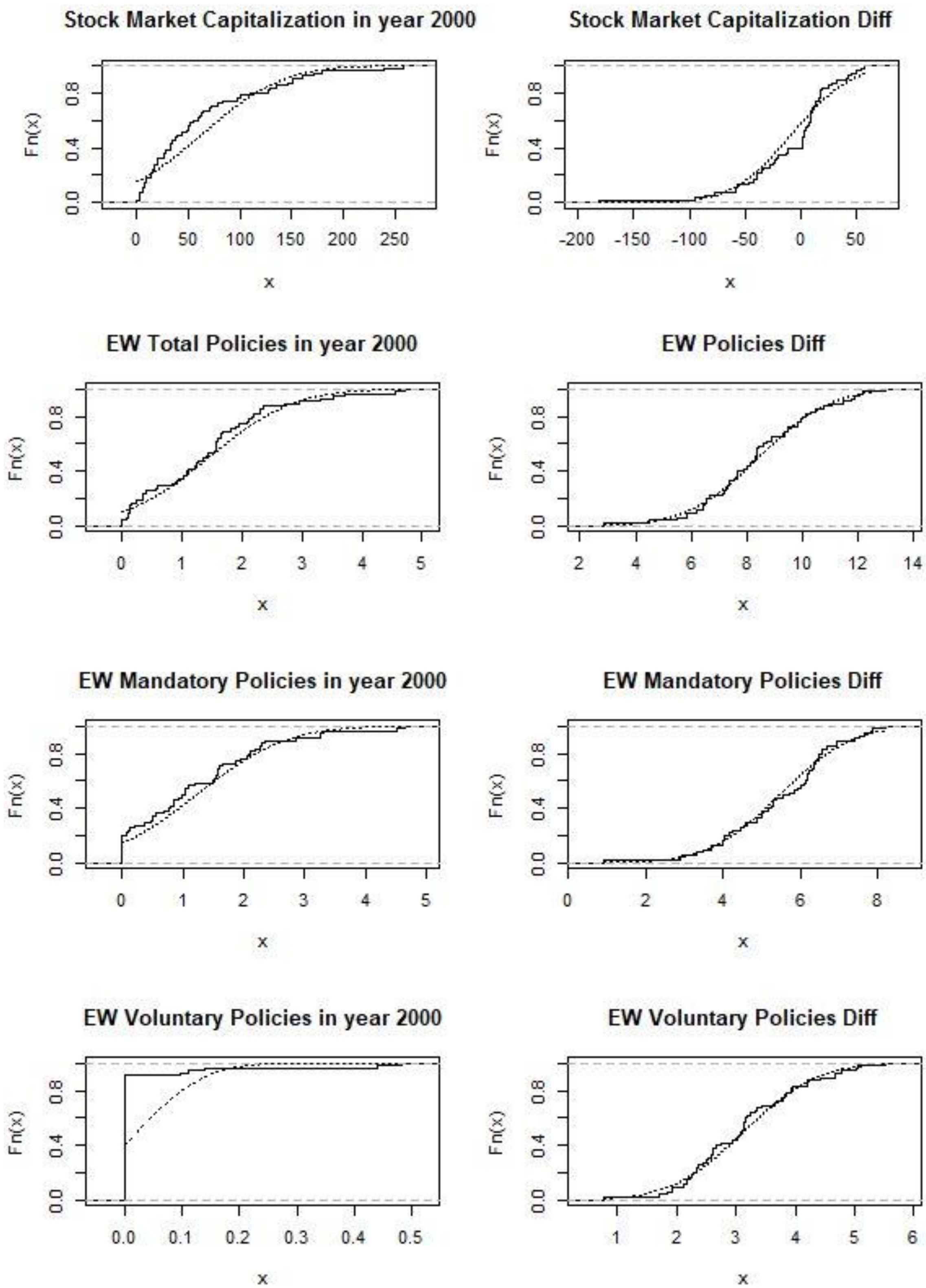
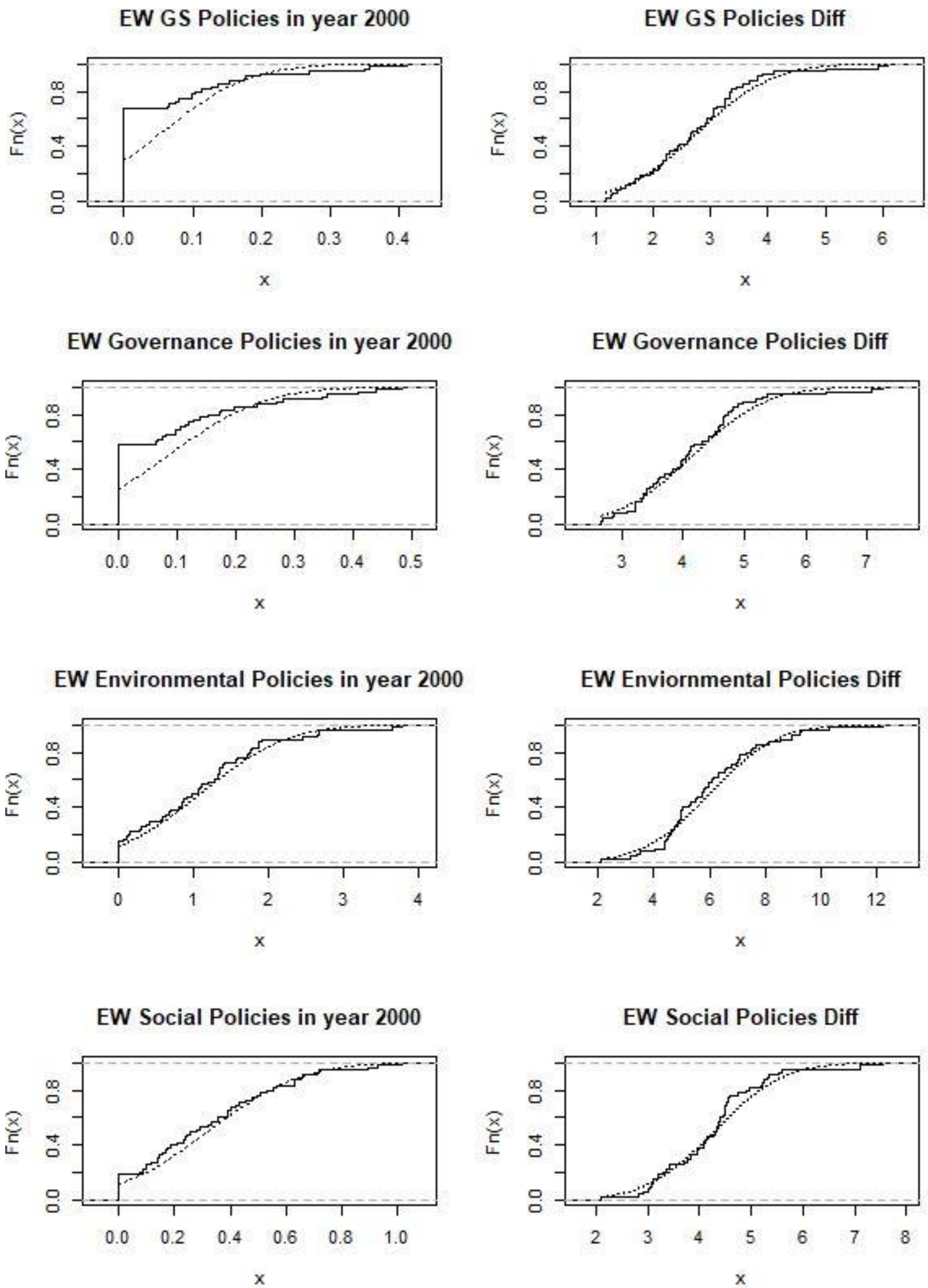
Appendix A TECHNICAL APPENDIX FOR CHAPTER 1
Appendix A.1: The C.D.F. of Level and Differences Variables[11]

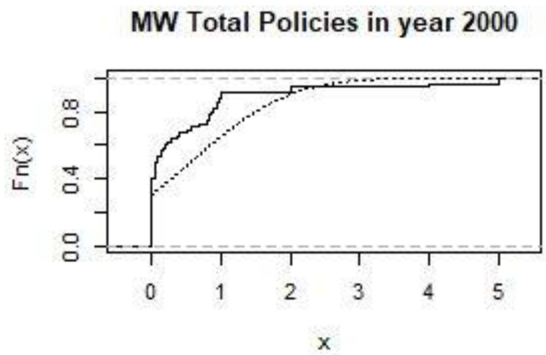


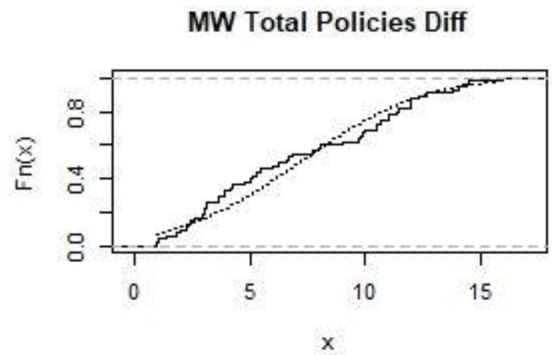
[11] "MW" means the bordering countries' weighted average. "EW" means top 5 exports destination countries' weighted average. The solid line depicted C.D.F. function. The dotted line depicted the fitted normal distribution.

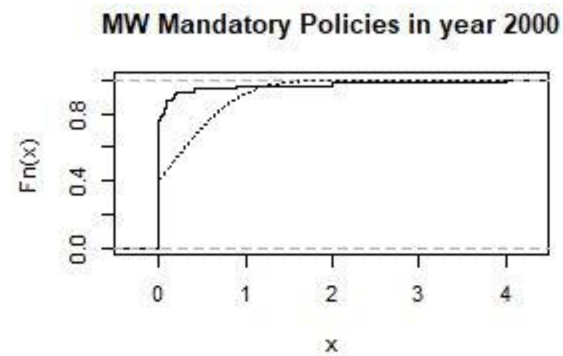

Social Policies Diff
Fn(x)
0.0
0.4
0.8
0
2
4
6
8
10
12
x
Democracy in year 2006
Fn(x)
0.0
0.4
0.8
4
6
8
10
x
Democracy Diff
Fn(x)
0.0
0.4
0.8
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
x
GNI per capita in year 2000
Fn(x)
0.0
0.4
0.8
0
10000
30000
x
GNI per capita in year 2000
Fn(x)
0.0
0.4
0.8
-10000
0
10000
30000
50000
x
GDP in year 2000
Fn(x)
0.0
0.4
0.8
0e+00
4e+12
8e+12
x
GDP Diff
Fn(x)
0.0
0.4
0.8
-2e+12
2e+12
6e+12
1e+13
x

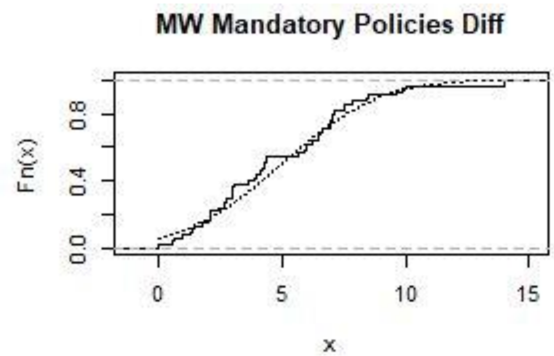

Stock Market Capitalization in year 2000
Fn(x)
0.0 0.4 0.8
0 50 100 150 200 250
x
Stock Market Capitalization Diff
Fn(x)
0.0 0.4 0.8
-200 -150 -100 -50 0 50
x
EW Total Policies in year 2000
Fn(x)
0.0 0.4 0.8
0 1 2 3 4 5
x
EW Policies Diff
Fn(x)
0.0 0.4 0.8
2 4 6 8 10 12 14
x
EW Mandatory Policies in year 2000
Fn(x)
0.0 0.4 0.8
0 1 2 3 4 5
x
EW Mandatory Policies Diff
Fn(x)
0.0 0.4 0.8
0 2 4 6 8
x
EW Voluntary Policies in year 2000
Fn(x)
0.0 0.4 0.8
0.0 0.1 0.2 0.3 0.4 0.5
x
EW Voluntary Policies Diff
Fn(x)
0.0 0.4 0.8
1 2 3 4 5 6
x

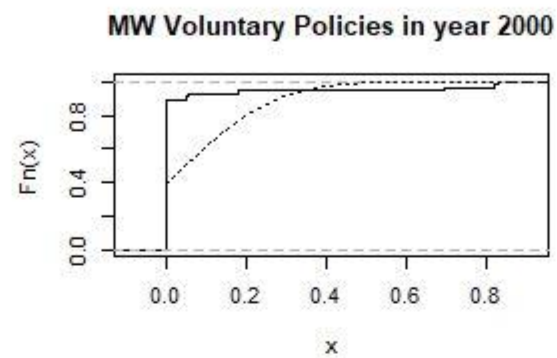

EW GS Policies in year 2000
EW GS Policies Diff
EW Governance Policies in year 2000
EW Governance Policies Diff
EW Environmental Policies in year 2000
EW Enviornmental Policies Diff
EW Social Policies in year 2000
EW Social Policies Diff
Fn(x)
x

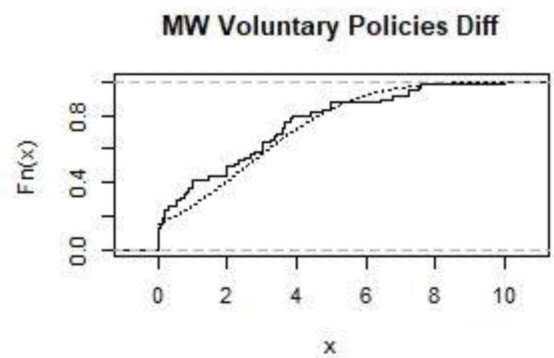

MW Total Policies in year 2000
Fn(x)
x

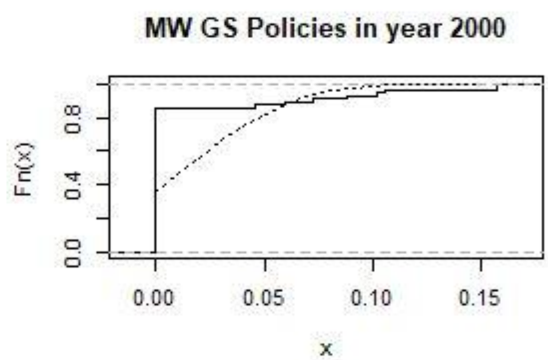

MW Total Policies Diff
Fn(x)
x

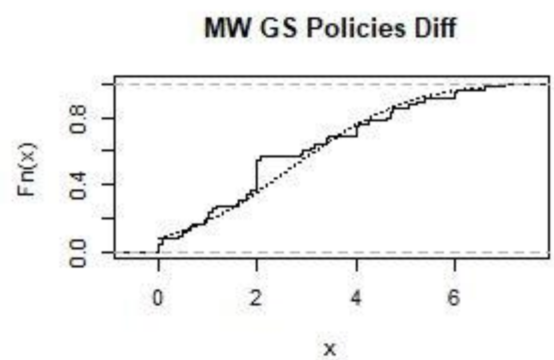

MW Mandatory Policies in year 2000
Fn(x)
x

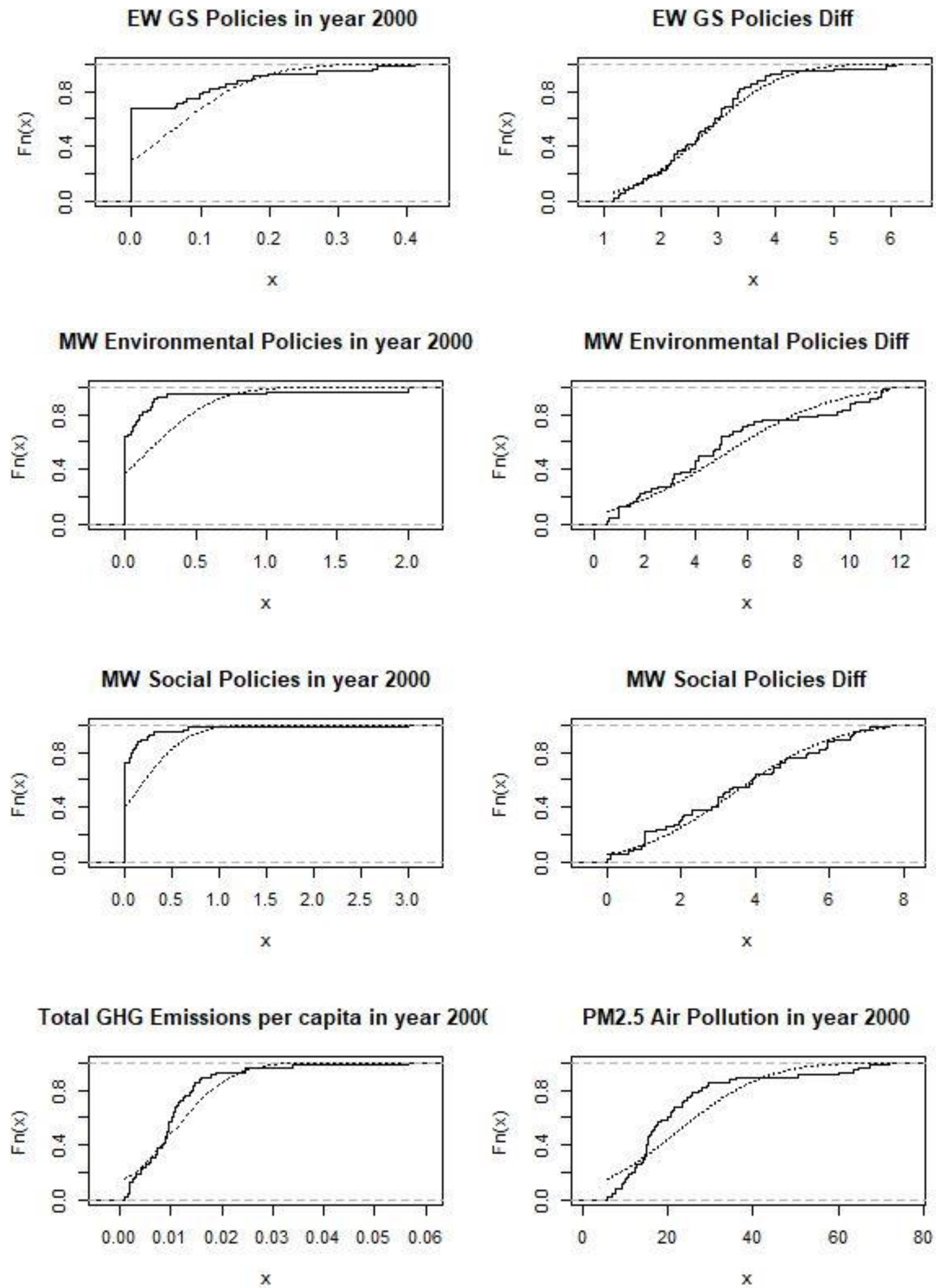

MW Mandatory Policies Diff
Fn(x)
x

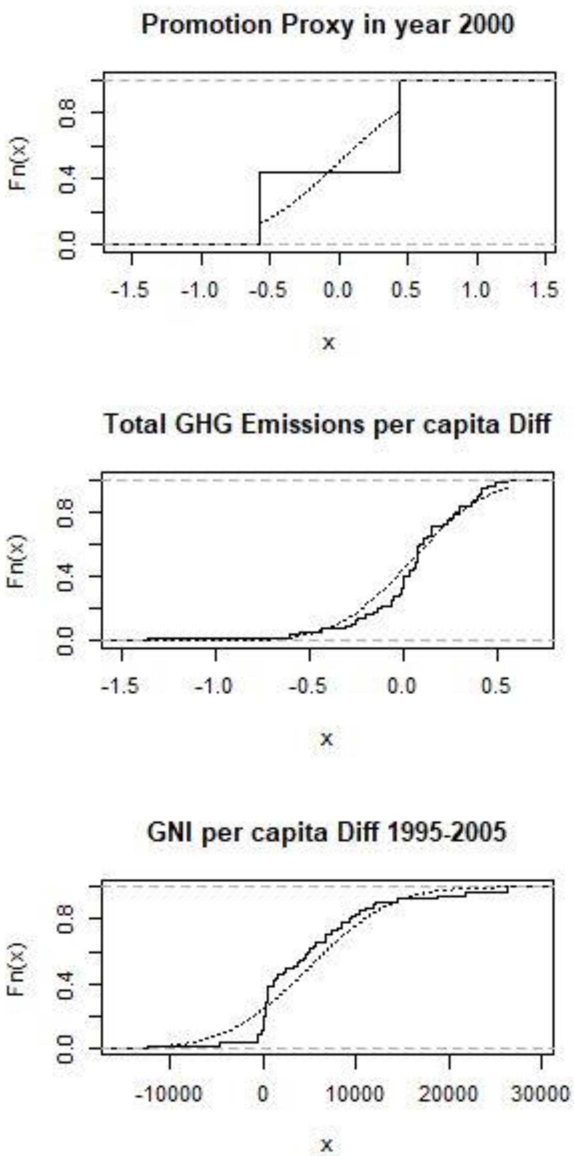

MW Voluntary Policies in year 2000
Fn(x)
x


MW Voluntary Policies Diff
Fn(x)
x


MW GS Policies in year 2000
Fn(x)
x

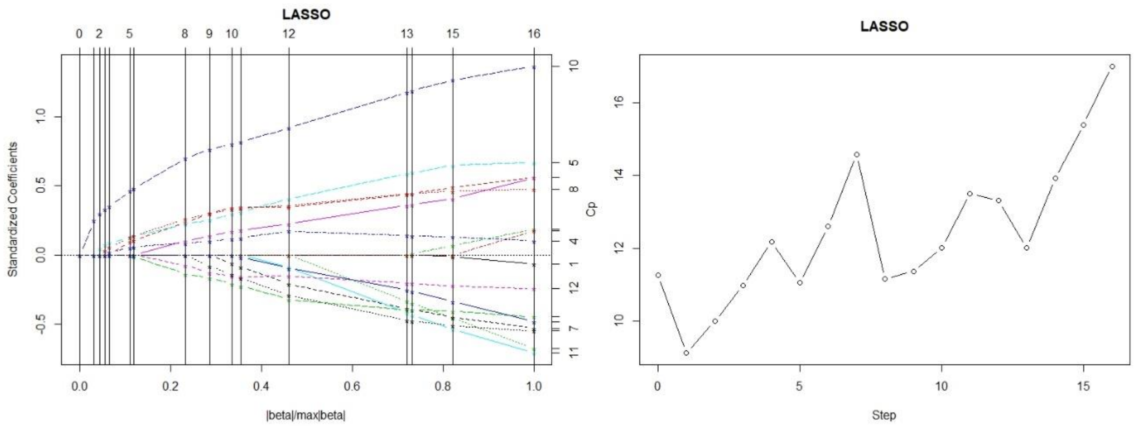

MW GS Policies Diff
Fn(x)
x


EW GS Policies in year 2000
EW GS Policies Diff
MW Environmental Policies in year 2000
MW Environmental Policies Diff
MW Social Policies in year 2000
MW Social Policies Diff
Total GHG Emissions per capita in year 200(
PM2.5 Air Pollution in year 2000
Fn(x)
x

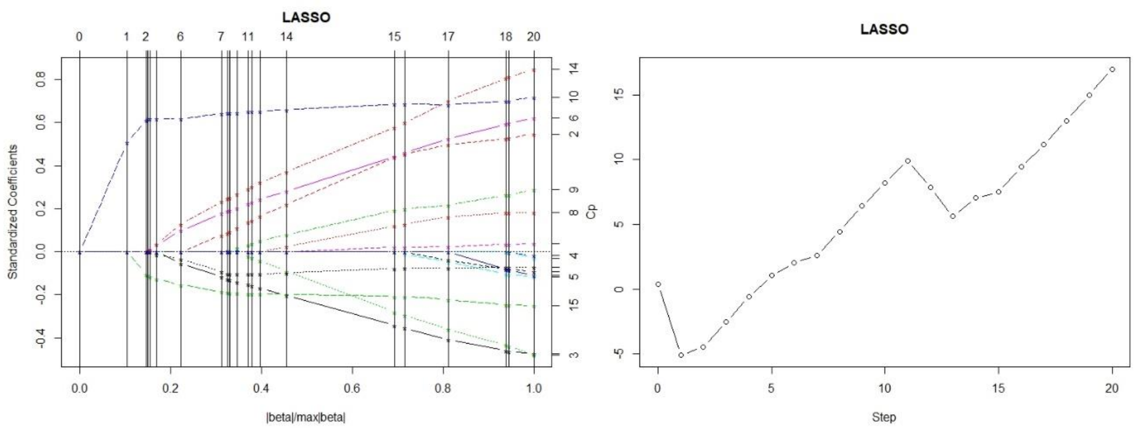

Promotion Proxy in year 2000
Fn(x)
0.0
0.4
0.8
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
x
Promotion Proxy Diff
Fn(x)
0.0
0.4
0.8
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
x
Total GHG Emissions per capita Diff
Fn(x)
0.0
0.4
0.8
-1.5
-1.0
-0.5
0.0
0.5
x
PM2.5 Air Pollution Diff
Fn(x)
0.0
0.4
0.8
-20
-10
0
10
x
GNI per capita Diff 1995-2005
Fn(x)
0.0
0.4
0.8
-10000
0
10000
20000
30000
x
GDP Diff 1995-2005
Fn(x)
0.0
0.4
0.8
-2e+12
0e+00
2e+12
4e+12
x

Appendix A.2: LARS-Lasso Estimates Coefficients Plots (left) and C_p Plots

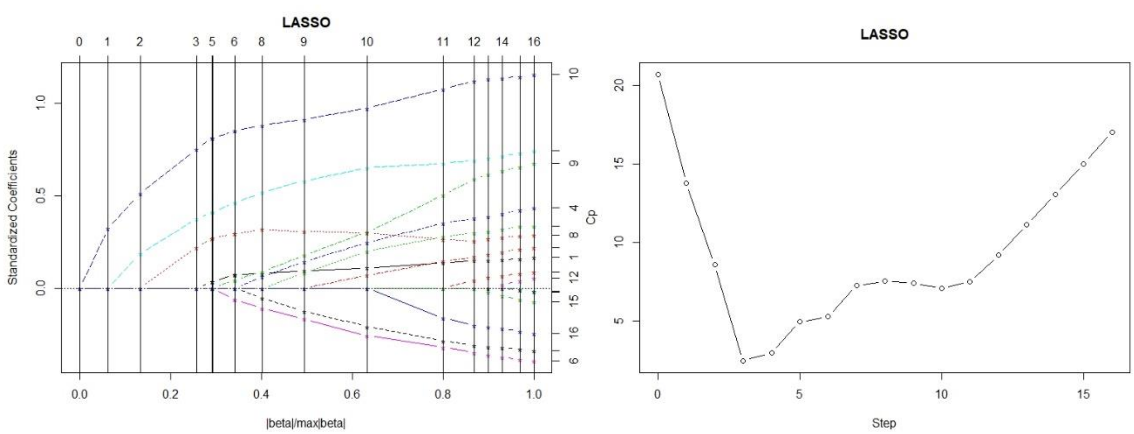
Equation 1: Total CSR Policies



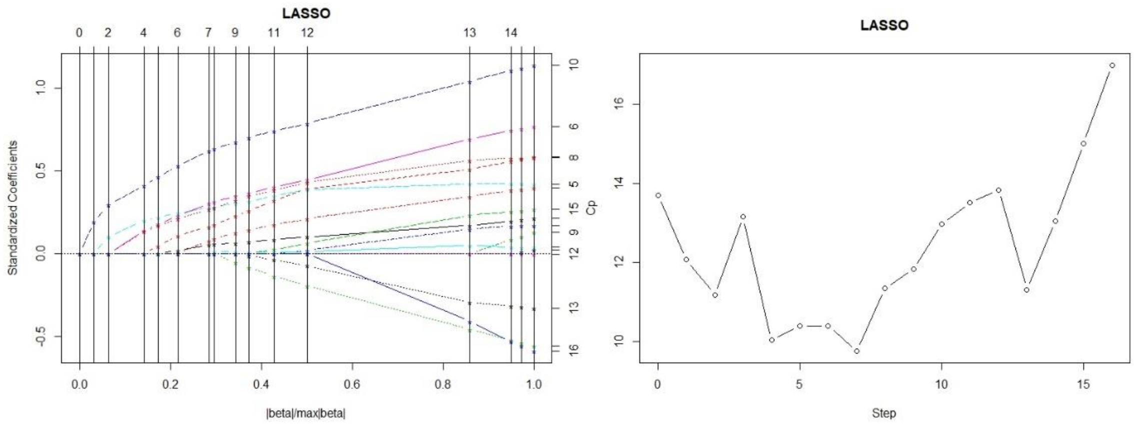
Equation 2: Mandatory CSR Policies



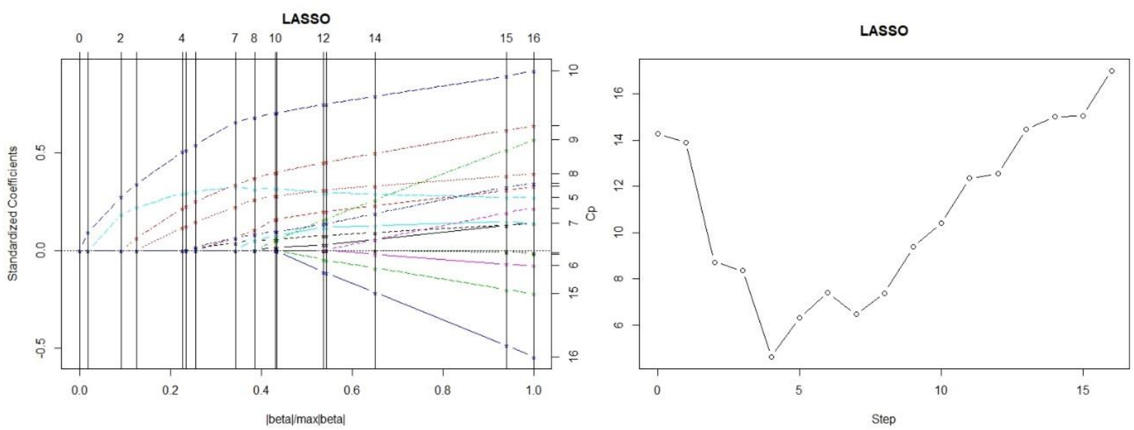
Equation 3: Voluntary CSR Policies



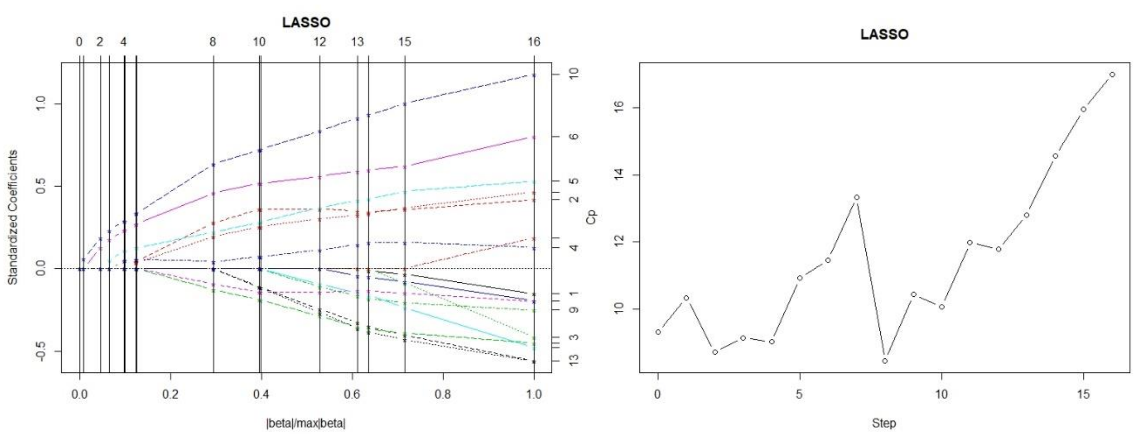
Equation 4: General Sustainability CSR Policies



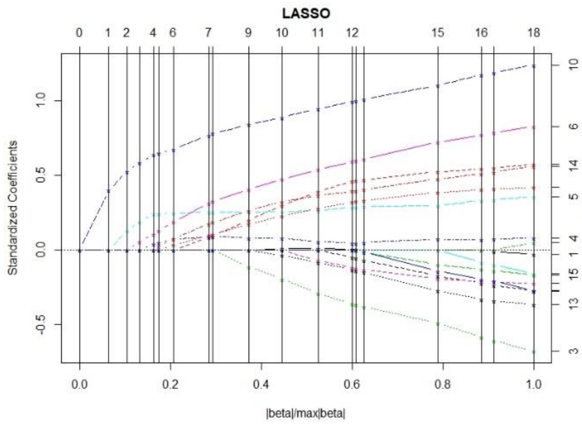
Equation 5: CSR Governance Policies

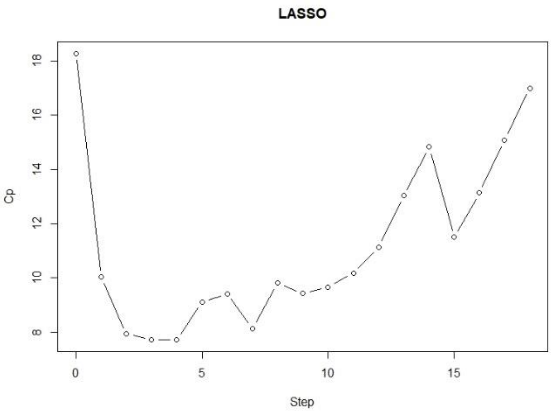


Equation 6: Environmental CSR Policies



Equation 7: Social CSR Policies





Appendix A.3: Robustness Check

Table A- 1 The SUR Estimates for Complete Models with Lagged Differences of Social Economic Factors

Policies Change *Long Differences in logs-Long Differences in logs & Level in logs*	(1) Total	(2) Mandatory	(3) Voluntary	(4) General Sustainability	(5) CSR Governance	(6) Environmental CSR	(7) Social CSR
Intercept	**-1.279**	**-1.723**	**-2.169·**	**-1.445**	**-1.060**	-1.106	**-1.552**
	(1.145)	(1.172)	(1.072)	(1.127)	(0.935)	(1.149)	(1.073)
Differences in log Democracy 2006 and log Democracy 2015	0.438	-0.818	0.855	0.447	0.707	-0.324	0.177
	(1.185)	(1.256)	(1.118)	(1.155)	(0.945)	(1.201)	(1.098)
Differences in log GDP 1995 and log GDP 2005	-0.016	0.309	-0.249	-0.137	-0.240	0.076	-0.204
	(0.346)	(0.370)	(0.322)	(0.342)	(0.276)	(0.363)	(0.325)
Differences in log Stock Market Capitalization (%GDP) 1995 and log Stock Market Capitalization (%GDP) 2005	0.031	0.094	-0.025	0.036	0.021	0.023	0.059
	(0.110)	(0.117)	(0.103)	(0.106)	(0.088)	(0.111)	(0.101)
Differences in log GHG emissions per capita 1995 and log GHG emissions per capita 2005	**0.615**	0.343	**0.577**	**0.593**	**0.664**	**0.548**	**0.757**
	(0.524)	(0.549)	(0.501)	(0.512)	(0.419)	(0.538)	(0.505)
Differences in log PM2.5 air pollution 1995 and log PM2.5 air pollution 2005	**1.480·**	0.106	**1.293**	0.671	0.460	**1.312**	0.733
	(0.868)	(0.847)	(0.809)	(0.750)	(0.634)	(0.838)	(0.735)
Differences in log Weighted Average Top 5 Exports Destination Countries' CSR Policies 2000 and log Weighted Average Top 5 Exports Destination Countries' CSR Policies 2015	-0.074	0.371	**-0.327**	**0.550·**	-0.245	0.261	**0.529·**
	(0.378)	(0.388)	(0.298)	(0.290)	(0.331)	(0.335)	(0.313)
Differences in log Weighted Average Bordering Countries' CSR Policies 2000 and log Weighted Average Bordering Countries' CSR Policies 2015	**-0.166**	-0.027	**-0.156**	**-0.151**	0.050	**-0.183**	**-0.183·**
	(0.119)	(0.134)	(0.111)	(0.116)	(0.096)	(0.115)	(0.105)
Differences in log International Organizations' Accumulative Promotion Effort 2000 and log International Organizations' Accumulative Promotion Effort2015	**0.029**	0.002	0.003	**0.039**	0.016	**0.030**	0.024
	(0.028)	(0.029)	(0.031)	(0.027)	(0.024)	(0.029)	(0.026)
Log Democracy 2006	-0.008	0.299	**0.639**	-0.135	0.320	-0.310	-0.194
	(0.510)	(0.526)	(0.478)	(0.497)	(0.406)	(0.513)	(0.473)
Log GDP 2000	**0.236****	**0.160·**	**0.230****	**0.174***	**0.155***	**0.199***	**0.190****
	(0.077)	(0.080)	(0.071)	(0.074)	(0.060)	(0.079)	(0.069)
Log Stock Market Capitalization (%GDP) 2000	-0.104	0.035	-0.108	0.040	0.006	-0.099	0.048
	(0.114)	(0.119)	(0.112)	(0.110)	(0.091)	(0.117)	(0.105)
Log GHG emissions per capita 2000	-0.076	-0.004	0.043	0.020	0.109	-0.099	-0.029
	(0.155)	(0.166)	(0.142)	(0.150)	(0.121)	(0.163)	(0.145)
Log PM2.5 Air Pollution (mean annual exposure by micrograms per cubic meter) 2000	**-0.330**	-0.169	-0.002	-0.178	-0.046	**-0.323**	**-0.250**
	(0.217)	(0.227)	(0.203)	(0.214)	(0.176)	(0.220)	(0.202)
Log Weighted Average Top 5 Exports Destination Countries' CSR Policies 2000	**-0.448**	**0.425**	-0.960	**0.870**	**0.972·**	-0.105	**0.484**
	(0.331)	(0.309)	(1.084)	(0.672)	(0.529)	(0.300)	(0.400)
Log Weighted Average Bordering Countries' CSR Policies 2000	-0.050	-0.201	0.679	-1.455	0.017	-0.109	**-0.327**
	(0.176)	(0.282)	(0.717)	(1.972)	(0.337)	(0.316)	(0.261)
Log International Organizations' Accumulative Promotion Effort till year 2000	-0.125	-0.088	-0.106	-0.116	**-0.159**	-0.008	-0.074
	(0.148)	(0.151)	(0.142)	(0.146)	(0.121)	(0.151)	(0.138)
Adjusted R^2	0.02358 8	-0.026583	0.235806	0.059874	0.135487	0.026153	0.16567 6

Table A- 2 The LARS-Lasso Refined Models Estimates with Lagged Social Economic Factors

Policies Change *Long Differences in logs-Long Differences in logs & Level in logs*	(1) Total	(2) Mandatory	(3) Voluntary	(4) General Sustainability	(5) CSR Governance	(6) Environmental CSR	(7) Social CSR
Intercept	**-0.846**	**-1.246***	**-1.632****	**-1.524***	**-1.342***	**-1.049·**	**-1.706****
	(0.592)	(0.560)	(0.601)	(0.577)	(0.542)	(0.606)	(0.534)
Differences in log Democracy 2006 and log Democracy 2015	–	–	–	0.571	–	–	–
	–	–	–	(0.834)	–	–	–
Differences in log GDP 1995 and log GDP 2005	–	–	-0.136	–	-0.042	–	–
	–	–	(0.250)	–	(0.219)	–	–
Differences in log Stock Market Capitalization (%GDP) 1995 and log Stock Market Capitalization (%GDP) 2005	–	–	**-0.088**	–	–	–	–
	–	–	(0.078)	–	–	–	–
Differences in log GHG emissions per capita 1995 and log GHG emissions per capita 2005	–	–	–	–	–	–	–
	–	–	–	–	–	–	–
Differences in log PM2.5 air pollution 1995 and log PM2.5 air pollution 2005	–	–	**0.934·**	**0.866**	**0.889***	–	**1.039***
	–	–	(0.554)	(0.523)	(0.434)	–	(0.479)
Differences in log Weighted Average Top 5 Exports Destination Countries' CSR Policies 2000 and log Weighted Average Top 5 Exports Destination Countries' CSR Policies 2015	–	–	–	**0.624***	–	**0.505·**	**0.429**
	–	–	–	(0.307)	–	(0.265)	(0.290)
Differences in log Weighted Average Bordering Countries' CSR Policies 2000 and log Weighted Average Bordering Countries' CSR Policies 2015	–	–	–	–	–	–	–
	–	–	–	–	–	–	–
Differences in log International Organizations' Accumulative Promotion Effort 2000 and log International Organizations' Accumulative Promotion Effort2015	–	–	**0.042***	**0.037·**	**0.028**	–	–
	–	–	(0.019)	(0.021)	(0.017)	–	–
Log GDP 2000	**0.132***	**0.160****	**0.185*****	**0.145****	**0.165*****	**0.114***	**0.175*****
	(0.053)	(0.050)	(0.052)	(0.049)	(0.046)	(0.053)	(0.046)
Log Weighted Average Top 5 Exports Destination Countries' CSR Policies 2000	–	–	–	–	**1.644***	–	–
	–	–	–	–	(0.694)	–	–
N	55	55	55	55	55	55	55
Adjusted R^2	0.08872	0.1465	0.3371	0.1932	0.2646	0.1139	0.2622
F-Statistics	F(1,53) =6.258 , p-value: 0.01549	F(1,53)=10 .27, p-value: 0.002289	F(5,49)=6. 491, p-value: 0.0001055	F(5,49)=3.586, p-value: 0.007655	F(5,49)=4.8 86, p-value: 0.001051	F(2,52)=4.471, p-value: 0.01615	F(3,51) =7.398, p-value: 0.00033 09

Appendix B TECHNICAL APPENDIX FOR CHAPTER 3

Appendix B.1 Descriptive Statistics

Figure B- 1 The graphs of aggregate R&D in logarithm of countries in the sample

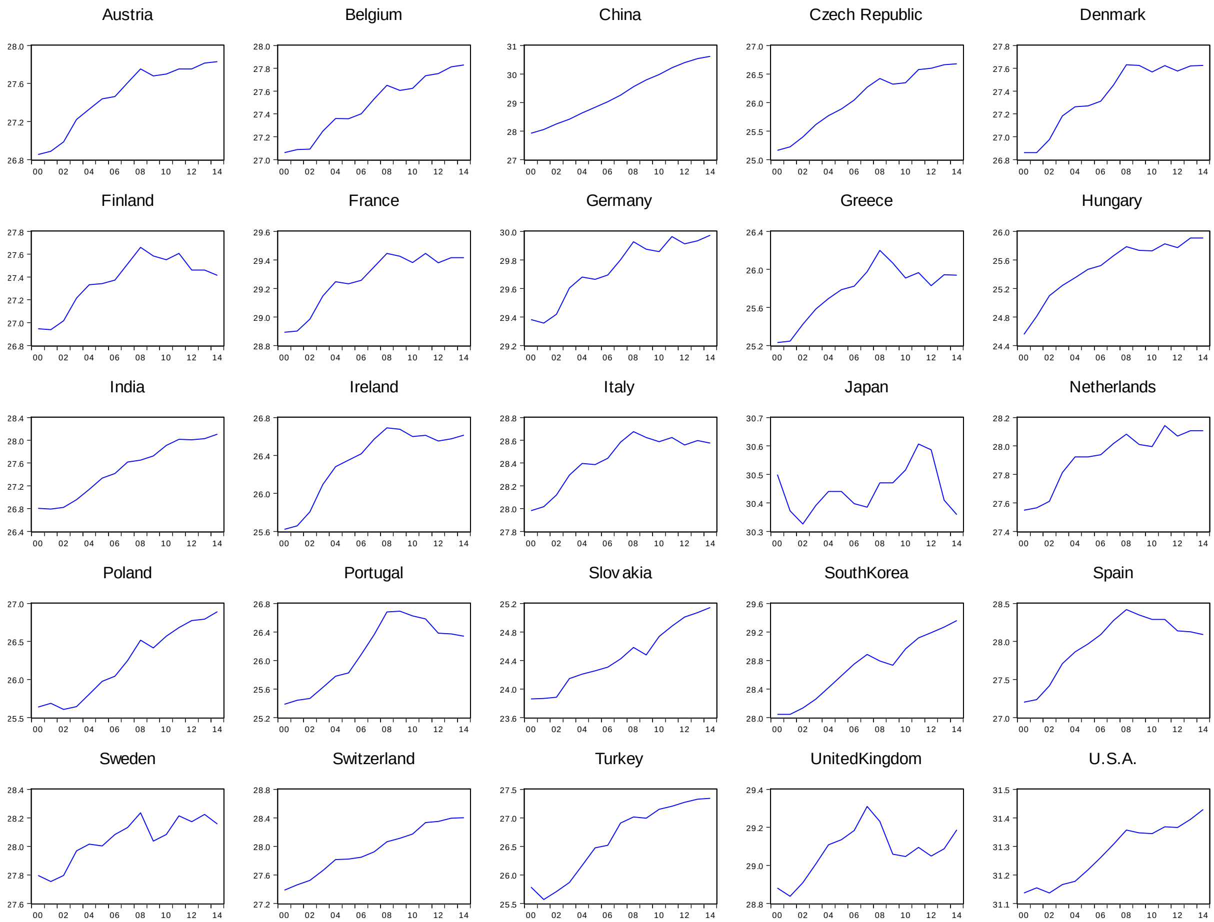


Figure B- 2 The graphs of general sustainability CSR policies (CSR1) in logarithm of countries in the sample

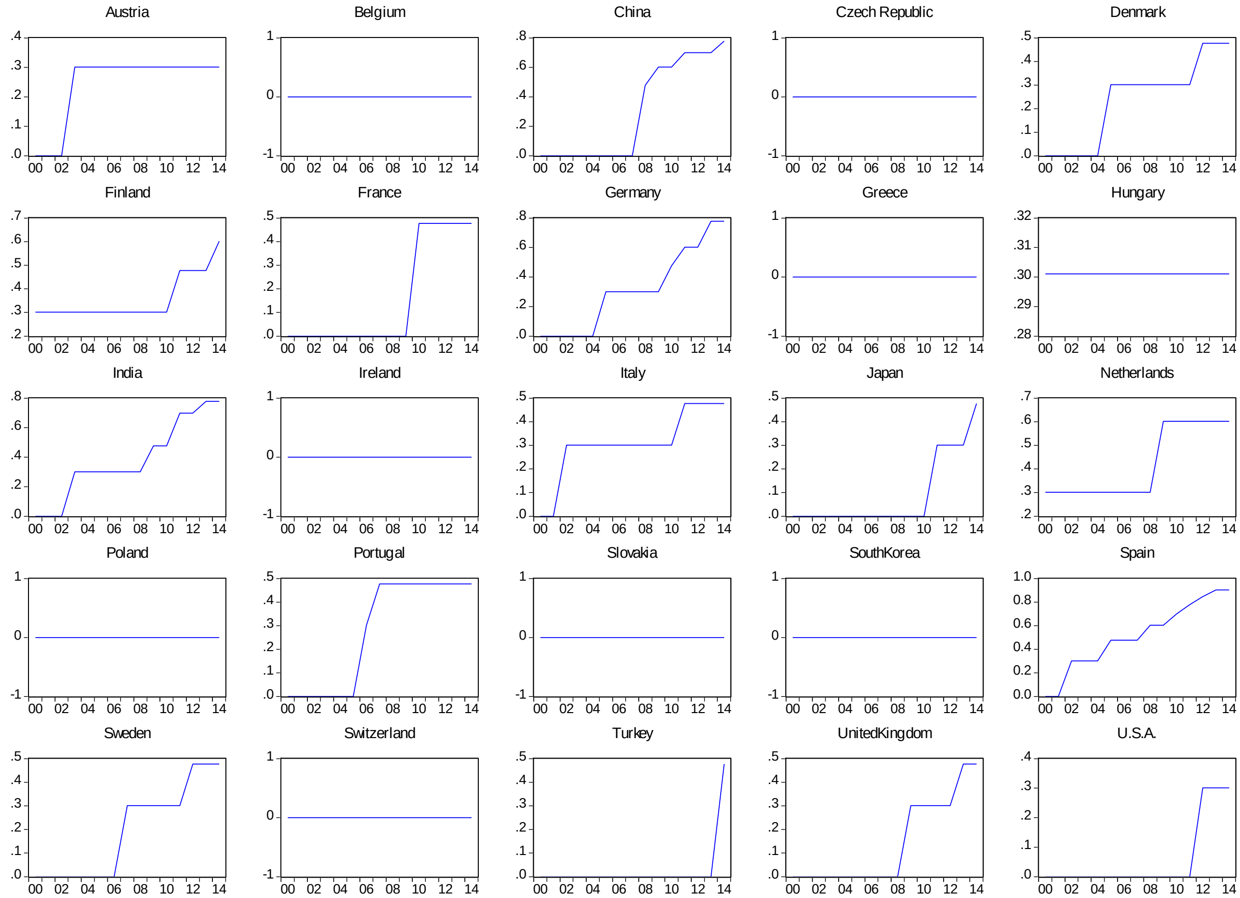


Figure B- 3 The graphs of environmental CSR policies (CSR3) in logarithm of countries in the sample

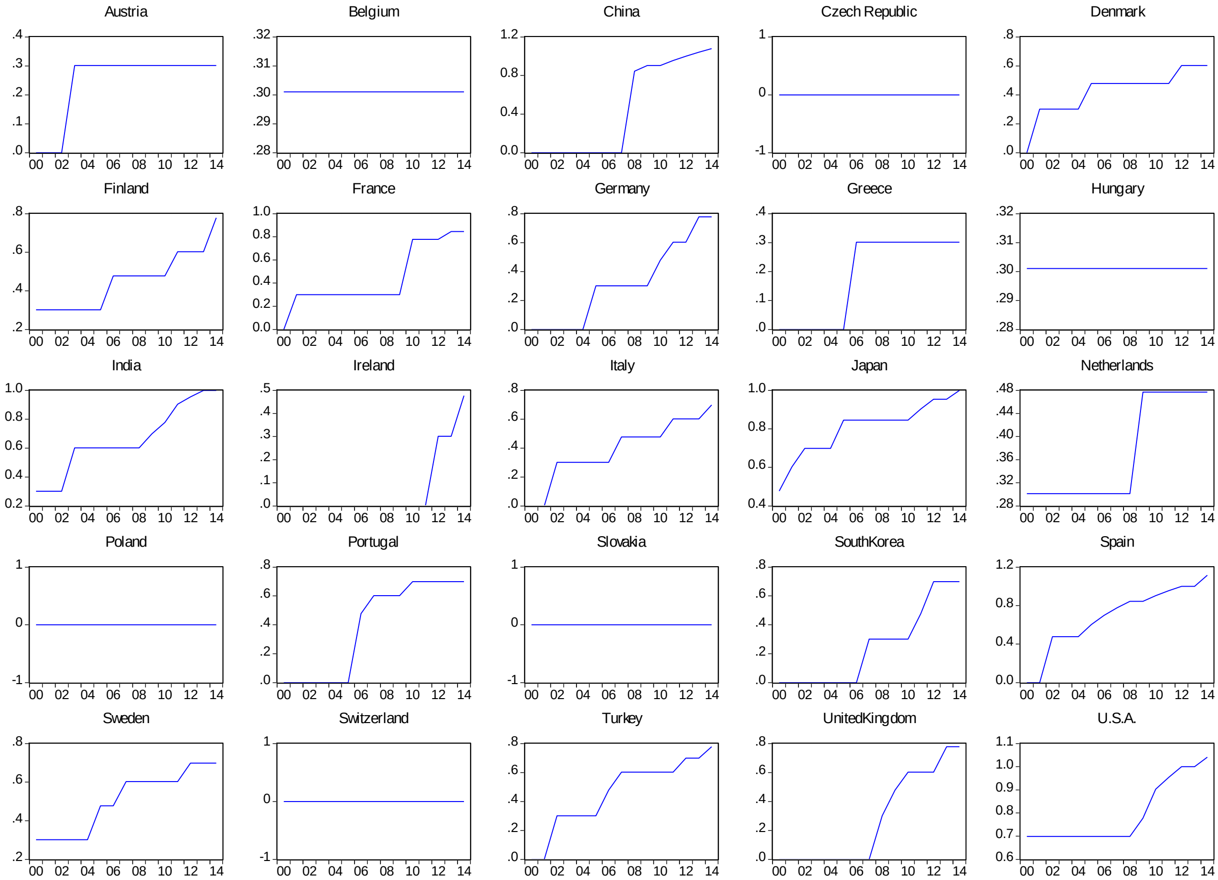


Figure B- 4 The graphs of EPS in logarithm of countries in the sample

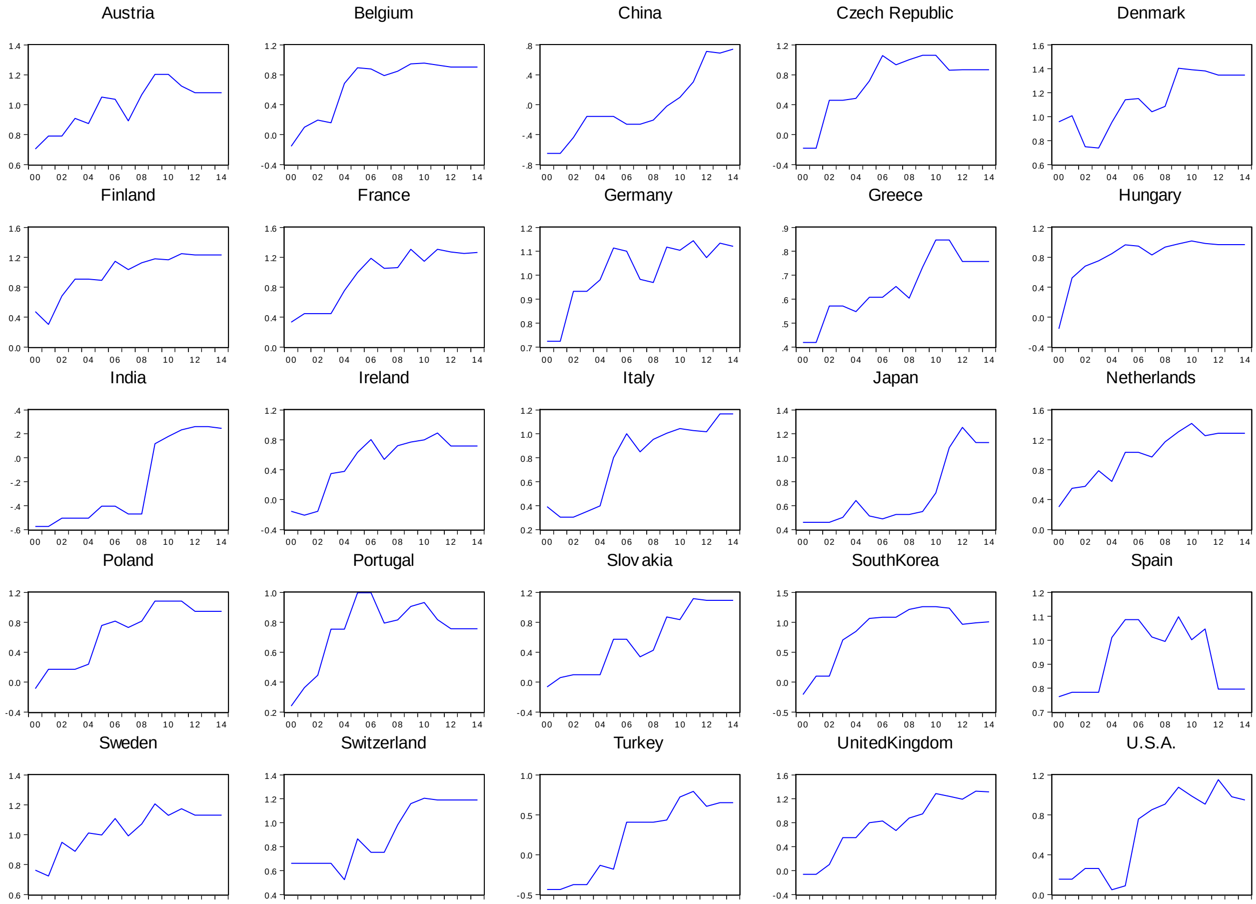


Figure B- 5 The graphs of AEPoP in logarithm of countries in the sample

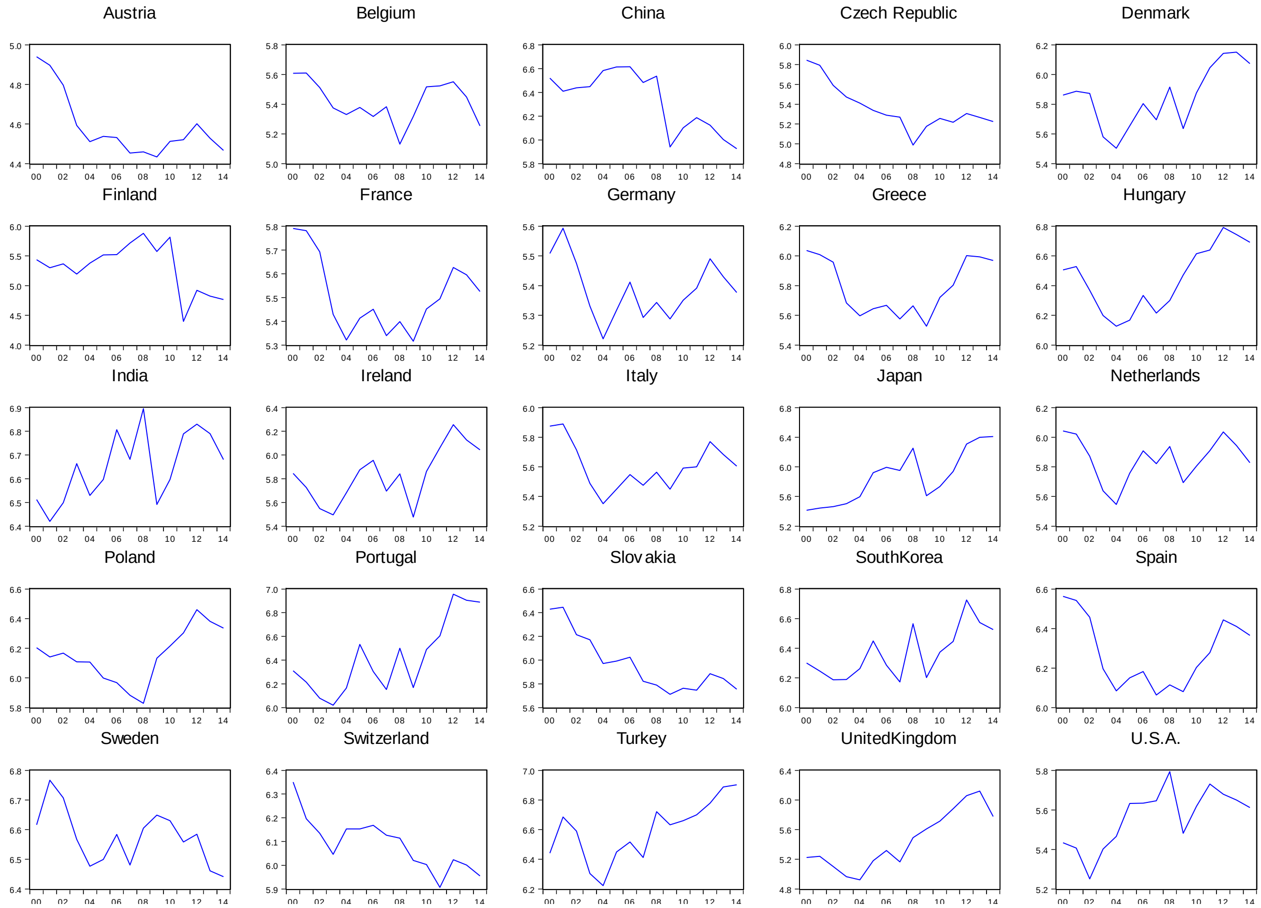
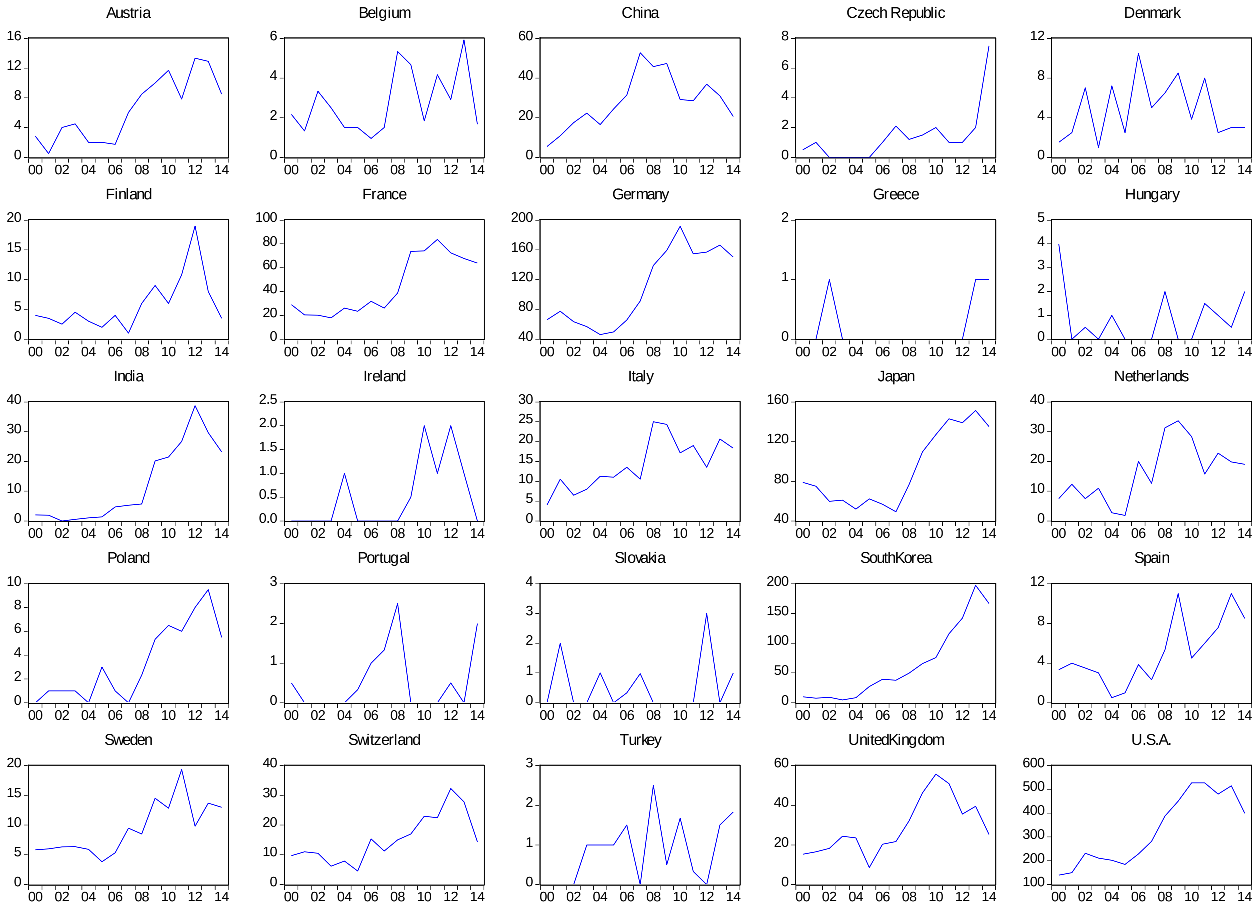


Figure B- 6 The graphs of lagged CO_2 reduction technology patents in the level form in the sample



Appendix B.2 Panel Cointegration Tests and Estimates

Table B- 1 Panel cointegration tests for energy intensity and CSR1 policies (with trend)

Panel Cointegration Test: use one-year lead of CSR1			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	2.974609**	Group rho-Statistic	2.313507
Panel rho-Statistic	0.868779	Group PP-Statistic	-2.657261**
Panel PP-Statistic	-2.513309**	Group ADF-Statistic	-3.292768***
Panel ADF-Statistic	-3.060117**		
Panel Cointegration Test: use same period of CSR1			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	4.062515***	Group rho-Statistic	1.830867
Panel rho-Statistic	0.244661	Group PP-Statistic	-3.102207**
Panel PP-Statistic	-2.762518**	Group ADF-Statistic	-4.021154***
Panel ADF-Statistic	-3.782186***		
Panel Cointegration Test: use one-year lag of CSR1			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	5.935444***	Group rho-Statistic	1.810771
Panel rho-Statistic	0.285611	Group PP-Statistic	-5.177879***
Panel PP-Statistic	-3.198723***	Group ADF-Statistic	-4.430504***
Panel ADF-Statistic	-4.55881***		
Panel Cointegration Test: use two-year lag of CSR1			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	5.889270***	Group rho-Statistic	1.604681
Panel rho-Statistic	-0.234672	Group PP-Statistic	-6.846891***
Panel PP-Statistic	-4.507484***	Group ADF-Statistic	-6.247334***
Panel ADF-Statistic	-5.38117***		
Panel Cointegration Test: use three-year lag of CSR1			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	8.857182***	Group rho-Statistic	2.449069
Panel rho-Statistic	0.852470	Group PP-Statistic	-6.388431***
Panel PP-Statistic	-4.330775***	Group ADF-Statistic	-6.282167***
Panel ADF-Statistic	-5.298799***		

Notes:

1. "***", significant at 0.001; "**", significant at 0.01; "*", significant at 0.05; "•" significant at 0.1.
2. Since 9 countries' *CSR1* takes 0 for all the periods, the panel cointegration tests for models using one-year lead of CSR1 and same period of CSR1 are based on 16 countries: Austria, China, Denmark, Finland, France, Germany, India, Italy, Japan, Netherlands, Portugal, Spain, Sweden, Turkey, UK, U.S.A. The panel cointegration tests for models using one-year lag of CSR1 and two year-lag of CSR1 are based on 15 countries, not including Turkey. The panel cointegration tests for the model using three-year lag of CSR1 are based on 14 countries, not including both Turkey and U.S.A.

Table B-1 (cont.)

3. The lag length is automatically selected based on SIC.

Table B- 2 Panel cointegration tests for energy intensity and CSR3 policies (with trend)

Panel Cointegration Test: use one-year lead of CSR3			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	1.608986·	Group rho-Statistic	2.582977
Panel rho-Statistic	1.005758	Group PP-Statistic	-3.661703***
Panel PP-Statistic	-2.583866**	Group ADF-Statistic	-3.2294***
Panel ADF-Statistic	-3.237234***		
Panel Cointegration Test: use same period of CSR3			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	4.427094***	Group rho-Statistic	2.268928
Panel rho-Statistic	0.545790	Group PP-Statistic	-3.474029***
Panel PP-Statistic	-2.544732**	Group ADF-Statistic	-3.580517***
Panel ADF-Statistic	-3.597448***		
Panel Cointegration Test: use one-year lag of CSR3			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	3.685176***	Group rho-Statistic	2.111573
Panel rho-Statistic	0.456973	Group PP-Statistic	-4.072687***
Panel PP-Statistic	-2.985069**	Group ADF-Statistic	-4.937178***
Panel ADF-Statistic	-4.497416***		
Panel Cointegration Test: use two-year lag of CSR3			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	4.178806***	Group rho-Statistic	2.504777
Panel rho-Statistic	0.797979	Group PP-Statistic	-5.768402***
Panel PP-Statistic	-3.23468***	Group ADF-Statistic	-5.776242***
Panel ADF-Statistic	-4.073316***		
Panel Cointegration Test: use three-year lag of CSR3			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	6.795186***	Group rho-Statistic	2.598653
Panel rho-Statistic	0.864326	Group PP-Statistic	-6.357508***
Panel PP-Statistic	-3.632161***	Group ADF-Statistic	-4.914455***
Panel ADF-Statistic	-4.025043***		

Notes:

1. "***", significant at 0.001; "**", significant at 0.01; "*", significant at 0.05; "•" significant at 0.1.
2. Since 6 countries' CSR3 takes 0 for all the periods, the panel cointegration tests for models using one-year lead of CSR3, same period of CSR3, one-year lag of CSR3 and two-year lag of CSR3 are based on 19 countries: Austria, China, Denmark, Finland, France, Germany, Greece, India, Ireland, Italy, Japan, Netherlands, Portugal, South Korea, Spain, Sweden, Turkey, UK, U.S.A. The

Table B-2 (cont.)

cointegration test for the model using three-year lag of CSR3 is based on 18 countries, not including Ireland.

3. The lag length is automatically selected based on SIC.

Table B- 3 Energy intensity and CSR1 policies long run equilibrium relation FMOLS estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR1 (1)	-0.030875	0.025985	-1.188198	0.2365
T	13			
n	16			
N	208			
Adjusted R^2	0.991692			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR1	-0.021846	0.024648	-0.886338	0.3767
T	14			
n	16			
N	224			
Adjusted R^2	0.991299			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR1(-1)	-0.004693	0.025001	-0.18771	0.8514
T	13			
n	15			
N	195			
Adjusted R^2	0.992095			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR1(-2)	0.00127	0.024729	0.051359	0.9591
T	12			
n	15			
N	180			
Adjusted R^2	0.993124			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR1(-3)	0.032432	0.023503	1.379919	0.1706
T	11			
n	14			
N	154			
Adjusted R^2	0.993068			

Notes:

1. We use heterogenous first-stage long-run coefficients to estimate this FMOLS model.
2. The countries included in each FMOLS estimation are consistent with countries included in the cointegration tests as we specified in the notes for Table B- 1 Panel cointegration tests for energy intensity and CSR1 policies (with trend).

Table B- 4 Energy intensity and CSR3 policies long run equilibrium relation FMOLS estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3 (1)	-0.037349	0.02388	-1.564046	0.1194
T	13			
n	19			
N	247			
Adjusted R^2	0.991463			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3	-0.028928	0.021884	-1.321882	0.1876
T	14			
n	19			
N	266			
Adjusted R^2	0.991334			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3(-1)	-0.030661	0.021834	-1.404287	0.1618
T	13			
n	19			
N	247			
Adjusted R^2	0.991999			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3(-2)	-0.00563	0.022509	-0.250143	0.8028
T	12			
n	19			
N	228			
Adjusted R^2	0.99282			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3(-3)	0.035348·	0.020586	1.717115	0.0881
T	11			
n	18			
N	198			
Adjusted R^2	0.993028			

Notes:

1. We use heterogenous first-stage long-run coefficients to estimate this FMOLS model.
2. The countries included in each FMOLS estimation are consistent with countries included in the cointegration tests as we specified in the notes for Table B- 2 Panel cointegration tests for energy intensity and CSR3 policies (with trend).

Table B- 5 Panel cointegration tests for energy intensity and EPS policies (with trend)

Panel Cointegration Test: use one-year lead of EPS			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	6.446609***	Group rho-Statistic	2.867433
Panel rho-Statistic	1.631049	Group PP-Statistic	-3.900782***
Panel PP-Statistic	-1.761665*	Group ADF-Statistic	-6.080796***
Panel ADF-Statistic	-3.633295***		
Panel Cointegration Test: use same period of EPS			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	8.989538***	Group rho-Statistic	2.428818
Panel rho-Statistic	1.041678	Group PP-Statistic	-4.403157***
Panel PP-Statistic	-2.03732*	Group ADF-Statistic	-4.653356***
Panel ADF-Statistic	-3.505023***		

Panel Cointegration Test: use one-year lag of EPS			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	7.474453***	Group rho-Statistic	2.704355
Panel rho-Statistic	1.093277	Group PP-Statistic	-4.035446***
Panel PP-Statistic	-2.497976**	Group ADF-Statistic	-4.270444***
Panel ADF-Statistic	-3.815735***		

Panel Cointegration Test: use two-year lag of EPS			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	6.847165***	Group rho-Statistic	2.225442
Panel rho-Statistic	0.613001	Group PP-Statistic	-5.741226***
Panel PP-Statistic	-4.01732***	Group ADF-Statistic	-7.002672***
Panel ADF-Statistic	-5.373751***		
Panel Cointegration Test: use three-year lag of EPS			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	4.625125***	Group rho-Statistic	2.980617
Panel rho-Statistic	1.500316	Group PP-Statistic	-5.1801***
Panel PP-Statistic	-2.898729**	Group ADF-Statistic	-5.42999***
Panel ADF-Statistic	-3.143832***		

Notes:

1. "***", significant at 0.001; "**", significant at 0.01; "*", significant at 0.05; "•" significant at 0.1.
2. The lag length is automatically selected based on SIC.

Table B- 6 Energy intensity and EPS long run equilibrium relation FMOLS estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS (1)	-0.020042	0.013871	-1.444831	0.1496
T	13			
n	25			
N	325			
Adjusted R^2	0.988347			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS	-0.006191	0.012908	-0.479629	0.6318
T	14			
n	25			
N	350			
Adjusted R^2	0.988379			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS (-1)	-0.009686	0.012954	-0.747744	0.4553
T	13			
n	25			
N	325			
Adjusted R^2	0.988592			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS (-2)	-0.02697*	0.012857	-2.097729	0.0369
T	12			
n	25			
N	300			
Adjusted R^2	0.989291			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-3)	-0.040657**	0.014185	-2.866309	0.0045
T	11			
n	25			
N	275			
Adjusted R^2	0.989299			

Note: We use heterogenous first-stage long-run coefficients to estimate this FMOLS model.

Table B- 7 The panel cointegration testing results for energy intensity and AEPoP (with trend)

Panel Cointegration Test: use same period of AEPoP			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	10.73327***	Group rho-Statistic	1.592599
Panel rho-Statistic	0.015457	Group PP-Statistic	-6.324653***
Panel PP-Statistic	-4.797462***	Group ADF-Statistic	-6.794755***
Panel ADF-Statistic	-6.317559***		
Panel Cointegration Test: use one year lag of AEPoP			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	11.23055***	Group rho-Statistic	2.107997
Panel rho-Statistic	0.509552	Group PP-Statistic	-5.17001***
Panel PP-Statistic	-4.159237***	Group ADF-Statistic	-5.867668***
Panel ADF-Statistic	-5.788824***		

Panel Cointegration Test: use two-year lag of AEPoP			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	9.974521***	Group rho-Statistic	2.251310
Panel rho-Statistic	0.418702	Group PP-Statistic	-4.6384***
Panel PP-Statistic	-3.866462***	Group ADF-Statistic	-6.348704***
Panel ADF-Statistic	-5.413759***		

Panel Cointegration Test: use three-year lag of AEPoP			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	9.159220***	Group rho-Statistic	2.719828
Panel rho-Statistic	0.967753	Group PP-Statistic	-6.608275***
Panel PP-Statistic	-3.845463***	Group ADF-Statistic	-6.506258***
Panel ADF-Statistic	-5.364488***		
Panel Cointegration Test: use four-year lag of AEPoP			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	10.54176***	Group rho-Statistic	2.488832
Panel rho-Statistic	0.624900	Group PP-Statistic	-8.178557***
Panel PP-Statistic	-5.978334***	Group ADF-Statistic	-9.506256***
Panel ADF-Statistic	-7.760608***		
Panel Cointegration Test: use five-year lag of AEPoP			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	5.981731***	Group rho-Statistic	3.740993
Panel rho-Statistic	1.741810	Group PP-Statistic	-6.136543***
Panel PP-Statistic	-4.870503***	Group ADF-Statistic	-7.920347***
Panel ADF-Statistic	-6.957617***		

Table B-7 (cont.)

Panel Cointegration Test: use six-year lag of AEPoP			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	7.402179***	Group rho-Statistic	3.516301
Panel rho-Statistic	2.023614	Group PP-Statistic	-8.59732***
Panel PP-Statistic	-5.215692***	Group ADF-Statistic	-6.140788***
Panel ADF-Statistic	-4.880708***		
Panel Cointegration Test: use seven-year lag of AEPoP			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	4.125089***	Group rho-Statistic	3.899850
Panel rho-Statistic	2.192940	Group PP-Statistic	-11.17164***
Panel PP-Statistic	-7.681642***	Group ADF-Statistic	-6.132826***
Panel ADF-Statistic	-6.151335***		
Panel Cointegration Test: use eight-year lag of AEPoP			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	2.275332*	Group rho-Statistic	3.914040
Panel rho-Statistic	2.278738	Group PP-Statistic	-14.44573***
Panel PP-Statistic	-10.58816***	Group ADF-Statistic	-8.676835***
Panel ADF-Statistic	-7.77241***		

Notes:

1. "***", significant at 0.001; "**", significant at 0.01; "*", significant at 0.05; "•" significant at 0.1.
2. The lag length is automatically selected based on SIC.

Table B- 8 Energy intensity and AEPoP long run equilibrium relation FMOLS estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-2)	0.019174·	0.011618	1.650301	0.1001
T	12			
n	25			
N	300			
Adjusted R^2	0.989042			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-3)	0.009195	0.012053	0.762916	0.4463
T	11			
n	25			
N	275			
Adjusted R^2	0.988933			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-4)	0.030693*	0.01229	2.497459	0.0133
T	10			
n	25			
N	250			
Adjusted R^2	0.9893			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-5)	-0.006185	0.013031	-0.474661	0.6356
T	9			
n	25			
N	225			
Adjusted R^2	0.989844			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-6)	-0.085724***	0.015532	-5.519091	0.0000
T	8			
n	25			
N	200			
Adjusted R^2	0.991138			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-7)	-0.074997***	0.015124	-4.958725	0.0000
T	7			
n	25			
N	175			
Adjusted R^2	0.990088			

Table B-8 (cont.)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-8)	-0.046691**	0.014080	-3.316193	0.0013
T	6			
n	25			
N	150			
Adjusted R^2	0.989987			

Note: We use heterogenous first-stage long-run coefficients to estimate this FMOLS model.

Table B- 9 The pairwise Padroni (1999, 2004) cointegration tests among covariates for CO_2/E models

	Dependent Variables (Without Trend)				
	lnRE	lnCSR1	lnCSR3	lnEPS	Lag lnCO2Tech
lnRE	-	(3)*, (4)**, (6)*, (7)***	(3)**, (4)***, (6)***, (7)***	(3)***, (4)***, (6)***, (7)***	(1)***, (2)***, (3)**, (4)***, (5)***, (6)***, (7)***
lnCSR1	(3)·, (4)*, (7)*	-	-	(4)·, (7)·	(2)***, (3)***, (4)***, (6)***, (7)***
lnCSR3	(7)*	-	-	(3)*, (4)**, (6)*, (7)**	(1)·, (2)***, (3)***, (4)***, (6)***, (7)***
lnEPS	No	No	No	-	(1)·, (2)***, (3)***, (4)***, (5)*, (6)***, (7)***
LaglnCO2Tech	No	No	No	(3)·, (4)*, (6)*, (7)*	-
	Dependent Variables (With Trend)				
	lnRE	lnCSR1	lnCSR3	lnEPS	Lag lnCO2Tech
lnRE	-	(4)*, (7)**	(4)**, (6)*, (7)***	(3)*, (4)***, (6)*, (7)***	(2)**, (3)***, (4)***, (6)***, (7)***
lnCSR1	(1)***, (3)**, (4)**, (6)***, (7)***	-	-	(1)·, (4)*, (7)*	(3)***, (4)***, (6)**, (7)**
lnCSR3	(1)***, (3)**, (4)***, (6)**, (7)***	-	-	(1)*, (4)*, (7)*	(2)·, (3)***, (4)***, (6)***, (7)***
lnEPS	(1)***, (3)***, (4)***, (6)***, (7)***	(4)**, (7)**	(4)**, (6)**, (7)***	-	(2)*, (3)***, (4)***, (6)***, (7)***
LaglnCO2Tech	(1)***, (3)**, (4)***, (6)***, (7)***	No	(6)*	No	-

Table B-9 (cont.)

Notes:

1. "***", significant at 0.001; "**", significant at 0.01; "*", significant at 0.05; "•" significant at 0.1.
2. Variables in columns are dependent variables.
3. Number (1) to (7) denotes seven different panel cointegration test statistics from Pedroni (1999, 2004) tests without trend:

   (1). Panel v-Statistic

   (2). Panel rho-Statistic

   (3). Panel PP-Statistic

   (4). Panel ADF-Statistic

   (5). Group rho-Statistic

   (6). Group PP-Statistic

   (7). Group ADF-Statistic

   "No" means no statistic is significant.
4. Since 9 countries' *CSR1* takes 0 for all the periods, the panel cointegration test involving *CSR1* is based on 16 countries: Austria, China, Denmark, Finland, France, Germany, India, Italy, Japan, Netherlands, Portugal, Spain, Sweden, Turkey, UK, U.S.A.
5. Since 6 countries' *CSR3* takes 0 for all the periods, the panel cointegration test involving *CSR3* is based on 19 countries: Austria, China, Denmark, Finland, France, Germany, Greece, India, Ireland, Italy, Japan, Netherlands, Portugal, South Korea, Spain, Sweden, Turkey, UK, U.S.A.
6. The lag length in ADF is automatically selected based on SIC.

Table B- 10 The panel cointegration testing results for CO_2/E and CO_2Tech (with trend)

Panel Cointegration Test: use one year lag of CO_2Tech			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	2.586579**	Group rho-Statistic	2.422761
Panel rho-Statistic	0.525320	Group PP-Statistic	-4.108266***
Panel PP-Statistic	-4.167397***	Group ADF-Statistic	-3.547138***
Panel ADF-Statistic	-5.003169***		
Panel Cointegration Test: use two-year lag of CO_2Tech			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	5.009312***	Group rho-Statistic	2.647949
Panel rho-Statistic	0.086251	Group PP-Statistic	-4.773169***
Panel PP-Statistic	-6.774553***	Group ADF-Statistic	-6.242038***
Panel ADF-Statistic	-9.401614***		
Panel Cointegration Test: use three-year lag of CO_2Tech			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	5.109110***	Group rho-Statistic	2.393108
Panel rho-Statistic	1.199136	Group PP-Statistic	-6.90165***
Panel PP-Statistic	-7.262554***	Group ADF-Statistic	-7.6595***
Panel ADF-Statistic	-8.846652***		
Panel Cointegration Test: use four-year lag of CO_2Tech			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	6.418540***	Group rho-Statistic	2.753252
Panel rho-Statistic	1.105143	Group PP-Statistic	-8.794144***
Panel PP-Statistic	-6.717967***	Group ADF-Statistic	-9.70462***
Panel ADF-Statistic	-8.026721***		

Notes:

1. "***", significant at 0.001; "**", significant at 0.01; "*", significant at 0.05; "•" significant at 0.1.
2. The lag length is automatically selected based on SIC.

Table B-11 CO_2/E and CO_2Tech long run equilibrium relation FMOLS estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCO2Tech(-1)	0.003241	0.003786	0.856134	0.3926
T	14			
n	25			
N	350			
Adjusted R^2	0.991853			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCO2Tech(-2)	-0.000248	0.003407	-0.072696	0.9421
T	13			
n	25			
N	325			
Adjusted R^2	0.992501			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCO2Tech(-3)	0.00053	0.003	0.176753	0.8598
T	12			
n	25			
N	300			
Adjusted R^2	0.992845			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCO2Tech(-4)	-0.005239·	0.003065	-1.709319	0.0888
T	11			
n	25			
N	275			
Adjusted R^2	0.993056			

Note: We use heterogenous first-stage long-run coefficients to estimate this FMOLS model.

Table B-12 The panel cointegration testing results for CO_2/E and CSR1 (with trend)

Panel Cointegration Test: use same period of CSR1			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	-0.388898	Group rho-Statistic	1.741377
Panel rho-Statistic	0.622599	Group PP-Statistic	-2.847904**
Panel PP-Statistic	-3.685484***	Group ADF-Statistic	-3.842243***
Panel ADF-Statistic	-5.546037***		
Panel Cointegration Test: use one−year lag of CSR1			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	3.177587***	Group rho-Statistic	1.275011
Panel rho-Statistic	-0.354305	Group PP-Statistic	-6.197762***
Panel PP-Statistic	-5.898195***	Group ADF-Statistic	-5.558072***
Panel ADF-Statistic	-6.653761***		
Panel Cointegration Test: use two-year lag of CSR1			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	2.959053**	Group rho-Statistic	2.592108
Panel rho-Statistic	0.671825	Group PP-Statistic	-4.424877***
Panel PP-Statistic	-6.672601***	Group ADF-Statistic	-6.262559***
Panel ADF-Statistic	-8.222498***		
Panel Cointegration Test: use three-year lag of CSR1			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	2.920843**	Group rho-Statistic	2.454643
Panel rho-Statistic	1.389123	Group PP-Statistic	-4.439236***
Panel PP-Statistic	-3.585191***	Group ADF-Statistic	-5.012412***
Panel ADF-Statistic	-6.064714***		
Panel Cointegration Test: use four-year lag of CSR1			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	2.551827**	Group rho-Statistic	2.458480
Panel rho-Statistic	1.114759	Group PP-Statistic	-7.011147***
Panel PP-Statistic	-2.271707*	Group ADF-Statistic	-5.376725***
Panel ADF-Statistic	-2.37134**		
Panel Cointegration Test: use five-year lag of CSR1			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	3.567120***	Group rho-Statistic	1.962817
Panel rho-Statistic	0.377709	Group PP-Statistic	-7.626479***
Panel PP-Statistic	-4.860246***	Group ADF-Statistic	-5.610423***
Panel ADF-Statistic	-4.974817***		

Table B-12 (cont.)

Panel Cointegration Test: use six-year lag of CSR1			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	1.678626*	Group rho-Statistic	2.358612
Panel rho-Statistic	1.016819	Group PP-Statistic	-7.703313***
Panel PP-Statistic	-7.618776***	Group ADF-Statistic	-4.117839***
Panel ADF-Statistic	-5.128388***		

Table B-13 The panel cointegration testing results for CO_2/E and CSR3 (with trend)

Panel Cointegration Test: use same period of CSR3			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	1.745272*	Group rho-Statistic	1.547751
Panel rho-Statistic	0.232885	Group PP-Statistic	-4.135152***
Panel PP-Statistic	-3.964804***	Group ADF-Statistic	-4.515242***
Panel ADF-Statistic	-5.380415***		
Panel Cointegration Test: use one−year lag of CSR3			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	1.799663*	Group rho-Statistic	1.698843
Panel rho-Statistic	0.186501	Group PP-Statistic	-4.330007***
Panel PP-Statistic	-3.990904***	Group ADF-Statistic	-4.674053***
Panel ADF-Statistic	-6.554406***		
Panel Cointegration Test: use two-year lag of CSR3			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	2.256021*	Group rho-Statistic	2.569215
Panel rho-Statistic	1.097100	Group PP-Statistic	-3.716855***
Panel PP-Statistic	-4.197047***	Group ADF-Statistic	-3.780778***
Panel ADF-Statistic	-5.67456***		
Panel Cointegration Test: use three-year lag of CSR3			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	4.343896***	Group rho-Statistic	2.716884
Panel rho-Statistic	1.502332	Group PP-Statistic	-5.261533***
Panel PP-Statistic	-4.786884***	Group ADF-Statistic	-5.536209***
Panel ADF-Statistic	-6.128888***		

Table B-13 (cont.)

Panel Cointegration Test: use four-year lag of CSR3			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	3.079023**	Group rho-Statistic	2.696898
Panel rho-Statistic	1.230887	Group PP-Statistic	-9.114311***
Panel PP-Statistic	-4.347854***	Group ADF-Statistic	-7.233205***
Panel ADF-Statistic	-4.707188***		
Panel Cointegration Test: use five-year lag of CSR3			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	1.915002*	Group rho-Statistic	3.226446
Panel rho-Statistic	2.388576	Group PP-Statistic	-6.388666***
Panel PP-Statistic	-2.21253*	Group ADF-Statistic	-6.296698***
Panel ADF-Statistic	-4.322728***		
Panel Cointegration Test: use six-year lag of CSR3			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	0.401374	Group rho-Statistic	2.716389
Panel rho-Statistic	2.505338	Group PP-Statistic	-9.585247***
Panel PP-Statistic	-3.812183***	Group ADF-Statistic	-6.171795***
Panel ADF-Statistic	-3.140186***		

Table B-14 CO_2/E and CSR1 long run equilibrium relation FMOLS estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR1	-0.003186	0.021461	-0.148437	0.8822
T	14			
n	16			
N	224			
Adjusted R^2	0.991432			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR1(-1)	0.009251	0.020631	0.448381	0.6546
T	13			
n	15			
N	195			
Adjusted R^2	0.991995			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR1(-2)	0.004912	0.020784	0.236331	0.8136
T	12			
n	15			
N	180			
Adjusted R^2	0.99247			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR1(-3)	0.004946	0.025559	0.193492	0.8470
T	11			
n	15			
N	165			
Adjusted R^2	0.992764			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR1(-4)	-0.015872	0.027089	-0.585921	0.5598
T	10			
n	12			
N	120			
Adjusted R^2	0.99537			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR1(-5)	-0.004027	0.027232	-0.147882	0.8831
T	9			
n	11			
N	99			
Adjusted R^2	0.994934			

Table B-14 (cont.)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR1(-6)	-0.0261	0.034298	-0.760966	0.4551
T	8			
n	10			
N	80			
Adjusted R^2	0.994939			

Note: We use heterogenous first-stage long-run coefficients to estimate FMOLS models.

Table B-15 CO_2/E and CSR3 long run equilibrium relation FMOLS estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3	-0.001472	0.018038	-0.081588	0.9351
T	14			
n	19			
N	266			
Adjusted R^2	0.992187			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3(-1)	-0.011179	0.018005	-0.620874	0.5354
T	13			
n	19			
N	247			
Adjusted R^2	0.992975			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3(-2)	-0.01377	0.017433	-0.789914	0.4306
T	12			
n	19			
N	228			
Adjusted R^2	0.993451			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3(-3)	-0.010029	0.015986	-0.627343	0.5314
T	11			
n	18			
N	198			
Adjusted R^2	0.993555			

Table B-15 (cont.)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3(-4)	-0.014772	0.018002	-0.820558	0.4134
T	10			
n	18			
N	180			
Adjusted R^2	0.993775			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3(-5)	0.000274	0.020986	0.013037	0.9896
T	9			
n	18			
N	162			
Adjusted R^2	0.994824			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3(-6)	-0.013267	0.021436	-0.61889	0.5378
T	8			
n	16			
N	128			
Adjusted R^2	0.994662			

Note: We use heterogenous first-stage long-run coefficients to estimate FMOLS models.

Table B-16 The panel cointegration testing results for CO_2/E and EPS (with trend)

Panel Cointegration Test: use same period of EPS			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	4.590410***	Group rho-Statistic	2.086772
Panel rho-Statistic	-0.37262	Group PP-Statistic	-5.745038***
Panel PP-Statistic	-6.577595***	Group ADF-Statistic	-5.965562***
Panel ADF-Statistic	-5.805029***		
Panel Cointegration Test: use one year lag of EPS			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	3.946477***	Group rho-Statistic	2.420253
Panel rho-Statistic	-0.06584	Group PP-Statistic	-7.008407***
Panel PP-Statistic	-6.930241***	Group ADF-Statistic	-7.846113***
Panel ADF-Statistic	-8.389265***		

Panel Cointegration Test: use two-year lag of EPS			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	2.633415**	Group rho-Statistic	2.748787
Panel rho-Statistic	1.406570	Group PP-Statistic	-5.920642***
Panel PP-Statistic	-4.160837***	Group ADF-Statistic	-6.480718***
Panel ADF-Statistic	-5.89515***		

Panel Cointegration Test: use three-year lag of EPS			
Alternative hypothesis: common AR coefs. Within-dimension		Alternative hypothesis: individual AR coefs. Between-dimension	
	Statistic		Statistic
Panel v-Statistic	2.062611*	Group rho-Statistic	2.651004
Panel rho-Statistic	1.719291	Group PP-Statistic	-6.00439***
Panel PP-Statistic	-3.855563***	Group ADF-Statistic	-7.679608***
Panel ADF-Statistic	-6.23839***		

Table B-17 CO_2/E and EPS long run equilibrium relation FMOLS estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS	0.025068**	0.00796	3.149091	0.0018
T	14			
n	25			
N	350			
Adjusted R^2	0.991965			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-1)	0.018524*	0.00806	2.298193	0.0223
T	13			
n	25			
N	325			
Adjusted R^2	0.99258			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-2)	0.009247	0.00912	1.013906	0.3116
T	12			
n	25			
N	300			
Adjusted R^2	0.992851			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-3)	0.003451	0.010334	0.333971	0.7387
T	11			
n	25			
N	275			
Adjusted R^2	0.993009			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-4)	0.005965	0.01058	0.563865	0.5735
T	10			
n	25			
N	250			
Adjusted R^2	0.99324			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-5)	-0.007212	0.01031	-0.69948	0.4852
T	9			
n	25			
N	225			
Adjusted R^2	0.994174			

Table B-17 (cont.)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-6)	-0.019575*	0.009577	-2.043821	0.0427
T	8			
n	25			
N	200			
Adjusted R^2	0.993774			

Note: We use heterogenous first-stage long-run coefficients to estimate FMOLS models.

Appendix B.3 Robustness Check

A. Energy Intensity

Table B-18 The DOLS estimates of cointegrating relations for energy intensity (SIC based)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3(-3)	0.042283·	0.023498	1.799412	0.0741
T	11			
n	18			
N	198			
Adjusted R^2	0.993271			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-2)	-0.047638**	0.016897	-2.819313	0.0052
T	12			
n	25			
N	300			
Adjusted R^2	0.988843			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-3)	-0.029285	0.018246	-1.605015	0.1101
T	11			
n	25			
N	275			
Adjusted R^2	0.989186			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnRDE	-0.041888*	0.018119	-2.31189	0.0215
T	14			
n	25			
N	350			
Adjusted R^2	0.988636			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-2)	0.018321	0.015302	1.197274	0.2325
T	12			
n	25			
N	300			
Adjusted R^2	0.988953			

Table B-18 (cont.)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-4)	0.025655*	0.012175	2.107186	0.0365
T	10			
n	25			
N	250			
Adjusted R^2	0.988727			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-6)	-0.118259***	0.017777	-6.652495	0.0000
T	8			
n	25			
N	200			
Adjusted R^2	0.991831			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-7)	-0.084598***	0.016624	-5.088756	0.0000
T	7			
n	25			
N	175			
Adjusted R^2	0.990757			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-8)	-0.016106	0.019483	-0.826659	0.4111
T	6			
n	25			
N	150			
Adjusted R^2	0.988814			

Note: The number of lead & lag is determined based on SIC.

Table B-19 The DOLS estimates of cointegrating relations for energy intensity (fixed 1 lead & 1 lag)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCSR3(-3)	0.156871***	0.038573	4.066848	0.0001
T	9			
n	18			
N	162			
Adjusted R^2	0.996377			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-2)	-0.087179**	0.030998	-2.812441	0.0057
T	10			
n	25			
N	250			
Adjusted R^2	0.988612			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-3)	-0.078840*	0.037836	-2.083757	0.0398
T	9			
n	25			
N	225			
Adjusted R^2	0.9883			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnRDE	-0.102290***	0.029866	-3.425010	0.0008
T	12			
n	25			
N	300			
Adjusted R^2	0.987753			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-2)	0.101746**	0.030643	3.32036	0.0012
T	10			
n	25			
N	250			
Adjusted R^2	0.989455			

Table B-19 (cont.)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-4)	-0.008084	0.039932	-0.202446	0.8401
T	8			
n	25			
N	200			
Adjusted R^2	0.99108			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnAEPoP(-6)	-0.282495***	0.059883	-4.717410	0.0001
T	6			
n	25			
N	150			
Adjusted R^2	0.992172			

B. CO2 Emissions

Table B-20 The DOLS estimates of cointegrating relations for energy intensity (SIC based)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnRE	-0.119418***	0.021161	-5.643302	0.0000
T	14			
n	15			
N	350			
Adjusted R^2	0.994316			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCO2Tech(-4)	-0.005155	0.005176	-0.99603	0.3204
T	11			
n	25			
N	275			
Adjusted R^2	0.994813			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS	0.020407·	0.011071	1.843322	0.0664
T	14			
n	25			
N	350			
Adjusted R^2	0.99336			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-1)	0.01072	0.011302	0.948453	0.3438
T	13			
n	25			
N	325			
Adjusted R^2	0.994303			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-6)	-0.011196	0.015827	-0.707415	0.4806
T	8			
n	25			
N	200			
Adjusted R^2	0.996247			

Note: The number of lead & lag is determined based on SIC.

Table B-21 The DOLS estimates of cointegrating relations for energy intensity (fixed 1 lead & 1 lag)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnRE	-0.108216***	0.031947	-3.387321	0.0009
T	12			
n	25			
N	300			
Adjusted R^2	0.99682			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnCO2Tech(-4)	-0.001279	0.00888	-0.144049	0.8858
T	9			
n	25			
N	225			
Adjusted R^2	0.996757			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS	0.033009·	0.017423	1.894615	0.0598
T	12			
n	25			
N	300			
Adjusted R^2	0.995492			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-1)	0.02782	0.017776	1.565043	0.1197
T	11			
n	25			
N	275			
Adjusted R^2	0.996151			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEPS(-6)	0.092202·	0.050616	1.821601	0.081
T	6			
n	25			
N	150			
Adjusted R^2	0.99946			

C. PM2.5

Table B- 22 Robustness check main estimate results for PM2.5 model (using CSR1)

Variables	PM2.5 (using CSR1)		
	PFAE		
	Model 1 (3-year lag)	Model 2 (3-year lag)	Model 3 (4-year lag)
PM2.5$_{i,t-1}$	0.270***	0.269***	0.297***
	(0.035)	(0.035)	(0.037)
TotalCO2	0.127*	0.109*	0.080
	(0.050)	(0.049)	(0.056)
Population	-0.007	0.213	-0.026
	(0.184)	(0.168)	(0.208)
SoliFuelCO2	0.147·	0.193*	0.234**
	(0.079)	(0.078)	(0.088)
CSR1	-0.096**	-0.093**	-0.082*
	(0.033)	(0.033)	(0.037)
CSR1$_{i,t-1}$	-0.025	-0.021	0.008
	(0.043)	(0.043)	(0.047)
CSR1$_{i,t-2}$	0.114**	0.106*	0.069
	(0.044)	(0.044)	(0.046)
CSR1$_{i,t-3}$	-0.099**	-0.101**	-0.143**
	(0.034)	(0.034)	(0.047)
CSR1$_{i,t-4}$	–	–	0.026
	–	–	(0.038)
EPS	-0.056**	-0.066***	-0.049*
	(0.018)	(0.017)	(0.020)
△ISO14001	-0.039*	-0.046**	-0.026
	(0.017)	(0.017)	(0.019)
PM2.5Tech$_{i,t-1}$	–	–	–
	–	–	–
PM2.5Tech$_{i,t-2}$	–	–	–
	–	–	–
PM2.5Tech$_{i,t-3}$	0.025**	–	–
	(0.009)	–	–
PM2.5Tech$_{i,t-4}$	–	–	-0.007
	–	–	(0.010)
Year Dummies	Yes	Yes	Yes
n	25	25	25
T	12	12	11
N	765	765	900
Adjusted R^2	0.5116	0.5068	0.372
F-Statistic	F(22,743)=37.42, p-value: < 2.2e-16	F(21,744)=38.44, p-value: < 2.2e-16	F(22,590)=17.48, p-value: < 2.2e-16

Table B-23 Robustness check main estimate results for PM2.5 model (using CSR3)

Variables	PM2.5 (using CSR3)				
	PFAE				
	Model 1 (current period)	Model 2 (1-year lag)	Model 3 (2-year lag)	Model 4 (3-year lag)	Model 5 (4-year lag)
$PM2.5_{i,t-1}$	0.288***	0.286***	0.286***	0.289***	0.324***
	(0.025)	(0.025)	(0.028)	(0.032)	(0.033)
TotalCO2	0.051	0.044	0.041	0.033	-0.039
	(0.031)	(0.031)	(0.037)	(0.042)	(0.047)
Population	-0.021	-0.025	0.061	0.012	0.234
	(0.108)	(0.108)	(0.128)	(0.150)	(0.171)
SoliFuelCO2	0.123*	0.118*	0.143*	0.221**	0.294***
	(0.051)	(0.051)	(0.058)	(0.067)	(0.074)
CSR3	0.016	–	–	–	
	(0.016)	–	–	–	
$CSR3_{i,t-1}$	–	0.040**	-0.002	–	–
	–	(0.015)	(0.027)	–	–
$CSR3_{i,t-2}$	–	–	0.019	–	–
	–	–	(0.026)	–	–
$CS33_{i,t-3}$	–	–	–	-0.018	–
	–	–	–	(0.018)	–
$CS31_{i,t-4}$	–	–	–	–	-0.034·
	–	–	–	–	(0.020)
EPS	-0.038**	-0.035**	-0.027·	-0.047**	-0.034·
	(0.013)	(0.013)	(0.014)	(0.017)	(0.018)
△ISO14001	-0.037***	-0.035**	-0.043***	-0.048**	-0.020
	(0.011)	(0.011)	(0.013)	(0.014)	(0.016)
$PM2.5Tech_{i,t-1}$	0.022***	0.023***	–	–	–
	(0.006)	(0.006)	–	–	–
$PM2.5Tech_{i,t-2}$	–	–	0.006	–	–
	–	–	(0.007)	–	–
$PM2.5Tech_{i,t-3}$	–	–	–	0.015·	–
	–	–	–	(0.007)	–
$PM2.5Tech_{i,t-4}$	–	–	–	–	-0.002
	–	–	–	–	(0.008)
Year Dummies	Yes	Yes	Yes	Yes	Yes
n	21	21	21	21	21
T	15	14	13	12	11
N	1386	1375	1155	945	756
Adjusted R^2	0.4425	0.4449	0.4546	0.4659	0.3165
F-Statistic	F(21,1365)=53.39, p-value: < 2.2e-16	F(20,1365)=53.91, p-value: < 2.2e-16	F(21,1134)=46.84, p-value: < 2.2e-16	F(19,926)=44.39, p-value: < 2.2e-16	F(18,738)=20.45, p-value: < 2.2e-16