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Assessment of Allowance Mechanism in China's Carbon Trading Pilots

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Abstract

The allowance mechanism is one of the core and sensitive aspects in design of a carbon trading scheme and affects the compliance cost for each company covered under the scheme. By examining China's allowance mechanism from two aspects including allowance allocation and allowance distribution, this paper compares China's carbon trading pilots with the EU Emissions Trading System and California Cap-and-Trade Program, and through the comparison identify issues that affect the efficiency of the pilots. The paper also recommends course of actions to strengthen China's existing pilots and build valuable experiences for the establishment of the national cap-and-trade system in China.

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Keywords: cap-and-trade pilot; allowance allocation; carbon trading; China ETS; climate change

1. Introduction

Due to its rapid economic expansion over the last decade, China has become the world's largest energy consumer and greenhouse gases (GHGs) emitter. With growing resources and environmental constrains domestically and the need for meeting international commitment to GHGs abatement, China's National Development and Reform Commission (NDRC)launched a series of local carbon cap-and-trade pilots in seven provinces and cities including Shenzhen, Beijing, Tianjin, Shanghai, Chongqing, Guangdong, and Hubei[1], each of which has started its operation between 2013 and 2014.

The design of Chinese carbon trading pilots (CTPs) has become the focus of many researchers. Han et al [2] and Lo [3] are the early researchers to study the preparation of the pilots and argued that there would be tremendous challenge and influence on the theory and practices of the emissions trading. Zhang et al. conducted an overall assessment of China's seven CTPs [4], while several other researchers such as Jiang et al.[5],Wu et al.[6] and Qi et al.[7], examined some specific aspects of these pilots including their institutional structures and design features. Shen et al.[8] conducted a comprehensive analysis in which they compared China's CTPs with the California Cap-and-Trade Program (CA CAT) in multiple aspects. In spite of some discussion on the allowance mechanism in China's CTPs, however, none of the existing researches have focused on the details of the allowance design in China's pilots. As one of the core components in a carbon trading scheme, allowance mechanism affects the abatement responsibility and compliance cost of each covered entity and is always the most sensitive topic that draws a great deal of attention from the research community and policy makers. Therefore, it is important to conduct a comprehensive and in-depth analysis on the allowance mechanism in China's CTPs.

In this paper, we examines the allowance mechanism of China's pilots from two aspects, one is the allowance allocation, and the other is the allowance distribution and make comparisons in the two

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aspects with EU Emissions Trading System (EU ETS) and CA CAT. Allocation determines how the carbon emission cap on the total number of emission allowances is set and how emission allowances are allocated among covered entities within the cap. Allowance distribution deals with distribution of allocated allowances to all covered entities as well as dynamic allowance management in post-distribution.

2. Allowance allocation in China's pilots

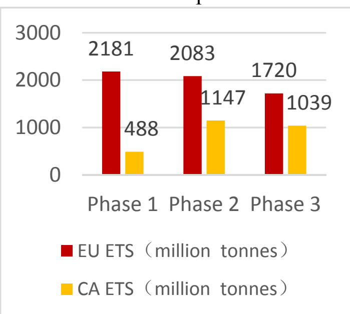
2.1 comparative analysis on emission cap and structure of allowances

The EU ETS has created decreasing emissions caps over its three phases. From the first (2005-2007) to the second phase (2008-2012), the cap declines from 2,181 million to 2,083 million allowances per year [9]. In the phase 3 (2013-2020), this cap decreases each year by 1.74% of the average total quantity of allowances issued annually in 2008-2012 to 1,720 million allowances in 2020 [10].In the EU ETS structure, allowances are divided into two parts, one for the existing facilities and the other is reserved for new capacities.

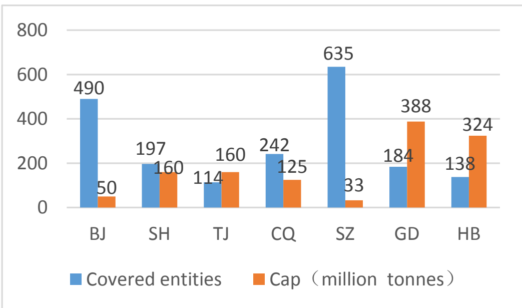
Similar to the EU ETS, CA CAT has also created a declining carbon emissions caps for the covered entities, which is set at about2% below the emission level for previous year in the initial compliance period (2012-2014)and at 3% annually for the second (2015-2017) and third (2018-2020) compliance periods[11]. In three separate compliance periods in the CA CAT, the total allowance cap is set at 488 million, 1,147million, and 1,039 million allowances, respectively [12].Drawing a lesson from EU ETS, the CA CAT reserves a certain number of allowances to create the allowance price containment reserve to ensure that the auction prices for allowances are kept in an acceptable range. Figure 1 displays the declining caps in both EU ETS and CA CAT.

In China's carbon trading pilots (CTPs), caps and allowance structures are different due largely to the difference in the economic structures of these pilots. As shown in figure 2, the local emission cap ranges from the lowest 33 million in Shenzhen to the highest 388 million in Guangdong in 2013. However, the number of covered entities in Shenzhen is much higher than Guangdong. This divergence reflects the significant difference of industrial structure between them, in which Shenzhen's economy is largely centered on the tertiary industry while the economy in Guangdong concentrates on the heavy industry that emits large amount of carbon emissions. Over the common pilot period (2013-2015), caps in Beijing, Shanghai, Tianjin, and Shenzhen pilots will remain unchanged while Guangdong and Hubei will increase the cap to cover increasing production of their industrial enterprises and Chongqing will decrease the cap by 4.13% per year. Figure 2 shows the caps and number of covered entities in China CTPs.

In a developing economy like China, CTPs are designed differently than the EU ETS and CA CAT and have taken into the consideration of the local needs for economic expansion and industrialization. As a result, Beijing, Shenzhen, Guangdong, and Hubei have divided their allowances into three parts including the quotas for the existing facilities, for production expansion, and for possible adjustment, respectively, and Shanghai and Tianjin have allocated allowances separately to existing facilities and new production. Only in Chongqing, all allowances are allocated to existing facilities because of no consideration of new production.



Source: Ellerman et al.(2010), EC(2009,2012), CARB (2010,2011).
Figure1. The declining caps of EU ETS & CA CAT



Source: China's ETS pilots management rules and allocation plans.
Figure 2. The caps and covered entities of China's CTPs in 2013

2.2 comparative analysis on allowances allocation methods

In the initial implementation of EU ETS, allowances allocation was mainly based on a grandfather approach focusing on historical emissions for existing facilities due to data availability and political feasibility. In pace with the development of the trading scheme and accumulation of emissions data, however, EU ETS has switched its allocation method to using benchmarks in the third phase and established a benchmarking system that includes 52 types of product benchmarks and various benchmarks for fuels, heat and production processes. The allowances allocated to each covered entity are determined by four factors: product benchmark, historical production, carbon leakage factor, and cap adjustment factor. If there is no corresponding product benchmark available, then the fallback methodology will be used as an alternative option[13].

In CA CAT, allowances allocation utilizes the benchmarking approach that has created a benchmark system consists of 28 different types of product and three fallback benchmark value [12]. Unlike EU ETS, the fall back method in CA CAT is based on the energy (electricity, fuel and heat) rather than the production processes. For the covered facilities under CA CAT, the number of allowances are allocated by the following factors: benchmark, three-year moving average output, industrial leakage factor, and cap decline factor.

Table 1. Comparison of allocation methods in China CTPs, EU ETS and CA CAT

Region	Historical emissions		Historical intensity		Benchmarking	
	Coverage	Allocation formula	Coverage	Allocation formula	Coverage	Allocation formula
BEI JING	existing facilities of manufacturing, other industrial and service sectors	historical average emissions ×decline coefficient	existing facilities in electricity and heat	historical average carbon intensity × power (or heat) supply × decline coefficient	new production of the covered industries	Industrial benchmark × output
SHANG HAI	industrial sectors other than electricity; shopping malls, hotels, commercial buildings, and railway station	historical emissions base + early abatement incentives	none	none	electricity, aviation, airport and port sectors	Industrial benchmark ×generated electricity ×load correction factor; Industrial benchmark ×business volume+ early abatement incentives
TIAN JIN	existing facilities of iron &steel, chemical, petrochemical, oil and gas extraction	historical emissions base × performance coefficient × industrial emission control factor	existing facilities in electricity and heat	historical average carbon emissions of per unit power (or heat) × power supply (or heat)	new production of the covered industries	Industrial benchmark × output
CHONG QING	Aluminum, metal alloys, calcium carbide, cement, steel, caustic soda	the highest of historical annual emissions	none	none	none	none
SHEN ZHEN	none	none	none	none	electricity, water, gas, construction and manufacturing	Industrial benchmark × output
GUANG DONG	cogeneration, cement mining and other grinding processes, petrochemical, short process steel	historical average emissions ×decline coefficient	none	none	pure power generation, cement clinker production and grinding process, long process steel	benchmark × historical average output × decline coefficient
HU BEI	pre-allocated quota of power enterprises; industrial enterprises	historical emissions base × cap adjustment factor	none	none	Ex-post adjustment quotas of electricity producers	Industrial benchmark × excess or shortage of generated electricity
EU ETS Phase1& Phase2	power, petrochemical, iron and steel, building materials, paper, aviation	historical average emissions	none	none	new production of the covered industries	Product benchmark× production capacity
EU ETS Phase3	none	none	none	none	electricity, paper, petrochemical, iron and steel, building materials, chemicals, aviation, aluminum	Product benchmark× median of historical production× carbon leakage factor ×cap adjustment factor
CA CAT	none	none	none	none	electricity, oil refining, oil and gas, glass, food processing, cement transportation	Product benchmark × three-year moving average output × industrial leakage factor × cap decline factor

Source: Ecofys (2009), EC(2012), CARB (2010,2011), and China's ETS pilots management rules and allocation plans.

Due to short preparation and the lack of adequate emissions data, China's CTPs mostly use historical emissions and intensity with limited benchmarking in allocating allowances. The use of a combined approach is aimed at coordinating the dynamic relationships between economic growth, industrial transition and emissions control. As shown in Table 1, Beijing and Tianjin use a combination of historical emissions, carbon intensity, and industrial benchmark. Shanghai considers of historical emissions and industrial benchmark along with early abatement incentives and rolling baseline year. Guangdong and Hubei mixes the historical emissions with rolling baseline year and for certain industries industrial benchmark Shenzhen and Chongqing have taken different approaches. For example, with a large number of covered entities, Shenzhen employs a competitive game theory method to allocate free allowances to manufacturing enterprises while Chongqing takes an approach of issuing the permits in accordance with the emissions reported by the covered entities themselves with total number of permits shrinking by 4.13 percent per year through 2015.

3. Allowance distribution in China's pilots

3.1 comparative analysis on allowances distribution patterns

In EU ETS, the allowances are distributed to covered entities mainly through free distribution and competitive auction. In its initial phases, in order to attract and encourage enterprises to actively participate in the trading system, the EU mainly used free distribution which, accounted for over 95% of total allowances, while the proportion of competitive auction was below 5% [9].From the third phase, the European Commission made a provision to auction at least 50% of the total permits in sectors other than the energy industry in which permits were obtained 100 percent through auction in 2013[14].

In CA CAT, the allowance distribution includes free distribution, competitive auction, and fixed price sale. For most industrial facilities, they can receive free allowances in the initial stage, but the proportion of the subsequent free allowances will vary across difference industries depending upon the degree of carbon leakage risk in different sectors. For example, high-risk industries will receive 100% free allowances in all three compliance periods while the middle-risk and low-risk sectors will receive descending number of free allowances [12], as shown in Table 2.

In order to establish the initial carbon market and attract enterprises to actively participate in trading, China's CTPs have taken a more realistic approach which uses free distribution with auction and fixed price sale as supplementary measures as shown in Table 2.

Table 2.Distribution patterns of allowances in China's pilots, EU ETS and CA ETS

Distribution Patterns	China's CTPs							EU ETS			CA CAT		
	BJ	SH	TJ	SZ	CQ	GD	HB	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
Free distribution	≥ 95%	100%	100%	≤ 95%	100%	≤ 97%	≥ 90%	≥ 95%	≥ 90%	≤ 50%	H:100% M:100% L:100%	H:100% M:75% L:50%	H:100% M:50% L:30%
Competitive auction	< 5%	0%	0%	≥ 3%	0%	≥ 3%	≤ 3%	≤ 5%	≤ 10%	≥ 50%	H:0% M:0% L:0%	H:0% M:25% L:50%	H:0% M:50% L:70%
Fixed price sale	< 5%	0%	0%	≥ 2%	0%	0%	< 7%	0%	0%	0%	≤ 1%	≤ 4%	≤ 7%

Note: 'H' represents the high risk of carbon leakage, 'M' represents the middle risk leakage, 'L' represents the low risk leakage.
Source: Ecofys(2009), EC(2012), CARB (2010,2011), and China's ETS pilots management rules and allocation plans.

3.2 comparative analysis on dynamic management of allowances

Compared with China where the economy is experiencing fast change, growth in EU and the U.S. is more flat. With less change in economic output and more reliable emissions data in EU and California, EU ETS and CA CAT can make more accurate determination on allowances. In China's CTPs, however, large discrepancy between pre-allocated allowances and enterprise actual emissions occurs due to China's high growth and incomplete business and emissions information. Therefore, policymaker tend to take measures to prevent enterprises from having a serious shortage or excess of allowances.

China's CTPs have thus designed a unique mechanism which uses an ex-post dynamic adjustment. For example, in Hubei pilot, if an enterprise's actual emissions increases or decreases by 20% from the allocated allowances, the government will add or take back the difference between the actual and the upper or lower 20% of pre-allocated allowances. Similarly, Chongqing also designs the ex-post adjustment measures, but the range of up or down adjustment is limited to 8%. In other pilots, Beijing, Tianjin, Shanghai, and Shenzhen have also included relevant language concerning ex-post adjustment in their trading pilot management regulation, but not provided specific adjustment ranges.

4. Issues with China's CTPs and Recommendations for Solution

There are issues in the design of the allowance mechanism in China's CTPs due to limited preparation and lack of reliable business information and emissions data. First,

the cap that was established during the fast economic growth periods of past Five-Year Plan will be mostly like looser than the current reality under the economic 'new normal' in which lower economic growth becomes a routine phenomenon. It is important for China's CTPs to make necessary adjustment to reflect the change of carbon emissions and avoid allocating excessive allowances like EU ETS did in its initial phases.

Second, free allocation based on grandfathering will create the unintended consequence of "whipping the fast ox" penalizing the entities that take actions on abating the climate change. Except for Shanghai and Tianjin, China's current CTPs mostly use historical emissions without crediting businesses for taking initiative to reduce carbon emissions. To make the allocation more effectively and fairly for achieving optimal reduction of carbon emissions, China needs to transit its allocation scheme from the grandfathering rule to the benchmarking approach that more accurately reflects the actual emissions and to award credits for businesses that have taken early abatement actions.

Third, for China's CTPs, double-counting is an outstanding issue in the allowance allocation. For example, all CTPs require both consumers and producers of electricity power to get allowances for the power they have consumed or produced. The double-counting of emissions will result in over-supply of allowances, creating negative impacts on the emissions trading scheme [15]. It is important for China to address the issue by assigning the responsibility to the sources of pollution.

Fourth, China's CTPs have employed some benchmarking measures for allowances but in a quite limited scale and for very few sectors. The benchmarking approach requires extra effort in collecting detailed information on products and technologies; yet it is a better method than the grandfather approach which relies predominantly upon historical emissions. To improve the effectiveness of its carbon trading scheme, China needs to consider of changing the allocation method from the grandfather to benchmarking. This change, however, needs to be supported by sufficient product and business performance data.

Furthermore, the majority of allowances in China's CTPs is currently free with very small percentage (3%-5%) of total allowances being auctioned. In spite of its importance to reduce the compliance cost of covered entities in the initial phase of a carbon trading scheme, the free allocation reduces the carbon efficiency of China's CTPs, resulting in less carbon reduction and/or lead to higher abatement cost resulting from lack of motivation to innovate. Also, the free allocation cannot provides an effective mean for governments to get necessary revenue to support government and community programs in reducing carbon emissions. It is therefore important for China CTPs to start shifting from free allocation to auctioning of allowances at least for leakage-prone industries or certain sectors that are characterized as overcapacity.

Finally, China's CTPs have made little effort in releasing important information such as what and how various factors are used to determine the allowances. This type of information is important as it helps covered entities understand the effort they need to make to reduce their emissions and enables researchers to identify potential flaws in the design. It will be in China's benefit to create clarity and strengthen transparency in the design of its CTPs' allowance allocation.

5. Conclusion

After two years of preparations, China's seven CTPs have officially started in 2013 and 2014 and covered entities in Beijing, Shanghai, Tianjin, Guangdong and Shenzhen have completed their first compliance year. Due to unique situation in China, its CTPs have some unique features, including a specific cap combined with flexible structure, an allowances allocation rule based on historical emissions combined with some benchmarking, free allowance distribution arrangement combined with some level of auction, and pre-determined quotas combined with ex-post allowance adjustment.

There are also some particular issues related to China's CTPs. The issues regarding the design of the allowance mechanism in China's CTPs include over-supply of allowances, lack of allowances credits for businesses that take early abatement actions, double counting on allowances, heavy reliance on historical emissions, and lack of the clarity and transparency. China is considering of establishing a national carbon trading market. In order to develop a robust and effective a national level carbon trading scheme in China, it is critical for the country to thoroughly assess the problems that have been discovered in the seven CTPs and carefully identify ways to address these issues.

6. Copyright

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Biography

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