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Policy Diffusion of the Emission Trading Scheme in China: Progress and Prospects*

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Chinese national emissions trading scheme (ETS) of greenhouse gas (GHG) was scheduled to start simulation trading in the power sector in 2020. Now it is good timing to review its progress and prospect. This study first examines policy diffusion in relation ETSs in China and particularly those for CO_2 emissions, including the causes, determinants, process, and impacts. It argues in a centralized political system with highly and widely differentiated local circumstances, policy diffusion is progressed through a more complicated process, presented as a three-tier process in the paper, illustrating how international arrangement, national jurisdiction, and local administration interact and influence policy-making in a follower's jurisdiction. China, which is now the biggest GHG emitter, has been preparing to establish a national ETS since 2017. So far, eight sub-national governments have introduced ETS pilot programs to feedback their experiences and to determine best practice for the national scheme. These eight pilots, especially the relatively successful ones, are found to be motivated by a competitive relationship that aims to stabilize its carbon market, which may eventually contribute to the progress of policy diffusion of the ETS in China.

Keywords: emissions trading scheme (ETS), greenhouse gas, climate change, EUETS, pilot ETS, Kyoto Protocol, Paris Agreement

Introduction

One market-based approach to reducing greenhouse gas (GHG) emissions, the so-called emissions trading scheme (ETS), has been adopted by several sub-national municipalities, countries, and supranational institutions. These include New Zealand and Asian countries (Korea, Japan, and China, particularly), as well as North American states and the European Union (EU) (IEA, 2014). Although an ETS was not negotiated under the latest global climate change agreement in Paris in December 2015, voluntary implementation of a domestic ETS is strongly encouraged under the current international framework. In 2005, the EU introduced the first-ever ETS as the Kyoto Protocol came into effect. Since 2013, China has introduced eight experimental pilot programs across the country to identify the optimal system for implementation. President Xi Jingping and the Chinese government officially announced (on January 22, 2016) its reduction targets and a plan to introduce a national ETS in 2017.

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Regarding the policy diffusion of ETSs, Paterson and others have argued that it is best described as a case of polycentric diffusion where various ETSs "all serve similar goals under a broad policy framework guided loosely by the UN-based climate regime" (Paterson, Hoffmann, Betsill, & Bernstein, 2014). In their study, Betsill and Hoffmann (2011) found ETSs were widely spread as a policy tool to address climate change; however, there was a diversity of modifications or adjustments in different jurisdictions (Cheng, Michida, & Kojima, 2016). Along with the adoption of the Paris Agreement, the birth of a global carbon market is considered to be an effective market approach to GHG emissions. As for the cause of ETS diffusion, Meckling (2011a; 2011b) argues that the business community could influence the regulatory style of abatement policy by promoting the introduction of carbon trading in industrialized countries.

Since China is now the largest GHG emitter in the world, the Chinese ETS is the focus of this study. Although the details of its national ETS are still under development, it is worthwhile to explore the current ETS pilots implemented in China by analyzing the causes, process, and problems, since the Chinese carbon market will probably become one of the largest such markets in the coming years. This is, therefore, a crucial moment to analyze the prospect of a Chinese ETS and its impact on the global carbon market. The success or failure of a Chinese ETS will have an impact on the effectiveness of GHG emissions reduction governance after the adoption of the Paris Agreement.

In China, it has been suggested that, in a departure from Meckling's argument, state and subnational governments, instead of business and private sectors, have influenced the establishment of ETS pilot programs and the forthcoming national ETS (Lo & Howes, 2014). Also, the Chinese carbon market is going to face several challenges since the nature of its national ETS does not simply and completely follow market principles (Lo, 2016).

We already know that politics will significantly influence the progress of ETS introduction in China, and so what are the motivations of political elites and the determinants of policy introduction? Can the composing elements of policy diffusion well illustrate the process of introducing ETS in China? What will be the characteristics of Chinese case in terms of cause, process, determinant, and consequences? Also, because the level of economic development differs from one region to another, how should the central government design a trading scheme that suits its highly and widely differentiated national circumstances? Lastly, in what way does the central government's position on ETSs influence the existing subnational pilot programs?

So far, the existing literature on the spread of ETSs in China focuses on either the phenomenon itself or the mechanism of ETS diffusion as an efficient policy tool, or on the characteristics and institutional challenges of a Chinese ETS (Munnings, Morgenstern, Wang, & Liu, 2014; Lo, 2016; Lo & Howes, 2014). However, analysis of the determinants and process of ETS development in China from the perspective of policy diffusion is still lacking. This paper aims to make a novel contribution to policy diffusion literature by explaining a market approach to tackling climate change in a non-fully industrialized communist country and showing the limits of the existing literature in explaining the regulatory diffusion in environmental studies, particularly in a major developing country with high GHG emissions.

In the following sections, the factors that influenced the policy diffusion of ETSs to the Chinese pilot program will be analyzed first. Jörgens (2003; 2004) and Biedenkopf's (2012) model of policy diffusion may partially explain the Chinese ETS; however, the explanation is not comprehensive since the international supports and global negotiations on climate change seem to be influential in facilitating the introduction of an ETS in China. However, the process of constructing the national scheme fosters an obvious competitive

relationship among ETS pilot programs, which allows observing differences. This rivalry is arguably a driver for local officials and policy makers to learn and absorb western experiences and then modify (or even create) arrangements adapted to the local circumstances.

Causes and Process of Policy Diffusion Related to ETSs

Causes

Jörgens (2003) enumerated several causes of policy diffusion, such as mimetic isomorphism, international pressure for conformity, attempts by political elites to increase legitimacy and to enhance self-esteem within an international society, political competition that minimizes the cost of political and economic adjustments to upcoming binding regulations, and economic competition in which regulatory policies are modified to sustain or improve national competitiveness in a global economy. According to Jörgens' (2003) research, political competition increases the prospect of international harmonization or future diffusion, while economic competition makes possible a "race to the top," in which "countries seek to emulate new and ambitious programs at an early stage of their international diffusion in order to secure the first-mover advantages and not lag behind other states" (p. 8).

Since the Kyoto Protocol, there have been no compulsory or legally binding measures for all states to reduce GHG emissions. Additionally, there has been no international agreement aimed at introducing a domestic or international ETS in any country or region. However, ETSs have been advocated as an efficient market-based approach to reducing GHG emissions (The World Bank, 2016; Meckling & Jenner, 2016; Ovodenko & Keohane, 2012; Meckling, 2011a; 2011b), and many countries and regions have already established, or are considering constructing, an ETS on a voluntary basis.

The expansion of domestic GHG ETSs around the world, including in China, in the past decade can be attributed to international efforts to tackle climate change. Since the 1990s, emissions trading under the Kyoto Protocol has been a flexible, economical, and effective tool for reducing GHG. Although the post-Kyoto framework that was recently established in Paris does not provide a clause regarding emissions trading, voluntarily developed trading schemes within states or across borders are welcomed (Article 6, Paris Agreement). With progress in international negotiations as the background, ETSs have been introduced across a number of regions, and even within the borders of the biggest emitter, China. The reasons for pursuing the establishment of an ETS can be viewed from both policy and economic perspectives, and these will be analyzed in the following paragraphs.

From a policy-oriented perspective, an ETS serves as a flexible and more effective mechanism for restricting gas emissions than exogenous compulsory regulations that target emitters, such as energy/power producers. Therefore, an ETS is a type of policy tool that helps regions at any scale achieve GHG reduction goals efficiently (Meckling, 2011a; 2011b).

There are also economic motivations to accept an ETS as a domestic measure to cut emissions. For example, under the Kyoto Protocol, actual emission units, such as the assigned amount units (AAUs) and certificated emission reductions (CERs), generated from Clean Development Mechanism[1] program activities can be traded. Under the cap and trade system, trading provides emitters incentives to reduce emissions below

[1] Under the Clean Development Mechanism, emission-reduction projects in developing countries can earn CER credits. These saleable credits can be used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol, UNFCCC official website: https://cdm.unfccc.int/about/index.html.

the cap and sell the allowance for a profit while discouraging polluters from emitting by requiring them to purchase credits if they emit beyond the established threshold. If the ETS market is growing and sufficiently stable, investors are encouraged to finance new programs to reduce emissions. Accordingly, countries or sub-national municipalities are expected to introduce an ETS as an environmental protection measure, while securing their access to the global market, that is, taking the initiative to construct their own carbon markets.

Process

According to Biedenkopf (2012), the process of policy diffusion comprises two steps: 1) a pioneering actor introduces a policy to a following actor; and 2) the policy is adjusted in the following actor's jurisdiction (Figure 1). Also, Biedenkopf (2012), based on existing researches (Busch, Jörgens, & Tews, 2005; Kern, Jörgens, & Jänicke, 2005; Tews, Busch, & Jörgens, 2003; Tews & Busch, 2001), defines the process of policy diffusion as follows: "the diffusion of policy starts with the introduction of policy with pioneering characteristics by a jurisdiction. The pioneering policy affects actors in other jurisdictions through one or combination of diffusion mechanisms—learning, emulation, and adjustment" (pp. 105-106).

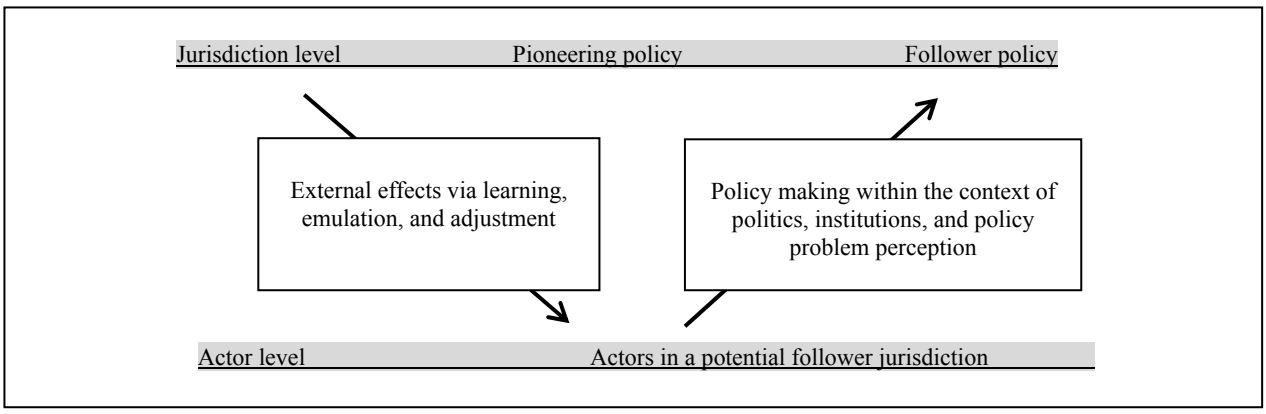

Figure 1. Process of policy diffusion: Two levels. Source: Biedenkopf (2012, p. 106).

Learning, according to Biedenkopf (2012), can be categorized into two types: rational learning, which means that actors search for optimal solutions, and bounded learning, which indicates that beliefs and ideologies matter in decision-making. Emulation often takes place at the early stage of policy diffusion when a potential follower jurisdiction adheres to common norms or shares common norms with other jurisdictions. Adjustment occurs when pioneering policy changes in the context of another jurisdiction, which alters the costs and benefits of diffused regulations and policies.

The second step of policy diffusion takes place in a potential follower jurisdiction; for example, China will be the follower jurisdiction in the following analysis. At the level of the following actor, policy-making occurs within the context of politics, institutions, and policy problem perception. Politics refers to the political struggle between various groups in favor of, or against, a follower policy that is similar to the pioneering policy (Sabatier, 1988; Biedenkopf, 2012, p. 109). Institutions determine the access of actors to the policy-making process and their influence. In the process of policy diffusion, a small group of actors (such as China's NDRC[2] and its local Development Reform Committee (DRC) must be affected via at least one mechanism underlying the diffusion (Biedenkopf, 2012, p. 109).

[2] NDRC stands for "National Development Reform Committee".

However, in authoritarian systems, the role of various stakeholder groups is minimal. For example, in the Chinese ETS case, groups and those with strong opinions against ETS implementation were not observed. Additionally, path dependencies may be created by existing policies, which can either promote or preclude the follower's policy. Lastly, policy problem perception means that strong pressure related to a problem, especially when the problem is perceived as important, makes diffusion more likely. Chinese law on hazardous substances in electronic products, and the ETS pilot programs introduced in Chinese provinces or major cities are good examples.

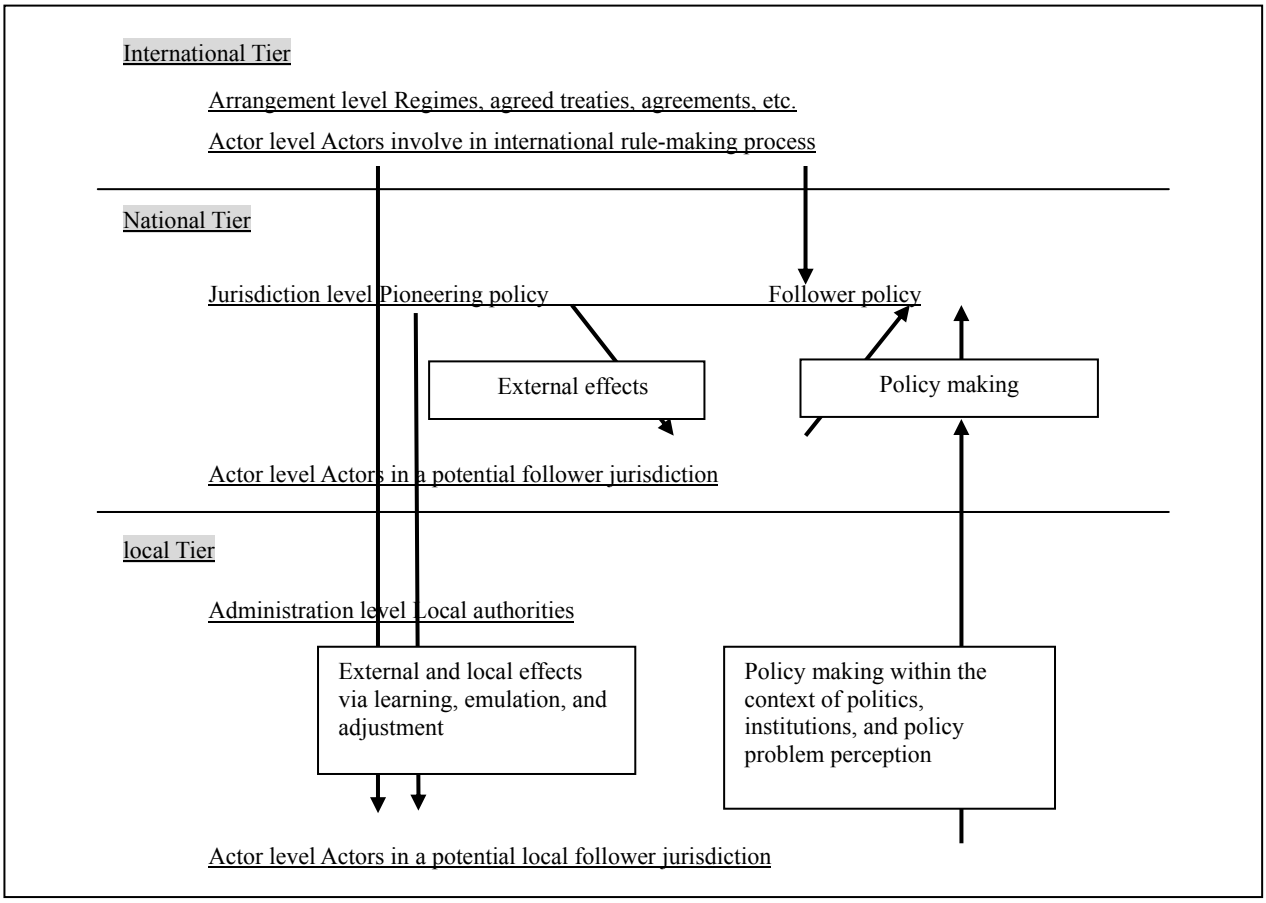

Figure 2. Process of policy diffusion: Three tiers. Source: Author.

Instead of the two-level process in policy diffusion, the paper argues that diffusion is motivated at three tiers: *international*-, *national*- and *local*-, between which pioneering policy is learned, modified, then finally decided and implemented as follower policy at national jurisdiction and actor level (Figure 2). Another characteristic of the argument is the mutual influence between the tiers. For instance, national jurisdiction, as well as its local administrations and their actors receive information from, and motivated by, the guidance of international arrangement which accelerate policy diffusion at respective tier.

On the other hand, at local tier, administrations and actors either take voluntary actions or obtain instructions from upper/central/national government. Like what have been argued in existing literatures, learning and policy-making process take place at local tier as well. Policies and regulations are highly likely to be moderately modified to suit its local circumstances, then will be reported, or suggested as policy options to

the upper/central/national tier. Considering its local opinions, jurisdiction and actors at national tier make decision within the context of politics, institutions, and policy problem perception, to be eventually reflected as the follower's policy.

This framework is assumed to be applied to national jurisdictions that own centralized political system, while embracing complicated local circumstances. This is because under such system, nationally wide policy and regulation is preferred while respective local and regional condition needs to be taken into consideration. Based on the heterogeneous capability, policy-making process, and local-central relations at local tier, it can be inferred that there may be competitive relationships among local governments and actors in promoting policy options to be reflected at national tier.

Diffusion of an ETS Across Regions

The design and implementation of ETSs can be traced back to the U.S., which advocated for an emissions trading system in the 1980s (Meckling & Jenner, 2016). The U.S. initially proposed taking advantage of this type of economic approach in the process of negotiating the Kyoto Protocol under the United Nations Framework Convention on Climate Change (UNFCCC). During the negotiations, the EU opposed a worldwide ETS, but eventually agreed to a flexible mechanism, the so-called Kyoto Mechanism, under the Protocol in 1997, which came into effect in 2005.

After the adoption of the Kyoto Protocol, the EU set its GHG emissions reduction target to 8% below the 1990 level for the whole EU region, known as the EU bubble, by 2012. In 2005, the EU established the first ever GHG emissions reduction scheme, named the EUETS, which was initiated with the enforcement of the Kyoto Protocol. Although an international agreement has not yet introduced a global ETS and carbon market, this has been a goal of the EU since the establishment of its ETS.

In the case of the GHG emissions trade, the U.S. first advocated for the system to be incorporated into an international agreement (e.g., the Kyoto Protocol) and subsequently implemented by another powerful actor (specifically, the EU) (Ovodenko & Keohane, 2012). The EU has attempted to broaden its scheme and link it with those of other regions. In recent years, many regions, nation states, and sub-regional jurisdictions have introduced or are considering introducing an ETS within their authority. These include major emitters such as Brazil, Russia, and Mexico, which are reported to be considering the establishment of national ETSs (ICAP, 2020).

Since the EUETS was implemented, a number of ETSs have been launched nationally, sub-nationally, and regionally, and some are even seeking mutual linkages (Table 1). Despite the lack of an international ETS, relatively mature and stable carbon markets, such as California and Quebec, have established mutual linkages. In 2014, the two states joined the Western Climate Initiative (WCI), under which they can use allowances from each other's cap and trade system. It is also possible for the two states to hold joint auctions and to establish co-management of emission allowances and offset credits, while maintaining the management rights for their own systems (California Air Resources Board).

The Chinese ETS pilot programs have been influenced by the EUETS, which is the pioneering system. Accordingly, a comparison between the two systems is needed to determine similarities and differences. Owing to the huge drop in carbon prices under the EUETS, the EU released a revised ETS Directive (EU Directive 2009/29/EC) to reform its scheme. Under the current system, both the Chinese pilots and the EUETS have a two-level structure in which targeted factories and companies in each member state participate. In China, local

governments are supposed to join the national ETS by sharing the free allocation and emission reduction target. Another common factor between China and the EU is the targeted emitters.

Under the EUETS and Chinese pilots, targeted emitters are "energy consumers," instead of energy suppliers (e.g., power plants and power generators). Currently, the targeted gas in China is limited to CO_2, as in the first phase of the EUETS. A third point in common is the allocation of emission allowances. Both the Chinese pilots and phases I and II of the EUETS are subject to free allocation; however, auctioning will be the preferred means of allocation in the EUETS during phase III. Learning from the European experience, the Guangdong and Shenzhen pilots introduced auctions for complementary allowances, but this is limited to less than 10% of the total allocated allowances. The last common factor is compliance, which specifies a penalty for targeted emitters when they do not comply with regulations under the EU and pilot schemes.

Like the WCI, the establishment of mutual linkage between the EUETS and other national or regional ETSs, particularly the Chinese ETS, has been discussed over the last several years. Nevertheless, problems and concerns described in prior research, such as cheating, heterogeneity among provinces, and a lack of legal rules, indicate the unpredictability of the future Chinese national ETS (Xiong & Qi, 2015; Lo, 2016). These concerns may make it difficult to establish linkages between the Chinese ETS and those of other regions.

Table 1

Currently Implemented Major Emissions Trading Schemes

Regional/national/ sub-national	Term	GHG emissions reduction target	Coverage
The European Union (EU ETS)	2005-2020	40% reduction from 1990 by 2030	EU27, Iceland, Norway, Liechtenstein; Covering 43% of EU GHG emissions
Switzerland	2013-2020	20% reduction from 1990 by 2020	950 companies from industrial sectors
California, U.S.	2013-2020	Emission reduction to 1990 level by 2020	Target energy industry, such as oil, gas. It extends to 85% of California's emissions after 2015
RGGI*, U.S.	2009-2018	10% reduction from 2014 by 2018	Power plants as target
China (under development)	2017~2020 (Preparation period)	Peak CO_2 emissions around 2030; to lower CO_2 emissions per unit of GDP by 60%-65% from 2005 levels	Expected to regulate up to 1,700 companies from the power sector, covering more than 3 billion tones of CO_2 equivalent in its initial phase, which accounts for about 30% of its national emissions.
Eight Pilots*	Pilots: 2013-2017	Subject to each pilot and to meet national target	Pilot programs were launched in seven major provinces/cities from 2013. In 2016, the eighth ETS was launched in Fujian Province.
Quebec, Canada	2013-2020	20% reduction from 1990 by 2020	Target energy industry, such as oil, gas. Link to California ETS from January 2014
Korea	2015-2026	30% reduction of BAU* by 2020	Target 490 emitters, total coverage reaches to 60% of emissions
New Zealand	2008-2020	~10%-20% reduction from 1990 by 2020	Target emitters from forest, energy industry (fossil fuels), agriculture, manufacturing industry, transportation business
Tokyo, Japan	2010-2019	25% reduction from 2000 by 2020	Link to Saitama ETS from September 2010

Notes. * RGGI: The Regional Greenhouse Gas Initiative (RGGI) is the first market-based regulatory program in the United States to reduce greenhouse gas emissions. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO2 emissions from the power sector; * Chinese ETS: seven pilots were established from 2013 in Shenzhen, Shanghai, Beijing, Guangdong, Tianjin, Hubei, and Chongqing; the eighth pilot was later established in 2016 in Fujian with a special focus on forestry sector and carbon sinks; * BAU stands for business as usual.

In China, eight pilot ETS programs have been launched, with different participants, targets, and rules. In the end of 2017, China launched its national ETS, under which the simulation trading in the power sector is expected to start in 2020 (ICAP, 2020) Although much attention has been paid to the establishment of the national ETS, it should be noted that variation among pilots with respect to rules and targets enables a competitive relationship among schemes, since the national rules and regulations will be determined based on the pilots' operating experiences. It is very difficult to predict which pilot will be picked up as the best practice model, but it is thought that the Chinese national scheme will be a conventional, single-rule system even though it has to account for regional industrial features and local circumstances. In the following section, two Chinese ETS pilot programs will be explored more in detail to reveal their common rules and differences.

Determinants and Process of ETS Policy Diffusion in China

To clarify the determinants, process, and possible impacts of ETS policy diffusion, the following sections will focus on the implementation of the pilot programs in China.

Seven (Later Eight) ETS Pilot Programs

In the Chinese 12th Five-year Plan (2010-2015), seven domestic pilot programs were initiated in major provinces and cities. The eighth pilot, the Fujian ETS, was set up and mandated by the State Council in 2016 with the endorsement of the "National Ecological Civilization Pilot Area Implementation Plan" (ICAP, 2020). Based on the experiences and outcomes of these pilot programs, the launch of a national Chinese ETS was taken into consideration under the 13th Five-year Plan, which lays out the guidelines of Chinese economic development from 2017 to 2020.

Commonalities between the eight pilots can be observed with respect to three main features. First, targeted enterprises are large-scale CO_2 emitters (heavy industries, manufacturers, and so on), including both direct and indirect emitters. Second, the allocation of emissions credits is free. Third, it is possible to trade external credits, that is, the Chinese Certified Emission Reductions (CCERs), with certain constraints (Table 2). Two of the pilots—Beijing and Hubei—will be discussed more in detail later.

Table 2.

Eight pilots for the Chinese Emissions Trading Scheme

Province/city	Start of Trading	Target emitters	Companies	Penalty (in RMB)
Shenzhen	2013/06/18	Industry: >5,000 t/year Public building: >20,000 m2 Government office: >10,000 m2	832	10,000~100,000
Shanghai	2013/11/26	Industry: >20,000 t/year Non-industry: >10,000 t/year	191	10,000~30,000
Beijing	2013/11/28	>10,000 t/year	490	<50,000; 3-5 times market average price for over-emission
Guangdong	2013/12/19	>20,000 t/year	242	3 times market average price
Tianjin	2013/12/26	>20,000 t/year	114	Unable to receive a variety of incentives for three years
Hubei	2014/04/02	>60,000 t/year	138	3 times market average price; subtracting 2 times excess emissions from next year's allowance
Chongqing	2014/06/19	>20,000 t/year	242	N/A
Fujian	2016/12/22	>10,000 t/year	255	10,000~30,000, or 1-3 times of market average price, etc.

Compared with EU ETS

EU ETS	2005~2007 2008~2012 2012~2020	For CO_2, thermal input > 20 MW	>12,000	€100/t-CO_2 for excess emissions, with consideration of inflation

Source: author; with reference to the Emissions Trading Worldwide: Status Report 2020, ICAP. Created on May 24, 2020.

Determinants

The determinants of ETS introduction in China can be analyzed based on three aspects: (1) domestic factors, including policies to tackle climate change and announce a domestic reduction target; (2) acquirement of market access; and (3) international support.

The first determinant is China's significant alteration of its position with respect to climate change since 2009. In 2009, China declared a national voluntary target of 40%-45% reductions in per capita CO_2 emissions by 2020, and in 2014 registered a target of 60%-65% reductions by 2030 as its nationally determined contribution (NDC) to the Paris Agreement. China also announced its target of total national CO_2 emissions peak-out by 2030. These targets are positioned as binding targets domestically so that the pressure to achieve the voluntary national targets has become one of the strongest reasons for China to promote its ETS.

The second determinant relates to the country's motivation of acquiring market access by the acceptance of ETS as a domestic measure for reducing emissions. Once the trading scheme becomes stable and the market grows to a significant scale, it can be argued that a country would like to pursue market power to influence the price and maximize its profit, instead of simply being a price-taker. Moreover, investors are also encouraged to finance new emission reduction projects. For this reason, it is supposed that China introduced its ETS because it would like to introduce environmental protection measures while securing access to the global market by constructing the carbon market.

The third determinant is international organizations. In the process of establishing the Chinese ETS pilot programs, the Chinese government received support and advice from the World Bank and the International Emissions Trading Association (IETA), based on the EUETS experience. The World Bank provided eight million euros to China to consider the introduction of an ETS under a program called the Partnership for Market Readiness. This may explain why the three factors described in the previous section are quite similar to those of systems under the EUETS.

Process

Is Biedenkopf's model of the process of policy diffusion applicable to an ETS in China? The answer will be given in the following paragraphs.

The Kyoto Protocol ruled that an ETS is a flexible method of achieving national emission reduction targets and is complementary to other methods to cut emissions (Article 17, the Kyoto Protocol). The EU first established its ETS in 2005 to meet its reduction target, while broadening the opportunity to acquire financial and economic interest. After experiencing a crash in carbon prices in 2013, the EU Parliament amended the GHG emissions trading directive by postponing the supply of emission allowances (back-loading). Additionally, to solve the fundamental problem of a significant emission allowance surplus, the European Commission proposed measures for improvements in 2014, such as providing an allowance reserve account to adjust the supply and demand of emission allowances. These experiences have provided China with a reference for designing its own trading scheme.

As mentioned in the previous section, China received financial and technical support from the World Bank and IETA based on the experience of the EUETS. The scale of the EU market is similar to that of China based on population, emissions, and the two-level structure of the political system. The EU and Chinese central governments are at the top of the system and states and provinces are at lower levels in the ETS (this information is from an interview with Chinese experts involved in the design of the Hubei pilot). The EUETS regards the Chinese national ETS as a potential target for future mutual linkage in order to construct a more prosperous market; accordingly, the EU supports China in the development of its ETS (this information is from an interview with NDRC officials).

After years of negotiation in the post-Kyoto framework, the Paris Agreement was accepted in 2015 with more than 188 countries voluntarily pledging their National Determined Contributions (NDCs). Some NDCs include emission reduction targets to mitigate damage from climate change. The president of China, which is now the biggest GHG emitter in the world, declared a plan to introduce its national ETS at the Sino-U.S. summit during his visit to the United States in September 2015, before the opening of the 21st Conference of Parties (COP21) of the UNFCCC held in Paris.

At the domestic level, the NDRC as well as local development and reform committees have played a particularly important role in designing policy and decision-making for the ETS and the pilots (interview with a China Beijing Environmental Exchange [CBEEX] researcher). The National Center for Climate Change Strategy and International Cooperation (NCSC) manages research that helps local governments understand the ETSs implemented in other countries. Owing to differences in energy supply/demand and industrial structure between regions, provinces, and cites, the Chinese ETS pilots demand varying designs to meet their specific needs. Therefore, the capability, implementation status, and problems vary from pilot to pilot. All these tasks are part of the decision-making process in the comprehensive consideration of rules and regulations for the forthcoming national ETS, in which central and local officials of the development reform committee and elites are involved. Each pilot, under the support of local DRC and officials, actively acquires information from international experience through capacity building, while searching for the best available institutional design that is compatible with the local situation and central preference.

Based on the analysis above, it can be argued that Biedenkopf's model of the policy diffusion process is useful for the explanation of the situation in China, but it is not comprehensive. In the process of introducing its ETS, China learned from the efforts of developed countries and sub-national municipalities, such as the EUETS, California Cap and Trade, and RGGI, while it progressed with international negotiations on climate change (Figure 3). At the same time, local governments and ETS-related organizations have been making efforts to design a scheme that works well with their local situations as a reference for central governments to consider comprehensively in designing the national ETS. As a matter of fact, the rivalry between strong pilot schemes, which has strengthened the motivation for learning, can be regarded as a feature of ETS policy diffusion in China. To sum up, the process of ETS diffusion to China is not a two-level structure but a three-level one in which international, national, and local levels influence each other.

In the following section, two pilot programs, Beijing ETS, and Hubei ETS, are briefly introduced based on interviews and fieldwork conducted in China. They are selected because both Beijing and Hubei have been making efforts to absorb western experiences by learning through research, workshops, training sessions, and communication with foreign experts. So far, these two pilots have had a relatively successful experience in operating the program with stable trading volume and price. Beijing, as a metropolitan area, provides lessons

and experience to the policy makers, while Hubei shows how a heavy industry-centered province copes with low carbon development.

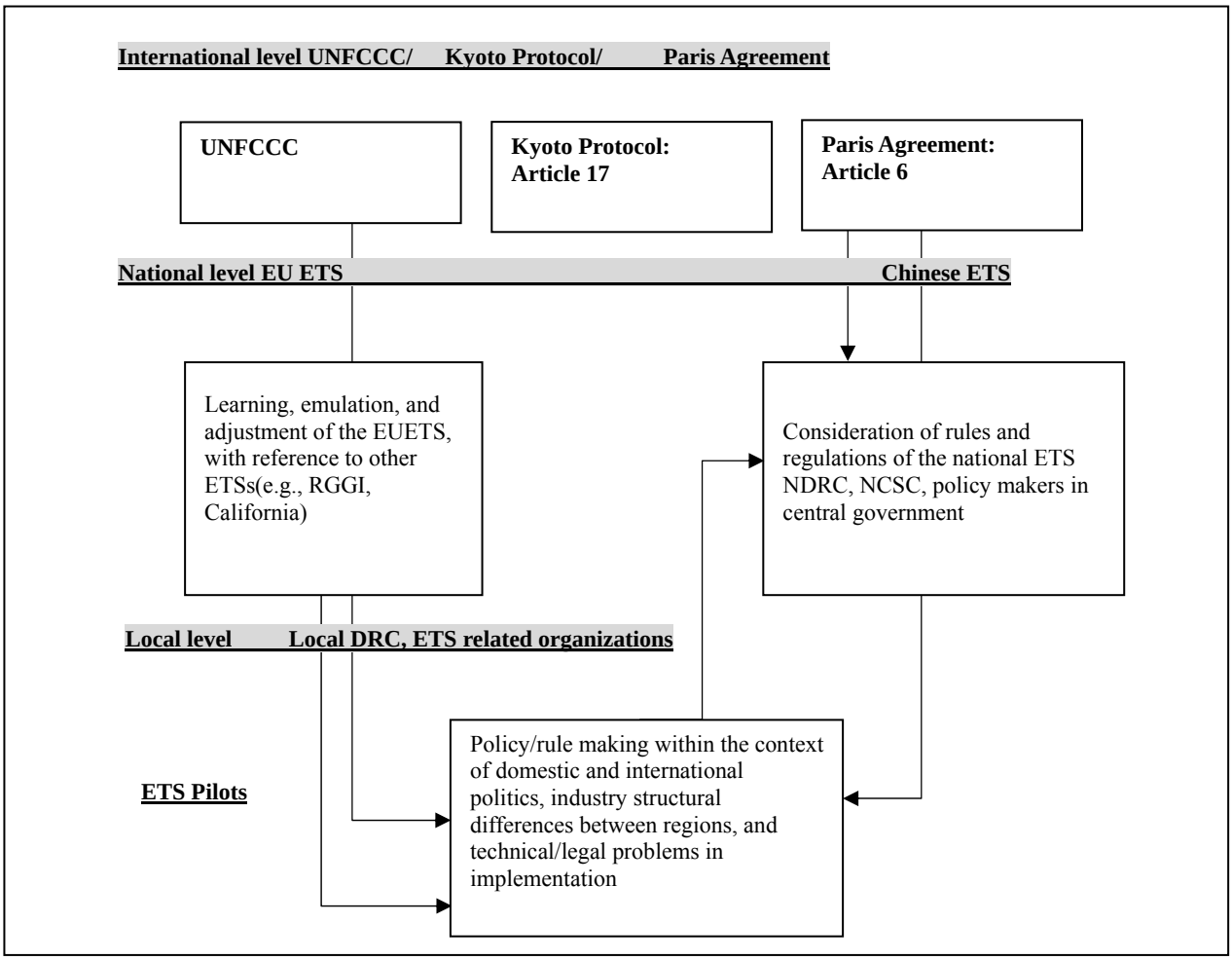

Figure 3. Policy diffusion process of the Chinese ETS. Source: Author.

Case Studies of Two Pilots: Beijing and Hubei

Beijing

The Beijing pilot began operation on November 28, 2013. The targeted emitters are those who emit more 10,000 tons of CO_2 per year (Table 2). There are currently more than 415 target emitters, comprising all industries and sectors, including public services and governmental businesses. The compliance measures are a penalty of up to 50,000 RMB which, like the EU ETS penalties, are 3 to 5 times the market average price for excess emissions (also see Table 2).

One feature of the Beijing pilot is the allocation of allowances, including the facility (equipment) allowance, new facility/equipment allowance, and an allowance adjustment to deal efficiently with annual production changes. The method for calculating the free allowance is based on an emitter's historical emissions from 2009 to 2012.

Both Beijing and Hubei enacted free allocation, auction, and pricing for sale. Auction and pricing for sale are allowances designed to balance the trading price and stabilize the market order. The modes of free

allocation and auction are like those of EU ETS. However, unlike the EUETS, the Beijing and Hubei pilots hold allowances for sales for the purpose of market adjustment (Table 3). In the Beijing pilot, the allowance for adjustments is no more than 5% of the total allowance. Hubei, however, reserves up to 10% of the total allowance to regulate the market, for which auction allowances account for 3% and sales for the remainder (also see Table 3).

Table 3

Comparison of Beijing, Hubei, and EU ETS in Terms of Allocation

Allocation of allowance	Chinese pilot ETS		EU ETS		
	Beijing	Hubei	Phase I	Phase II	Phase III
Free allowance	95%	90%	95%	90%	≤ 50%
Auction	< 5%	≤ 3%	≤ 5%	≤ 10%	50%
Pricing for sale	< 5%	< 7%	0%	0%	0%

Source: Xiong & Qi (2015, p. 196).

For its input to the establishment of a Chinese national ETS, the Beijing pilot needs to develop newer low-carbon financial products, learning from international experience and other pilots, to provide good practice. Currently, the trading volume for the Beijing ETS is fourth among the pilots, in part because the trading commodities are limited to spot trading. Other pilots, such as the one in Shenzhen, are more creative in designing trading commodities (interview with a CBEEX researcher). So far, the Beijing ETS has developed capacity building programs with nearby provinces such as inner Mongolia to expand its influence to other regions.

Hubei

The Hubei pilot started to operate relatively late, on April 2, 2014. The targeted emitters in Hubei are those who have emissions exceeding 60,000 tons of CO_2 per year (Table 3), far more than any other pilot. As a result, there are approximately 138 targeted emitters in Hubei, fewer than in Beijing. However, Hubei is currently regarded as the most successful pilot because its volume of trading is the highest and the price of carbon/ton is the most stable (around 21-28 RMB/ton). Under the Hubei ETS, targeted emitters are almost exclusively in heavy industry, including steel and automobile manufacturing, because Hubei province has long been an important industrial base and is one of the three largest steel bases in China. Like the EUETS, the penalty for non-compliance is three times the market average price or the subtraction of two times the excess emissions from the following year's allowance.

After learning from the EU's experience, the Hubei pilot set up several measures to avoid the collapse of its carbon price. One characteristic of its allocation of allowances is that it comprises an annual initial allowance, new allowance, and governmental reserves. The annual initial allowance controls existing emissions facilities, which limits the emissions to 97% of the 2010 emissions level. The governmental reserves account for 8% of the total allocation and up to 30% of the reserves can be sold by open auction to adjust market prices. Based on lessons from the EUETS, governmental reserves are aimed to prevent sudden, large price drops that lead to a market crisis. The rest is the new allowance for new production; governmental reserves can also be transferred to new allowance, if necessary. This measure can be considered a flexible mechanism to enable economic (emissions) growth.

In addition, under the Hubei pilot, the free allowance is calculated based on an emitter's historical emissions and carbon intensity with respect to industrial type. For manufacturing industries, the allowance lets

manufacturers revise their historical emissions in the year after experiencing a large change in production.

One of the problems associated with the implementation of the Hubei pilot is related to the capability for measurement, reporting, and verification (MRV) of third party organizations (interview with experts who are involved with the system design of the Hubei pilot). Since the MRV system is the core factor in establishing an efficient and workable ETS, not only Hubei, but also other pilots need to take measures to strengthen their MRV systems. For example, it is thought that China should develop and implement unified national emissions accounting methods and standards for each sector, develop systems of direct data collection and informational management, and establish a rigorous system of third party verification and management for emitters' emission reports (Li, Zhou, & Xu, 2015, p. 233).

Issues and Problems Revealed by the Operation of the Chinese ETS Pilot Programs

As indicated in the previous section, China is establishing its national carbon market not simply to meet its voluntary emission reduction target, but also to secure access to the carbon market, since the EU has a clear strategy to lead the commercialization of carbon dioxide, and to expand its ETS by implementing the European pricing process and rule-making (Li et al., 2015, p. 229). To set up its own ETS and market with stable prices and trading volumes, several important issues need urgent attention in China.

One of the major concerns related to the Chinese national ETS is the recently diminishing growth of the Chinese economy. The "new normal" economy indicates a huge adjustment in the current industrial structure, especially for high-energy-consuming and high-carbon-emitting industries. Because the current allocation was established previously, a decrease in the size of the economy may cause a surplus of emission allowances, particularly after the pandemic of coronavirus disease in 2020, which would directly lead to a drop in prices, like the EUETS has experienced. Compared to the EU, however, the Chinese economy grows at a much higher rate, though there is more uncertainty. Also, although the pilots are designed according to their respective regional circumstances, there may be huge gaps between allocated allowances and a manufacturer's actual emissions owing to incomplete information and complex variation in production among industries (interview with a CBEEX researcher).

For the establishment of the national ETS scheduled, there are common issues shared by the pilots that need to be considered. First, the Carbon Emission Trade Management Law must be prepared, which is under the NDRC's authority. The ETS must be effectively managed under a legal framework, including accreditation to a third party with sufficient capability, for the market to operate smoothly and efficiently.

Second, it is necessary to strengthen statistical analyses of emissions, data collection, and the development of capacity in non-pilot regions. Compared to pilot regions, non-pilot regions face great challenges in MRV, and local governments and manufacturers lack the knowledge and experience to promote a low-carbon economy. Since the ongoing Chinese national ETS encompasses all regions within the country, work to raise participation ability in non-pilot regions is an urgent issue.

Third, it is necessary to minimize the gap between ongoing pilots and the national ETS, which is not yet completely clear. For example, it has not been decided whether or how emitters under current pilot programs can use current allowances after the national ETS formally operate. In addition, it is also not completely clear if the current exchange platforms of pilot programs continue to operate parallelly to its national ETS. To guarantee the efficient operation of a national ETS, many issues need to be overcome before discussing links with the ETSs of other countries (such as the EUETS).

Fragmentation of Governance

In terms of global governance, fragmentation among the various regional and sub-regional schemes is clearly observed at the current time. Nevertheless, co-existing ETSs are not expected to obviously inconvenience or hinder each other or global GHG reduction management efforts because reducing emissions via trading is at the discretion of each jurisdiction under both the Kyoto Protocol and the Paris Agreement. Current relationships between the potential Chinese national ETS, the EUETS and other ETSs can be regarded as being in a situation of fragmentation since the current effort to reduce GHG emissions is based on voluntary action. This situation is like "division of labor," but it is more efficient when all countries work together to reduce global GHG emissions. Additional time, experience, and modifications are needed to achieve efficient "division of labor," barring future coordination among the various national and sub-national ETSs.

It is widely argued that linkage between ETSs, or even the establishment of a global common market, may make emissions reduction more efficient and avoid carbon leakage, a type of externality caused by having national or regional ETSs, which means the national carbon market would encourage emitters to move to where there are no regulations with respect to emissions. Not surprisingly, therefore, coordination between ETSs, especially the Chinese and EUETSs, has been discussed; however, the priority of the Chinese government and policy makers, at present, is the stabilization of its domestic carbon market and prices.

Conclusion

GHG ETSs have recently been introduced in many nations, regions, and sub-nations, and many others that are under consideration. In this study, the author examined Chinese pilots and national ETS planning, given that the country is projected to become the biggest carbon market. The Chinese ETS pilot programs are used to clarify the determinants and process of policy diffusion and it is found that the EUETS and past experiences in Europe strongly influenced the institutional design. A comparative analysis of the rules of trading and allocated emission allowances shows that the Chinese pilot ETSs are based on the experiences of other jurisdictions but are modified with the goal of avoiding the price slump experienced by the EU. In the process of introducing its national ETS, China learned, emulated, and adjusted the scheme to fit its industrial structure and various factors that differ among regions.

Also, the competitive relationship between pilot programs motivated learning from outside and each other to determine best available practice. Based on interviews with Chinese policy makers and ETS specialists, the Chinese ETS programs absorbed, learned, and modified the ETSs of other locations through interactions at the international, national, and local levels. It is premature to state which pilot provides best practice for the forthcoming national scheme, but a combined scheme that balances domestic and local diversity can be inferred from current operational experience.

Considering the uncertainty surrounding the Chinese national ETS, it is too early to comment on the possibility of linkage between the EU and China. In China, policy makers are encouraged to develop an effective ETS by referring to the EU experience. It is also in the interest of the EU that the Chinese ETS shares a common market with the EUETS. Future linkage between the two markets is possible, but considering local variation and market stability in China, Chinese policy makers tend to regard the enforcement of the legal system and the stabilization of its national schemes and the whole market as the current priority.

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