

The Impact of Carbon Emission Restriction Policy on Small and Medium Enterprises

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Abstract. In recent years, concerned by the environmental crisis caused by the overproduction of carbon emissions, governments around the world have set various means of solutions to reduce the pollution. Carbon tax, especially, give the firms opportunity of redemption to their external cost made. Carbon emission policies limit the amount of carbon dioxide emitted by companies through tradable permits and carbon tax. Therefore, it plays an obvious role in controlling the environmental pollution caused by excess carbon dioxide. In today's economy, large corporations often have the ability to survive restrictions (eg. buying a lot of tradable permits) due to economies of scale and capital. Conversely, small or medium-sized companies tend to be less optimistic. They are limited in production and R&D by carbon emission policies, and they are also unable to purchase sufficient tradable permits to support continued production because of their lack of funds. This also caused a series of problems. This paper reviews the impact of carbon emission policies on small and medium-sized enterprises, by analyzing the status quo and its quantifiable data. We will discuss carbon emission policies and both their positive and negative effects. Finally, carbon tax's challenges and conclusion based on our research that small and medium sized firms were not impacted too much, which is an inverse result compared with our prediction, will be explained specifically.

Keywords: Carbon tax; tradable permit; small-medium firms.

1. Introduction

Carbon dioxide pollution is one of the most pressing environmental issues of our time. The level of carbon dioxide in the atmosphere has been rising at an alarming rate, and this is causing serious problems for our planet. CO₂ is a greenhouse gas, and its presence in the atmosphere is trapping heat and causing global temperatures to rise. This is leading to climate change, which is causing all sorts of problems for us. For preventing those series of problems, governments proposed various means to solve this, and the most remarkable one is the carbon restriction policy. However, with the trend of globalization and competition, those taxation causes. Based on this background, we were inspired to explore the impact on small-medium sized firms. Thus, our research topic is "What is the impact of carbon restriction policy on small-medium firms?" Because small firms are always holding less funds, accordingly, their anti-risk capability will be weaker than those large enterprise groups. We predicted that the negative impact on small-medium firms will be severer, by which its production line will be stopped and harmed.

2. How does carbon tax affect small and medium-size businesses

2.1 Positive influences

Carbon tax is the policy that set fixed price on each ton of carbon or carbon dioxide gases emitted, which taxes on industrial users, distributors, fuel producers and consumers. Carbon tax sets a

‘pollution price’ for fossil fuels users to raise the awareness about negative influences of carbon footprint on both social and economic aspects.

Carbon tax may benefit those businesses which are not closely relate to fuel consumption such as firms in service industry and finance industry, as they emit less carbon or carbon dioxide gas. Due to carbon tax, the price level of other products and services may increase in a greater extent than that of service and finance industry. This might increase sales of service and financial products because consumers are attracted by the lower price. The fig.1 dedicates that more than half of the small businesses are in service industry, retail trade industry, wholesale trade industry and finance industry, which are affected in small extent by carbon tax. For instance, about 80 percent of small or medium size businesses in the US are in the service-producing sector. By contrast, Larger firm size with more than 1000 labors has approximately \$1.91 higher pollution abatement operation cost per \$1000 worth output than smaller firms with number of 50 or below labors [1]. Therefore, there’s a positive correlation between firms’ size and their incremental pollution abatement cost. Most of the small or medium-size businesses will not be affected by carbon tax in a gigantic extent.

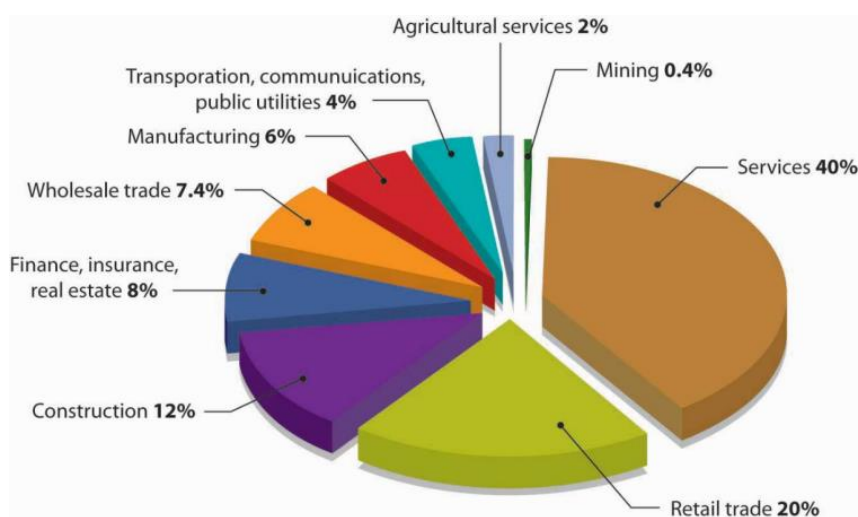


Fig 1. The industry with small-size companies [2].

Rise in governments’ taxation revenue may increase the amount of subsidies that small and medium-sized businesses could receive and also reduce some cost of the firms. The total amount of carbon emission of large businesses is more than that of small and medium-size businesses, the revenue earned by government from carbon tax emission can be substantial. As government usually subsidize small or middle size companies to encourage establishment of new firms and remain the competitiveness in the market, increase in government revenue may add the amount of subsidy for the small and medium-size businesses. In this case, subsidy compensate some of the negative effects brought by carbon tax to encourage the small and medium-size businesses to produce more goods and services. Furthermore, increase in taxation revenue enables the government to spend more on infrastructure and public services schemes. For example, if the government spend more money on public transportation scheme, the time spent on transportation by the firms may reduce and thus reduce the transportation cost for the small and medium-sized businesses.

In addition, as the education and propaganda of the negative influences of carbon dioxide emission, customers have higher concern on environmentally friendly of businesses. After the policy of carbon tax is implemented, businesses will utilize their available resources and technology to reduce their carbon dioxide emission. The small and medium-size businesses are more sensitive to the change of costs, so they might decrease their carbon dioxide emission in greatest extent. This probably will attract the customers who concern on carbon dioxide emission rate and stimulate them to purchase the products of the businesses. Rise in sales may compensate on the payment of carbon tax. Moreover, the reputation of the businesses may be improved as the small and medium-size businesses heighten their environmental awareness.

2.2 Negative influences

Nevertheless, the taxation on carbon or carbon gas emission may worsen off the position of businesses by several reasons. The direct short run negative effect of carbon tax on small and medium-size businesses is similar to all taxation ---- carbon tax increases the cost of production to the businesses. Businesses have to pay carbon taxes and thus profit level decreases. As of April 1, 2022, shown in fig. 2, among 27 countries which set carbon tax rates, the average carbon tax rate is about \$41.62 per metric ton of carbon dioxide.

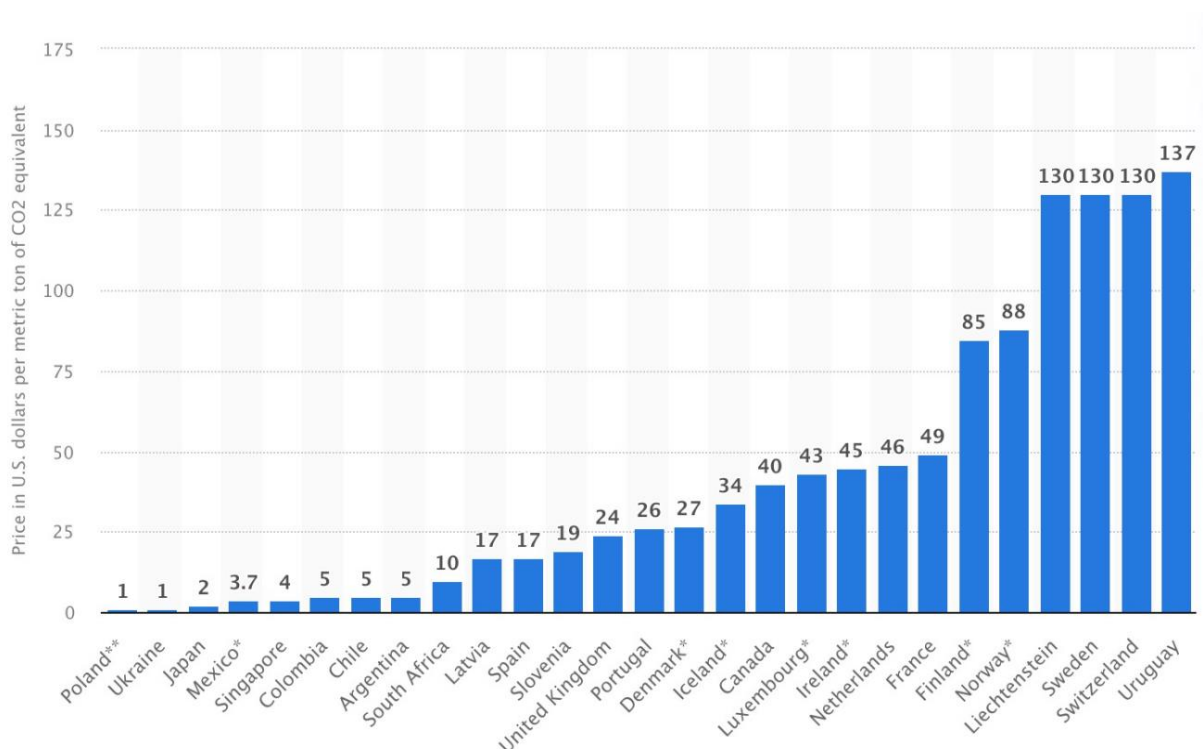


Fig 2. Carbon rates worldwide as of April 1, 2022, by country [3].

As small and middle-size businesses are less likely to reach economies of scale, this high level of carbon tax rate can be detrimental or even fatal. Fig 1.3 indicates the influence of carbon tax on average cost of small or medium-size businesses. The result of increase in average cost is reduction in total output. Fewer output produced leads to fewer sales revenue, if the profit level is lower than the break-even point, the businesses will face to the failure of business and might suffer from high debt and bankruptcy.

The supply curve shifts to the left due to three different reasons. First, suppliers tend to raise the price of raw materials as carbon tax also increase their production cost, the cost of raw materials to the businesses rise at the same time. Raise in price leads to small and middle-size businesses lose more competitiveness compared to the large companies. Second, the output effect will reduce the overall supply of labour which reduce the productivity. On one hand, the increase in the price level caused by carbon tax will lead to the decline of the power of peoples' earnings, which means the real wages fall. The reduction in real wages will have the net influence of causing workers to work less, thus the total supply of labour decline. On the other hand, the businesses might increase the wages for the workers to encourage them increase the labour productivity. In this case, businesses probably will make some of the employees redundant as the total cost increases if number of labour doesn't cut down [4]. Third, fossil fuel prices rise due to carbon tax will increase the production cost of producing new physical capital. The increase in cost of new capital will make the profits earned by the investors decline, causes the overall level of investment decreases.

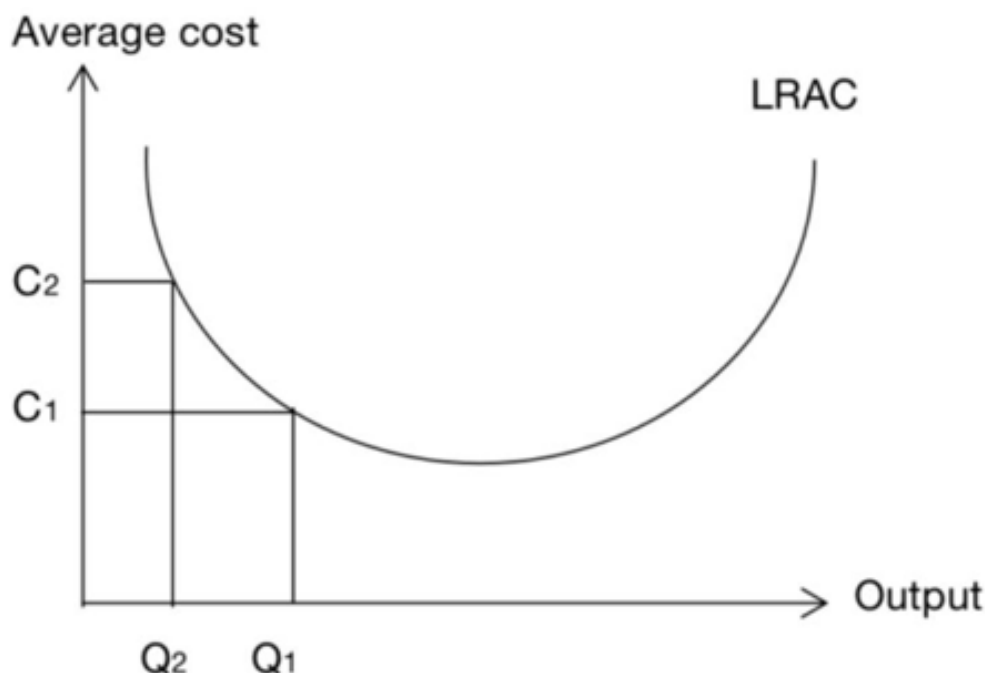


Fig 3. Cost curve for small or middle-size businesses Photo credit: Original.

Companies that are heavy polluters face higher costs until they discover and implement methods that enables them to reduce their carbon footprint. This is extremely averse to small businesses and medium-sized businesses as the high energy costs will deteriorate their financial position significantly. The small and middle-size businesses might intend to utilize high technology or develop effective methods to reduce carbon footprint in order to reduce their tax paid for carbon emission, nevertheless, lack of finance and existing resources restrict them to do so. Unlike large companies, small and middle-size businesses do not have competitive advantage. As a common characteristic of small and middle-size business, they lack finance because banks and lenders usually prefer to lend money to the large companies rather than small firms, due to credit and risk-bearing reasons. Lack of finance inhibit them to have the access to the latest existing technology. Development of technology by small firms themselves is nearly unrealistic. Therefore, small and medium-sized businesses probably will fail to cut down the amount of their carbon or carbon dioxide emissions significantly. Thus, their price of products and services will be higher due to expensive raw materials, which makes them even less competitive relative to the large companies.

Theoretically, small businesses are expected to pass the added costs from carbon tax down to customers. However, it is unrealistic in the reality. For instance, in Canada, about 80 per cent of small businesses in the four provinces, Saskatchewan, Ontario, Manitoba and New Brunswick, report that they are able to pass on less than one over four of the costs due to carbon tax [5].

3. How does Pollution Tradable Permits affect small and medium-size businesses

Pollution Tradable Permits significantly affects all the firms. Regardless of the impact on large corporations, there are several positive influences on small and medium-sized production and manufacturing. Firstly, the primary benefit of a Tradable permits system is it can create the opportunity for efficient exchange—one potential polluter can purchase permits from another polluter, keeping the overall amount of pollution unchanged. There will be no extra spending on pollution that does not exist for small and medium-sized manufacturing since they are small and could easily control the correct number of productivity and contamination. From Analysis of the effect of Emissions Trading on the total factor productivity of enterprises-based on DID of listed manufacturing companies:

“The pilot policy of SO₂ emission trading in 2007 turned into A quasi-natural experiment. Considering that the pilot policy was completed in 2017 and the availability of data, this paper manually screened 200 sulfur dioxide emitting enterprises according to the data of Shanghai-Shenzhen A-share manufacturing listed companies from 2004 to 2015, and adopted the double difference method. This paper empirically studies the impact and mechanism of emission trading pilot policy on total factor productivity of manufacturing enterprises.” [6].

The research findings are as follows: First, SO₂ emission trading has a significant promoting effect on the total factor growth rate of manufacturing enterprises. The assumption of sufficient parallel trends holds after adding control variables and testing the robustness of a smaller sample size.

Table 1. The results of Parallel trend assumption.

	2004	2005	2006
	TFP	TFP	TFP
treat2*prepost	-0.1913 (0.1948)		
treat2*prepost		-0.0507 (0.0978)	
treat2*prepost			-0.0327 (0.0417)
Q	0.0629 (0.1728)	0.6709*** (0.1367)	0.1533** (0.0652)
Ir	0.0998 (0.3228)	0.3636 (0.3209)	0.7543*** (0.1952)
size	0.2647*** (0.0599)	0.5265*** (0.0812)	0.3514*** (0.0672)
roa	4.7611*** (1.0726)	2.3777* (1.2622)	5.3692*** (1.3285)
HHI	0.8308* (0.4717)	0.7463** (0.3150)	0.6550* (0.3369)
_cons	-0.7179 (1.4230)	-7.0830*** (1.7331)	-3.6248** (1.5727)

The first column, the second and the third column representing 2004, 2005 and 2006, the policy effect of the regression results, three columns of regression coefficients were negative, indicating that policy year ago the experimental group and control group with the same change trend, shows that using the double difference method research on emissions trading policy effect is feasible.

Secondly, firms have incentives to invest in clean technology. Nowadays, people only look forward to net benefits and think there is no relationship between manufacturing and a lousy environment. With ETS (Emission Trading System), Firms would be encouraged to discover clean technology, like an environmentally friendly and utterly battery-electric car, rather than one that generates electricity from fuel. Extra income is obtained by the businesses that are more environmentally friendly. This can give them a competitive advantage over other businesses too. If two firms produce for same product with different procedures and compositions, the one who creates less pollution will be more competitive because there is less cost of emission, or they can produce more for the same amount of pollution. According to Research on the Impact of Pollution Emission Trading Policy on Enterprise Environmental Investment

“Paper enterprises emitting SO₂ were taken as research samples. Manually collect the SO₂ emission information disclosed in the annual report and corporate social responsibility report of paper enterprises. Referring to the target sample selection methods such as Renshengsteel, 24 listed companies were finally obtained through screening, a total of 288 sample enterprises

Industry observation value. Secondly, the enterprise rings are manually collected from the notes of the construction in progress management expenses and other items in the annual reports of listed companies. Data on capital expenditure, sewage charges, etc.” [7]

In Table 2, the paper gradually increases the control variables to ensure the reliability of the results. Where, column (1) control Property right (SOE), return on assets (ROA), shareholding ratio of the largest shareholder (First), efficiency of the company in using its own capital (Roe), Age of the company (Age), year fixed effect (YearFE) and Industry fixed effect (Industry FE) were formulated, but independent variables were not added. Column (2) introduces the independent variable (Treat*time) but does not control for the absence of year and industry fixed effects. Column (3) also controls for year fixed effects in addition to column (2). Column (4) not only controls for year and industry fixed effects. From columns (2)-(4), it can be found that the regression coefficients of the independent variable (Treat*time) are 2.771, 2.085 and 1.894 respectively, which are significant at 1%, 5% and 5% respectively, indicating that emission trading can significantly promote the treatment group enterprises and the control group enterprises to increase more environmental investment.”

However, there is one critical possibility for small and medium-sized firms. The ETS or governments might provide not enough carbon emissions to those firms making them not competitive because of a significant increase in their cost of production. Larger enterprises may buy many permits since they are well-developed and with a lot of working capital. Therefore, as a result, small and medium firms will be frustrated by ETS.

Table 2. Regression results of the influence of emission trading on environmental investment of enterprises.

dependent variable: EI	Model(1)	Model(2)	Model(3)	Model(4)
Treat*time		2.771*** (0.702)	2.085** (0.814)	1.894** (0.744)
SOE	2.591*** (0.805)	3.671*** (0.766)	3.620*** (0.770)	2.701*** (0.784)
Roa	-0.002*** (0.001)	-0.009*** (0.001)	-0.009*** (0.001)	-0.002*** (0.001)
First	-1.581 (2.148)	0.896 (2.344)	1.480 (2.414)	-2.063 (2.127)
Roe	-0.029** (0.012)	-0.051*** (0.010)	-0.044*** (0.011)	-0.033*** (0.012)
Age	-0.705 (0.907)	0.296 (0.652)	-0.176 (0.887)	-0.627 (0.878)
Constant	1.286 (1.445)	2.867 (1.777)	2.570 (1.909)	1.757 (1.423)
Observations	288	288	288	288
R-squared	0.201	0.064	0.082	0.208
Year FE	YES	NO	YES	YES
Industry FE	YES	NO	NO	YES

Note: () is the standard deviation, ***, ** and * are significant at 1%, 5% and 10% levels respectively.

The results show that the Emission Trading only plays a positive role in promoting environmental investment in enterprises with low industry competition, but it cannot play a role in promoting environmental investment in enterprises without high industry competition.

4. Policy Challenges

4.1 Challenges of the Carbon Taxation Policy

Currently, one issue deals with environmental policy are the asymmetric enforcement between firms due to information asymmetric. It can be told that the socially efficient level of emission is the

quantity where marginal damage (amount of damage caused by emission of an additional unit of carbon) equalizes with the marginal abatement cost (the cost required to reduce one additional unit of emission) [8].

In real life, a potential problem when setting emission standard through carbon taxation is that different regions might results in different marginal damage function. As the example shown below, the marginal damage curve varies dramatically between urban area and rural area. [9] Therefore, carbon taxation and level of regulation should be different in 2 areas. Nevertheless, it could be challenging as it involves higher time consumption and opportunity cost since authority need to obtain enough information about the marginal damage function for the small-medium manufacturing firms in different regions including urban, CBD, suburb, city periphery and rural in order to design the most tailored taxation level [10].

From the perspectives of the marginal abatement cost, the equimarginal principle should be hold, which states that when there's different firms with different marginal abatement cost that're emitting the pollution, then the level of emission should be controlled until all the firms have the same marginal abatement cost, in this way, different manufacturing firms should control within different degrees based on each of its MAC. Therefore, if there's asymmetric information between public agency and individual firm MAC, then the equimarginal principle can be hard to achieve [11].

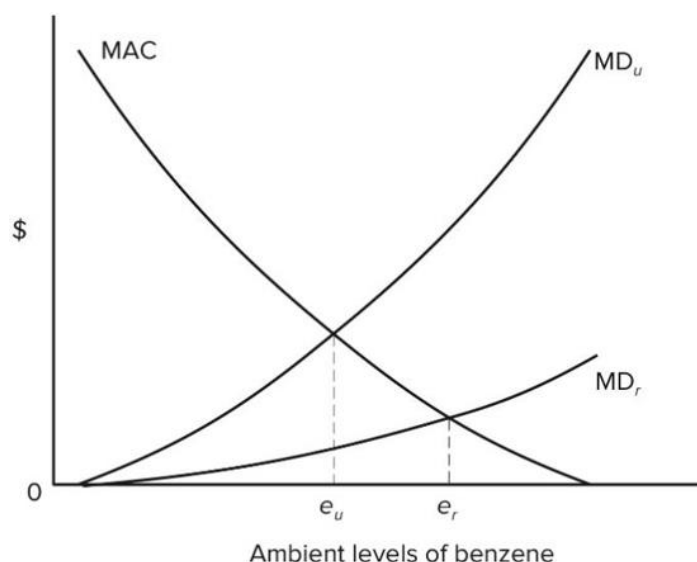


Fig 4. Socially efficient level of pollutant emission Photo credit: Original.

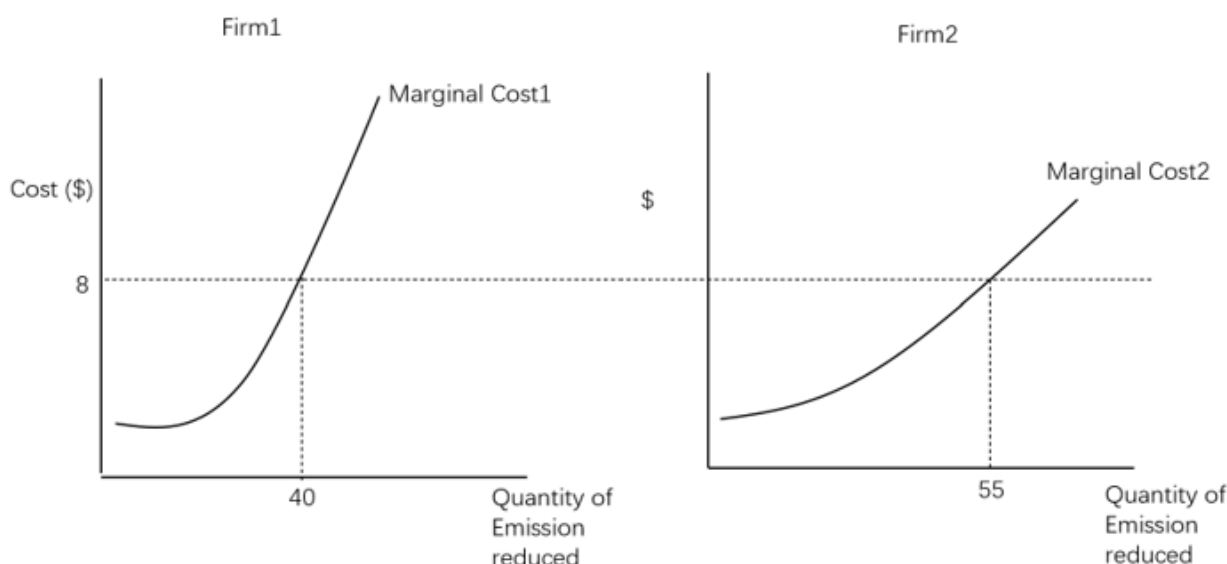


Fig 5. The Equi-Marginal Principal Photo credit: Original.

4.2 Challenges of the Cap and Trade

Perhaps the greatest challenge of cap and trade is the ability of governments to impose the correct cap on the producers of emissions and also being able to monitor polluters to see whether the emission of the manufacturing industry actually exceed the number of permits it holds. Previously, the European Commission established the Emissions trading system (ETS) in 2005, in an approach to restrict greenhouse gasses [12]. However, the problem is that the quantity of permits is too much, it creates no or little competitive pressure for firms to reduce emission.

On another hand, if we allow straight trading, the total number of permits might be held constant, but the damage caused by that total could change [13]. For example, if a firm in location A sold permits to a firm in location B, the emission damage in location B is likely to increase [14]. As a result, if there's lack of provision and simply allow one for one basis, firm with higher coefficient, whose emission therefore have a greater impact on ambient quality, could accumulate larger numbers of permits [15].

5. Summary

Theoretically, smaller firms will take up the majority of burden from carbon regulation since their profitability level and financial position can be largely impacted. However, based on multiple literature review, it can be concluded that smaller firms don't spend dramatically higher pollution abatement operation cost. Inversely, larger firms tend to have a larger pollution abatement cost, which means a positive correlation can be found. On the other hand, as government usually subsidize small or middle size companies to enhance the competition of the market, subsidy can possibly compensate some of the negative effects brought by carbon tax to encourage the small and medium-size businesses to produce more goods and services. Lastly, as more education of climate change disseminate through social medias, customers have higher concern on environmentally friendly of businesses. The small and medium-size businesses are more sensitive and flexible to changes, and able to adjust their production process greener and blend in the concept of Environment, Social, Government (ESG) within a shorter period of time, hence helping them to attract more investment and customers who concern on carbon dioxide emission rate and stimulate them to purchase the products of the businesses. Rise in sales may compensate on the payment of carbon tax.

According to Porter hypothesis, environmental policies can induce a net positive effect on firms' competitiveness as firms are encouraged to invest in greener technologies that enhance their productivities, which can be large enough to rescue the abatement cost. However, there're no persuasive proof to this hypothesis although past research has demonstrated that environmental regulation can encourage the technology innovation. As a result, further research needs to be done in investigating the extend and size of the net positive effect and whether it can completely offset the abatement cost.

References

- [1] Marc Chaput, carbon taxes and carbon tax rebates for small businesses, June 12,2020
- [2] John Case, "What Businesses Are Small Companies Really In—And Where Are They Scarce," Inc.com (May 2001)
- [3] Statista, Carbon tax rates worldwide as of April 1,2022, by country
- [4] Douglas W. Elmendorf, Effects of a Carbon Tax on the Economy and the Environment, May 2013
- [5] Milena Stanoeva, CFIB, small firms to pay almost half of the federal carbon tax; get 7 percent back
- [6] Liu Xing, Analysis of the effect of Emissions Trading on the total factor productivity of enterprises-based on DID of listed manufacturing companies
- [7] You Daming, Yuan Jingjie, Research on the Impact of Pollution Emission Trading Policy on Enterprise Environmental Investment

- [8] Randy A. Becker, Carl Pasurka, Ronald J. Shadbegian. Do environmental regulations disproportionately affect small businesses? Evidence from the Pollution Abatement Costs and Expenditures survey, 2013, Pages 523-538, ISSN 0095-0696, <https://doi.org/10.1016/j.jeem.2013.08.001>.
- [9] Weijian Du, Mengjie Li, Zhaohua Wang, The impact of environmental regulation on firms' energy-environment efficiency: Concurrent discussion of policy tool heterogeneity, 2022, ISSN 1470-160X, <https://doi.org/10.1016/j.ecolind.2022.109327>.
- [10] Gray, W. Environmental regulations and business decisions. IZA World of Labor 2015: 187 doi: 10.15185/izawol.187
- [11] Wang Q, Xu X, Liang K. The impact of environmental regulation on firm performance: Evidence from the Chinese cement industry. J Environ Manage. 2021 Dec 1; 299:113596. doi: 10.1016/j.jenvman.2021.113596. Epub 2021 Aug 28.
- [12] Environmental Economics: An Introduction, 6th edition, by Barry C. Field and Martha K. Field (McGraw-Hill, New York, 2012), pp. 458
- [13] Ben-Kheder, S., and N. Zugravu. 2012. Environmental regulation and French firms location abroad: an economic geography model in an international comparative study. Ecological Economics 77:48–61.
- [14] Carraro, C., E. De Cian, L. Nicita, E. Massetti, and E. Verdolini. 2010. Environmental policy and technical change: a survey. International Review of Environmental and Resource Economics. 4(2):163–219.
- [15] Gollop, F. M., and M. J. Roberts. 1983. Environmental regulations and productivity growth: the case of fossil-fuelled electric power generation. Journal of Political Economy. 9:654–74.