MIT CEEPR

MIT Center for Energy and Environmental Policy Research

Absolute vs. Intensity-based Caps for Carbon Emissions Target Setting: An Obstacle to Linking the EU ETS to a Chinese National ETS?

Yingying Zeng, Stefan E. Weishaar and Oscar Couwenberg

April 2016 CEEPR WP 2016-008

Absolute vs. Intensity-based Caps for Carbon Emissions Target Setting:

An Obstacle to Linking the EU ETS to Chinese National ETS?

Yingying Zeng, Stefan E. Weishaar and Oscar Couwenberg[*]

1 April 2016

Linking the European Union Emissions Trading System (EU ETS) to the Chinese national ETS promises considerable economic and political benefits. However, different policy choices regarding cap setting between the systems are likely to impede a potential linking. A striking distinction is that the EU ETS relies upon an absolute cap, while the Chinese national ETS appears to apply an 'intensity-based cap' during the early stages. The current linking literature focuses on mapping legal barriers in general and has not yet focused on EU and China, let alone the intricacies of policy design. This paper seeks to fill this gap by concentrating on (static and dynamic) efficiency and environmental effectiveness implications of linking and cap design. From the analysis of the cap we derive policy implications for a hypothetical ETS linking between the EU and China.

Key words: *carbon market, emissions trading, EU ETS, cap setting, linking*

JEL classification: Q54

1.   Introduction

The European Union Emissions Trading System (EU ETS), launched in 2005, was the first large greenhouse gas ETS and is currently the biggest in the world. Under the mounting domestic and international pressure, China has established seven pilot ETSs until June 2014 to reduce carbon emissions cost-effectively and intends to implement a national ETS in 2017 as the world's largest system. It will be twice the size of the EU ETS.[1]

Linking the EU ETS to the Chinese national ETS appears to be highly attractive in light of its potential economic and political gains, and both the EU and China expressed willingness to link to other (compatible) ETSs.[2] However, differences in cap design render potential linkage challenging. A striking distinction is that the emissions reduction target of the EU ETS is an absolute emissions cap, while the Chinese pilots de-facto rely on 'intensity-based caps'.[3] It appears very likely that the Chinese national ETS will also apply an 'intensity-based cap' during the early stages.

The linking literature available focuses on mapping legal barriers, and studies that are scarcely focusing on the associated legal and economic issues are yet to emerge in the context of the EU and China.[4] Also, despite the attention the

---

[1] *See, e.g.*, *China to Launch National Pollution-Trading System to Cut Emissions*, BLOOMBERG (Sep. 25, 2015), available at: http://www.bloomberg.com/news/articles/2015-09-25/china-said-to-plan-pollution-trading-expansion-to-cut-emissions; *see also* National Development and Reform Commission (NDRC), *Notice on launching the national carbon emissions trading market* (Jan. 11, 2016), available at: http://www.gov.cn/xinwen/2016-01/22/content_5035432.htm.

[2] To reduce global GHG emissions cost-effectively, the EU expects the international carbon market to develop through 'bottom-up' linking of compatible ETSs. The goal is to develop an OECD-wide market by linking throughout OECD countries and a even broader market by linking to other emerging markets. *See* European Commission, International climate policy post-Copenhagen: Acting now to reinvigorate global action on climate change (Communication), COM(2010) 86 final (March 2010), at 11-12.

 Chinese government also expressed its political willingness to link to other international ETSs. *See* NDRC, *The fundamental conditions and operational thinking on promoting the establishment of national carbon emissions trading market (in Chinese)*, 1 CHINA ECONOMIC & TRADE HERALD (2015).

[3] 'Intensity-based cap' is set within an ETS to impose carbon intensity targets.

[4] *See* Fitsum G. Tiche, Stefan Weishaar & Oscar Couwenberg, *Carbon Leakage, Free Allocation and Linking Emissions Trading Schemes*, 2 CARBON & CLIMATE LAW REV. 97 (2014); *see also* Charis A. Van den Berg, Oscar Couwenberg & Stefan E. Weishaar, *Carbon Leakage in the Regional Greenhouse Gas Initiative: Lessons Learnt for the European Union Emissions Trading Scheme*, *in* UNIVERSITY OF GRONINGEN FACULTY OF LAW RESEARCH PAPER SERIES 6.

cap setting has received in the literature thus far,[5] few studies examine different cap designs in the context of linking.[6] Further, the existing literature on China ETSs mainly describes pilots,[7] and the few studies analyzing the establishment of the national ETS barely discuss in detail cap design.[8]

In light of this gap in the literature, this paper examines how the differences in the cap design in the EU ETS and the Chinese national ETS could affect the linking between both systems.[9] To address this research question we employ a comparative Law and Economics approach. First we examine the key elements of a cap from an economic perspective. We use these as an input to analyze the legal ETS framework in both jurisdictions. Since the current Chinese national regulation is phrased vaguely, the legislator's intent cannot always be determined directly. In these situations a 'gap analysis' is used by assessing the

---

[5] *See* A. Denny Ellerman & Ian Sue Wing, *Absolute versus Intensity-Based Emission Caps*, 3 CLIMATE POLICY 7 (2003); *see also* William A. Pizer, *The Case for Intensity Targets*, *in* RESOUCES FOR THE FUTURE DISCUSSION PAPER 02 (2005); *see also* Ian Sue Wing, A. Denny Ellerman & Jaemin Song, *Absolute vs. Intensity Limits for CO2 Emission Control: Performance under Uncertainty*, *in* MIT JOINT PROGRAM ON THE SCIENCE AND POLICY OF GLOBAL CHANGE SERIES (2006); *see also* Frank Jotzo & John CV Pezzey, *Optimal Intensity Targets for Greenhouse Gas Emissions Trading under Uncertainty*, 38 ENVIRONMENTAL AND RESOURCE ECONOMICS 259 (2007).

[6] *See* Jane Ellis and Dennis Tirpak, *Linking GHG Emission Trading Schemes and Markets*, in ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT DISCUSSION PAPER, OECD (2006); *see also* STEFAN E. WEISHAAR, EMISSIONS TRADING DESIGN: A CRITICAL OVERVIEW (2014).

[7] *See* Jingjing Jiang, Bin Ye & Xiaoming Ma, *The Construction of Shenzhen′s Carbon Emission Trading Scheme*, 75 ENERGY POLICY 17 (2014); *see also* Frank Jotzo & Andreas Löschel, *Emissions trading in China: Emerging Experiences and International Lessons*, 75 ENERGY POLICY 3(2014); *see also* Clayton Munnings, Richard Morgenstern, Zhongmin Wang & Xu Liu, *Assessing the Design of Three Pilot Programs for Carbon Trading in China*, *in* RESOUCES FOR THE FUTURE DISCUSSION PAPER 36 (2014); *see also* Shaozhou Qi, Banban Wang & Jihong Zhang, *Policy design of the Hubei ETS pilot in China*, 75 ENERGY POLICY 31 (2014); *see also* Libo Wu, *Haoqi Qian & Jin Li, Advancing the Experiment to Reality: Perspectives on Shanghai Pilot Carbon Emissions Trading Scheme, 75 Energy Policy 22 (2014)*; *see also* Da Zhang, Valerie J. Karplus, Cyril Cassisa & Xiliang Zhang, *Emissions Trading in China: Progress and Prospects*, 75 ENERGY POLICY 9 (2014).

[8] *See* Frank Jotzo, *Emissions Trading in China: Principles, Design Options and Lessons from International Practice*, *in* CENTER FOR CLIMATE ECONOMICS & POLICY WORKING PAPER SERIES 1303 (2013); *see also* Zhang et al., *supra* note 7; *see also* Zhongxiang Zhang, *Carbon Emissions Trading in China: The Evolution from Pilots to a Nationwide Scheme*, *in* CENTER FOR CLIMATE ECONOMICS & POLICY WORKING PAPER SERIES 1503 (2015).

[9] It bears mentioning that the EU is currently legally inhibited to link to other systems that are not based on absolute caps. *See* Directive 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC, 2003 O.J.L 275/32, art. 25, at 1; *see also* Directive 2004/101/EC amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms, 2004 O.J.L 338/18, *rec.* 18.

Chinese ETS pilots to reveal the potential designs of the national ETS. Last, a Law & Economics approach[10] will be used to examine environmental effectiveness and efficiency implications (static and dynamic) of linking based on a qualitative cost-benefit analysis.

The paper is structured into six sections. Section 2 identifies key elements of cap setting. Section 3 analyzes those elements by examining the legal ETS framework in both jurisdictions. A law & Economics analysis of the cap in both systems will be implemented in section 4 (before linking) and section 5 (after linking) to assess whether and how differences identified affects the potential linking. Section 6 summarizes the main conclusions.

2. Elements of Cap-Setting

A GHG ETS may set a legal limit (*i.e.* a cap) on the quantity of GHG emissions that can be emitted within the system.[11] By imposing such a binding limit, a cap creates an allowance scarcity and a market price. Increasing the scarcity over time should generate a 'sufficiently high and stable' market price to induce continuous and consistent carbon abatement.[12] To better understand from an economic perspective how a cap creates scarcity and thus abatement incentives in an ETS, key elements of cap setting are identified in this section.

2.1 Duration of the cap

The cap is usually set over a 'compliance period' (normally one year), with a succession of annual caps amounting to a trajectory of caps over the trading period. The combination of short-term and long-term abatement targets encourages covered entities to form compliance strategies. Particularly, the long-term target helps to shape market expectations and incentivizes long-term investment behaviors in low-carbon technology.

---

[10] This paper uses a Law & Economics approach to better understand the strengths and weaknesses of an instrument like emissions trading, which rests upon "incentive structures and equally complex 'legal details' that may be fully comprehended only if a 'holistic view' is taken". *See* Michael G. Faure & Stefan E. Weishaar, *The role of environmental taxation: economics and the law, in* HANDBOOK OF RESEARCH ON ENVIRONMENTAL TAXATION (Janet E. Milne & Mikael Skou Andersen, eds, 2012), at 399-421.

[11] *Offsetting, banking and borrowing* are not considered in this paper because they constitute different ETS design elements.

[12] *See* Stefan E. Weishaar, *Incentivizing Technologic Change in Emissions Trading Systems: The Case of Excess Supply*, *in* ENVIRONMENTAL TAXATION AND GREEN FISCAL REFORM (Larry Kreiser, Soocheol Lee, Kazuhiro Ueta, Janet E. Milne & Hope Ashiabor, eds, 2014), at 132.

2.2 Absolute vs. relative emissions limit

To create scarcity and abatement incentivizes, policy makers could set an absolute emissions reduction target (absolute cap) to fix the maximum amount of emissions in the system, or set a relative emissions reduction target (*e.g.* the prescribed standard in credit-and-trade system and intensity target) that is framed in relative form, *i.e.* the amount of greenhouse gases emitted per unit of GDP or output. Hence, a cap-and-trade system (e.g. the EU ETS) is only concerned with the quantity of emissions, while an ETS designed to ensure an intensity target (*e.g.* the China pilot ETSs) considers two variables simultaneously, the quantity of emissions and GDP.

2.3 Variability of the cap and ex-post adjustment

Normally, the cap in a cap-and-trade system constitutes a fixed emissions limit. This fixed limit intends to assist price predictability and credibility by providing a consistent expected supply which is a necessary condition for companies to form expectations and make optimal investment decisions. When an ETS relies on a relative target, the pre-defined cap is not fixed and may be ex-post adjusted[13] when the actual economic growth deviated from the projected.

2.4 Stringency of the cap

Based on the absolute/relative emissions target and ex-post adjustment within an ETS, the stringency of a cap can be evaluated. The stringency of a cap may vary among different ETSs and will directly affect the scarcity of allowances and hence the carbon price. A high allowance price, ceteris paribus, incentivizes covered entities to invest in technological innovation, research and development,[14] provided the price signal is credible. To ensure the stringency and a sufficiently high price, a binding cap can be set by estimating variables such as business-as-usual emissions and abatement potential. An intensity-based cap would in addition require the prediction of an additional parameter such as GDP.

---

[13] Ex-post adjustment is a broad term with different meanings in different contexts. *See* WEISHAAR, *supra* note 6, at 200. In this paper, 'ex-post adjustment' refers to any adjustment of the pre-allocated allowances.

[14] *See* Weishaar, *supra* note 12, at 126.

2.5 Consistent stringency of caps over time

Further, to maintain scarcity and a predictable carbon price, the stringency of caps should be increased over time in a continuous and steady (not erratic) way so as to generate continuous and consistent abatement incentives.

ETS designers can increase the stringency of the cap over time in several ways: reducing the number of allowances linearly, exponentially, or in a step-wise fashion.[15] By consistently increasing the scarcity of allowances over time, a stable market price is created to induce consistent abatement. Otherwise, when the government sets the cap in an unexpectedly ambitious or lax way, the carbon price may fluctuate significantly and the long-term compliance strategy adopted may be nullified. For instance, when covered entities and investors suspect that the government will loosen climate policy, they may not duly invest in the first place.[16]

2.6 Transparency in cap setting

Before covered entities or investors make investment decisions, they have to predict allowance prices so as to determine the return on investment and the associated risks.[17] Hence, predictability and credibility of the price signal is crucial to create abatement incentives for covered entities.[18] In order to allow for the price predictability and credibility, covered entities or investors should be well informed of the cap (specifically, aforementioned elements of cap setting) before the compliance period so as to form and implement compliance strategies. Without sound knowledge of the cap, they may not be able to reliably predict future price changes[19] and, even worse, lack faith in the legitimacy of cap setting.

2.7 Summary

This section identified six key elements of a cap, namely (i) 'duration of the cap', (ii) 'absolute (or relative) emissions limit', (iii) 'ex-post adjustment' that directly affect the scarcity of allowances, (iv) 'stringency of the cap' and (v) 'consistent stringency of the cap over time' to indicate the status quo of the scarcity, and (vi)

---

[15] *See* WEISHAAR, *supra* note 6, at 54.

[16] *See* Carsten Helm, *International emissions trading with endogenous allowance choices*, 87 J. OF PUBLIC ECONOMICS 2737 (2003).

[17] *See* Weishaar, *supra* note 12, at 132.

[18] *See* WEISHAAR, *supra* note 6, at 54.

[19] *See* Munnings *et al.*, *supra* note 7, at 33.

'transparency in cap setting' to inform the public of aforementioned elements of the cap. These elements will be examined in the following sections.

3. Examining the Legal Framework: An Analysis of Cap Setting in the EU ETS and the Chinese National ETS

This section analyzes how the above elements are addressed in the legal framework in both jurisdictions.

3.1 Cap and cap setting in the EU ETS (phase 3)

To achieve the GHG emissions target[20] in an economically efficient manner, the EU ETS was launched in 2005 with Directive 2003/87/EC, which was amended in 2009 by Directive 2009/29/EC to improve and extend the EU ETS.[21] This paper examines the EU cap in phase 3 (2013-2020) as it coincides with the introduction of the Chinese national system.

Elements of the cap to be considered first include the duration of the cap, its absolute emissions limit and its variability. An absolute emissions cap is set over the compliance period (one year), with annual caps amounting to a trajectory of caps over phase 3. Specifically, two separate caps are set: one cap for fixed installations (which will be reduced annually by 1.74% of the 'average total quantity of allowances issued in 2008-2012'[22]) while the other cap for the aviation sector remains unchanged over phase 3.[23] Further, the cap is fixed in phase 3 so there is no 'ex-post adjustment'.

To safeguard the transparency of the cap and ensure non-discriminatory access, Member States and the Commission shall ensure that all decisions regarding the quantity of allowances are immediately disclosed in an orderly

---

[20] *See* Brussels European Council, Presidency Conclusions, 7224/1/07 REV 1 (March 2007), *para*.32.

[21] Directive 2009/29/EC brings about fundamental changes in the designs of the EU ETS. Additionally, the Directive 2003/87/EC was also amended in 2004 by Directive 2004/101/EC (Linking Directive) and in 2008 by Directive 2008/101/EC (aviation directive).

[22] *See* Directive 2009/29/EC of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community, 2009 O.J.L 140/63 [hereinafter Parliament and Council Directive 2009/29/EC], art. 9.

[23] *See* Directive 2008/101/EC of the European Parliament and of the Council amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community, 2008 O.J.L 8/3, art. 3c.

manner.[24] Since the trajectory of caps in phase 3 are clearly stated in the legislation covered entities are therefore well informed about the 'shape of the regulatory regime'.

As for the stringency of the cap, the EU ETS allowance market is presently oversupplied by the accumulated surplus of allowances [25] - reaching approximately 2.1 billion allowances in 2013[26] - due to the economic downturn. In view of the large surplus in the EU ETS, the EU currently intends to take measures such as the establishment of a Market Stability Reserve (MSR)[27] and the back-loading of allowances.[28] These measures will not be discussed in this paper since they do not change the cap.

3.2 An Examination of the 'Intensity-based Cap' in the Chinese National ETS (2017-2020)

Under mounting international and domestic pressure,[29] China introduced carbon emissions trading to cost-effectively achieve the emissions reduction target and

---

[24] *See* Parliament and Council Directive 2009/29/EC, *supra* note 22, art. 15(a).

[25] *See* Stefan E. Weishaar & Sami Madani, *Energy Community treaty and the EU Emissions Trading System: Evidence of an Unrecognized Policy Conflict*, 2 OIL, GAS & ENERGY LAW INTELLIGENCE 12 (2014), at 1-17.

[26] *See Market stability reserve: Council ready to negotiate with the European Parliament,* EUROPEAN COUNCIL (Mar. 25, 2015), available at http://www.consilium.europa.eu/en/press/press-releases/2015/03/25-market-stability-reserve-council-ready-negotiate-ep/.

[27] *See* European Commission, Proposal for a Decision of the European parliament and of the council of concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC, COM (2014) 20 final (January 2014); *see also Parliament adopts CO2 market stability reserve,* EUREPEAN PARLIAMENT (Jun. 8, 2015), available at http://www.europarl.europa.eu/news/en/news-room/content/20150703IPR73913/html/Parliament-adopts-CO2-market-stability-reserve.

[28] *See* Commission Regulation (EU) No 176/2014 of 25 February 2014 on amending Regulation (EU) No 1031/2010 in particular to determine the volumes of greenhouse gas emission allowances to be auctioned in 2013-20, 2014 O.J.L 56/11; *see also ETS market stability reserve: MEPs strike deal with Council,* EUROPEAN PARLIAMENT (May 6, 2015), available at http://www.europarl.europa.eu/news/en/news-room/content/20150504IPR49654/html/ETS-market-stability-reserve-MEPs-strike-deal-with-Council.

[29] *See* Yongrok Choi, Ning Zhang & Peng Zhou, *Efficiency and Abatement Costs of Energy-Related CO_2 Emissions in China: A Slacks-Based Efficiency Measure*, 98 APPLIED ENERGY 198 (2012); *see also* Matt McGrath, *China's Per Capita Carbon Emissions Overtake EU's*, BBC NEWS (Sept. 21, 2014), available at: http://www.bbc.com/news/science-environment-29239194.

promote industrial restructuring to shift to a low-carbon economy.[30] The National Development and Reform Commission (NDRC), China's top economic planning agency, authorized seven pilots to experiment with emission trading[31] and announced plans to implement a national ETS.[32] In the absence of national legislation, several local Development and Reform Commissions (DRCs) were entrusted to formulate carbon trading legislation.[33] In December 2014, *Interim administrative measures for carbon emissions trading* (hereafter 'national regulation') was issued by NDRC, providing a general framework for the national ETS. Additionally, the State Council is currently working on high-level regulation, *Carbon Emissions Regulation*, expected to be issued in 2016.[34]

While the national regulation provides a glimpse into the framework and functionality of the system, the cap in the national ETS (hereafter 'national cap') have yet to be fully determined.[35] The 'stringency of the cap' can therefore not be discussed. Elements to be analyzed include 1) the relative emissions limit, 2) ex-post adjustment and 3) the transparency of the cap. In those cases where the national regulation is not sufficiently clear and precise, the ETS pilots will be examined to help fill this 'gap'. This 'gap analysis' may be justifiable because the national ETS will build on the experience learned from pilots.[36]

---

[30] *See* Xiangnan Guo & Qianjin Hao, *Carbon Trading Market for Energy Saving and Emission Targets in China* (in Chinese), 4 CHINA ENVIRONMENTAL PROTECTION INDUSTRY 63 (2011); *see also* Jifeng Li, *Thoughts on Direct and Indirect Emissions Trading in China's Carbon Market* (in Chinese), 9 SPECIAL ZONE ECONOMY 110 (2012), at 164-165; *see also* Jifeng Li, Yaxiong Zhang, Xin Wang & Songfeng Cai, *Policy Implications for Carbon Trading Market Establishment in China in the 12th Five-year Period*, 3 ADVANCES IN CLIMATE CHANGE RESEARCH 3 (2012), at 163-165; *see also* Lianbiao Cui, Ying Fan, Lei Zhu & Qinghua Bi, *How Will the Emissions Trading Scheme Save Cost for Achieving China's 2020 Carbon Intensity Reduction Target?* 136 APPLIED ENERGY 1043 (2014); *see also* Zhang, *supra* note 8, at 4-7.

It bears mentioning that the ETSs in China are built on firm level not on installation level.

[31] *See Notification on the Implementation of Carbon Emissions Trading Pilots (in Chinese)*, NDRC (Oct. 29, 2011), available at http://www.sdpc.gov.cn/zcfb/zcfbtz/201201/t20120113_456506.html.

[32] *See* NDRC, *supra* note 2.

[33] For the carbon trading legislation and guidance documents promulgated in China ETSs (hereafter 'normative documents') referenced in this paper, see Appendix 1.

[34] See *One Belt, One Road: Regional Carbon Markets (in Chinese)*, 21ST CENTURY BUSINESS HERALD (Jun. 23, 2015), available at http://www.tanjiaoyi.com/article-10757-2.html; *see also The State Council Will Release Regulations on Management of Carbon Emissions Trading (in Chinese),* CNRENCAI (Mar. 16, 2015), available at http://www.cnrencai.com/zongjie/guizhangzhidu/153017.html.

[35] *See* NDRC, *supra* note 2.

[36] *See id*.

3.2.1 An 'intensity-based cap'

The relative emissions limit is examined first. According to the national regulation,[37] aggregate allowances (national cap) will be determined pursuant to the national GHG controlling target.[38] It is expected that the national GHG controlling target during 2016-2020 will be included in the 13th *Five-Year Plan* (2016-2020), which is to be issued at the end of 2015 and most likely framed in intensity terms pursuant to the Copenhagen pledge (*i.e.* cutting the intensity by 40-45% until 2020 vis-à-vis 2005). Therefore, the national ETS considers the quantity of emissions and economic growth simultaneously for cap setting.

In the national ETS, the carbon intensity target (framed in GHG emissions per unit of GDP) will be transformed into an 'intensity-based cap' (a limit on the quantity of emissions).[39] The first step is to transform intensity targets into 'targets in absolute values' by forecasting future economic development on the basis of a business as usual (BAU) scenario.[40] It bears mentioning that the ETS-specific economic growth target may differ from the growth target for the whole economy since an ETS does not cover every sector of the economy;[41] additionally, projections for covered sectors' growths need to be reasonable to leave room for industrial restructuring and development.[42]

In a second step the share of 'overall emissions covered by the national ETS' (in the total national emissions) is determined.[43] Based on these steps the overall number of allowances (for the covered sectors) is calculated. In this respect the 'cap' can be considered an 'intensity-based cap' because it helps to ensure the intensity target and also generate a scarcity of allowances. As a result, the Chinese national ETS may self-impose a constraint of an 'intensity-based cap'[44] which will be in line with the national GHG controlling target.

---

[37] *See* NDRC, Interim administrative measures for carbon emissions trading (Dec. 10, 2014) [hereinafter National Regulation], art. 8, available at http://qhs.ndrc.gov.cn/gzdt/201412/t20141212_652035.html

[38] And other factors considered during cap setting include economic growth, industrial structure, energy structure and specific circumstances of covered entities. *See id.*, art. 8.

[39] *See* Jotzo, *supra* note 8, at 15.

[40] See Jotzo and Pezzey, *supra* note 5; see also Xin Ma, Jifeng Li & Yaxiong Zhang, *An Important Question Before Copenhagen Meeting - BAU Scenario in the Climate Change Study and International Negotiation (in Chinese)*, 6 INTERNATIONAL ECONOMIC ASSESSMENT 5 (2009).

[41] *See* Simon Quemin & Wen Wang, *Overview of Climate Change Policies and Development of Emissions Trading in China*, in PARIS: CLIMATE ECONOMICS CHAIR INFORMATION AND DEBATE SERIES PAPER 30 (2014), at 31-32.

[42] As Appendix 3 shows, 'industrial restructuring and development' is an important factor considered during cap setting in most of the pilots, *e.g.* Shenzhen, Guangdong, Tianjin, Hubei and Chongqing.

[43] *See* Li *et al., supra* note 30, at 167-168.

[44] According to Xie Zhenhua, Deputy Director of NDRC, China is now researching an 'absolute cap' as well and intends to gradually achieve 'dual control' (i.e. carbon intensity and absolute emissions controlling) in

3.2.2 Ex-post adjustment

The variability of the cap is analyzed in this section. In the national ETS, an 'intensity-based cap' is pre-defined based on the projected GDP. If the projections prove wrong, regulators may adjust the cap ex-post to correct for the difference between the projected and the actual GDP. According to the national regulation,[45] when the covered entities closed down or ceased operation, merged, split up, or underwent significant changes in production capacity, the provincial DRCs shall adjust the pre-allocated allowances in line with their actual circumstances.

In the national framework, it remains unclear when and how ex-post adjustments will take place. Therefore we examine the rules of ex-post adjustment in pilots (see Appendix 2) to shed light upon the potential design of the national ETS. Based on the national and pilots' legal ETS framework, we may extrapolate the following designs on ex-post adjustment for the national ETS. First, the pre-defined cap may be adjusted ex-post – as is the case in all the pilots - ahead of the compliance date of the year considered and in the subsequent year in which 'specific changes' took place. 'Specific changes' are stipulated in Article 15 of the national regulation and trigger 'ex-post adjustment'. In this way, covered entities are able to surrender 'actual allowances' (adjusted allowances) to meet their 'actual obligations' (verified emissions) which can only be measured in the year after. Second, the ex-ante cap may be adjusted in line with the actual output in the year considered (as all the pilots[46]). And the adjustment basis on entity level is their 'actual circumstances' with regard to those 'specific changes'. As a result, not only the abatement target may be achieved, but regulators may also give leeway to unexpected economic growth. Specifically, supplementary allowances must be released when the economy unexpectedly prospers and allowances must be withdrawn when the economy contracts beyond what was predicted.[47]

---

the future. See *National Development and Reform Commission: Promoting the Establishment of National Carbon Emissions Trading Market and Implementing Dual Control of Intensity and Overall Emissions (in Chinese)*, HEXUNNET (Aug. 30, 2014), available at: http://news.hexun.com/2014-08-30/168038731.html.

Both an absolute cap and an 'intensity-based cap' are under consideration for the national ETS, but the latter may be preferred during the early stages.

[45] *See* National Regulation, *supra* note 37, art. 15.

The implementation of national reserve in China (*see* National Regulation, *supra* note 37, art. 11) is not considered as 'ex-post adjustment' and will not be discussed.

[46] The adjustment basis in all the pilots (*see* the column 'adjustment basis' in Appendix 2) is more or less related to the actual output of covered entities.

[47] It bears mentioning that not every covered entity will be issued supplementary allowances in this case, because 1) the adjustment is probably applied to limited sectors (*e.g.* in Shanghai and Guangdong ETS); 2)

3.2.3 Transparency in national cap setting

To safeguard the transparency of the cap, covered entities should be informed. However, disclosure of information on the national cap is not mandatory under the national regulation,[48] entailing that NDRC is not legally obliged to disclose the national cap.

On the basis of the pilots (see Appendix 3), two common patterns can be identified. First, overall allowances ('caps') are set pursuant to the GHG emissions controlling targets. But it remains unclear in law what the caps in all the pilots are and how they are chosen. Second, the local DRCs in all the pilots (except Shenzhen) have not officially disclosed any information with regard to the cap or cap-setting processes prior to the compliance period, and only a few pilots announced the pre-defined caps during the compliance period (Guangdong and Hubei) or after (Chongqing).[49]

Consequently the evidence from the pilots may give rise to concerns over the clarity and transparency of the national cap for the following reasons. First, cap setting in China appears rather difficult due to China's uncertain economy[50] and emissions structure. Such uncertainty may be derived from industrial restructuring, international economic fluctuations, and potential fiscal and monetary policy adjustments in response to economic challenges. Second, binding caps, once announced, may constrain emissions and leave no leeway for unexpected economic developments.[51] Further, the regulator may not announce the cap in the absence of an express obligation to do so.[52]

---

individuals' allowances are adjusted in line with individual economic circumstances (*e.g.* actual output) not the overall economic growth.

[48] NDRC is obligated to announce 'on time' to the public 'the coverage, allocation methods, banking and etc. (*see* National Regulation, *supra* note 37, art. 6, 7, 33 & 34).

[49] *See t*he column 'transparency of caps in practice' in Appendix 3.

[50] *See China's GDP Growth Slows to 7.4% in 2014: Govt data*, BUSINESS INSIDER (Jan. 19, 2015), available at: http://www.businessinsider.com/afp-chinas-gdp-growth-slows-to-7.4-in-2014-govt-data-2015-1#ixzz3VNykwUG2; *see also Expects Predict 2015 GDP Growth Target Will Be Decreased to 7%*, XINHUANET (Mar. 4, 2015), available at: http://news.xinhuanet.com/finance/2015-03/04/c_127544340.htm.

[51] *See* Queming & Wang, *supra* note 41, at 31-32.

[52] Currently, the law or political performance evaluation test does not impose requirements regarding the transparency of cap. Political performance evaluation has been a crucial part of officials management in China's political regime.

3.3 Comparison of cap setting between the ETSs

This section summarizes the analysis above and draws a brief comparison of cap setting between the EU and China (see table 3-1). A striking distinction is that the EU ETS applies an absolute cap, while the Chinese national ETS appears very likely to implement an 'intensity-based cap' at least during the early stages, which may be expected to be adjusted ex-post in the year after.[53]

Key elements of cap setting	EU ETS (phase 3)	Chinese national ETS (The operational improvement phase 2017-2020)
Duration of the cap	Annual caps & a trajectory of caps set	Annual caps set and no trajectory of caps mentioned officially
Absolute vs. relative emissions limit	Absolute cap	An 'intensity-based cap': relative emissions limit
Variability of the cap and ex-post adjustment	Fixed	Ex-post adjustment
Stringency of the cap	Approximately 2.1 billion accumulated surplus allowances in 2013	N/A (Ps: The cap is set mainly pursuant to the national GHG controlling target during 2016-2020)
Consistent stringency of caps over time	1.74% annual reduction except in aviation sector	N/A
Transparency in cap setting	Disclosure on cap is legally required Trajectory of caps in phase 3 is made publicly available prior to the start	Details of cap not fully determined and officially communicated Potentially opaque cap setting (gap analysis)

Table 3-1 Comparison of cap setting between the EU and China

4. A Law & Economics Analysis of the Cap in the EU ETS and Chinese National ETS

Building on the preceding sections, this section analyzes environmental effectiveness and efficiency implications (static and dynamic) of the different cap designs.

---

[53] In the EU ETS, when an installation has ceased operation or has had a significant capacity change, the allocation to the installation shall be adjusted accordingly as of the year following the cessation or capacity change. *See* Commission Decision of 27 April 2011 determining transitional Union-wide rules for harmonized free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council', 2011 O.J. L 130/1, *rec.* 37; art. 21 (1) (3), 22 (1)e (3). But those adjustments are not considered as ex-post adjustment because they adjust the allowances for the year after.

The cap design affects the scarcity and abatement incentives within an ETS. The EU ETS is examined (subsection 4.1) before the Chinese national ETS is reviewed (hereafter 'China ETS', subsection 4.2).

The basic role of carbon emissions trading is to achieve an environmental outcome at the least economic cost.[54] In this regard, an ETS mainly serves two purposes including *environmental effectiveness* and *efficiency.* On the one hand, as the prime objective of environmental policy instruments,[55] environmental effectiveness is safeguarded when a stringent abatement target is set[56] and accomplished. On the other hand, a scheme is efficient if it can deliver the prescribed reduction target at the lowest total costs,[57] and total costs is defined as the sum of implementation, participation and abatement costs.

Further, *static efficiency* is concerned with the efficient allocation of the given resources at a given point in time, while the analysis of *dynamic environmental effectiveness* and *dynamic efficiency*, in this paper, relies upon the incentives assessment allowing for uncertain economic growth. Uncertainty regarding 'future economic growth' influences people's expectations and preferences, which will then be reflected by investment decisions, thus affecting environmental effectiveness and efficiency.

4.1   A Law & Economics analysis of the EU cap (phase 3)

Elements to be considered first are the duration and transparency of the cap. As analyzed above, transparency about clearly defined abatement goals in both short and long term supports the credibility and predictability of the carbon price signal, and hence helps ensure both efficiency and environmental effectiveness. On the one hand, transparency allows covered entities to determine whether the current price reliably reflects scarcity on the market (credibility of price signal). On the other hand, transparency may also enable market participants to preempt future price changes (predictability of price signal) and incorporate their expectations into the investment decision-making.

An absolute cap provides a fixed limit on the quantity of emissions supplied and provides scarcity and abatement incentives if the economy develops as predicted. The magnitude of this incentive will depend on the

---

[54] *See* Richard Benwell, *Linking as leverage: emissions trading and the politics of climate change*, 21 CAMBRIDGE REV. OF INTERNATIONAL AFFAIRS 545 (2008), at 550.

[55] The European Court of Justice established that the prime goal of the EU ETS is to reduce GHG emissions in a substantial form (*i.e.* environmental effectiveness). *See* Iberdrola v. Administración del Estado, Joined Cases C-566/11, C-567/11, C-580/11, C-591/11, C-620/11 & C-640/11, ECLI: EU:C:2013:660, at 8.

[56] Namely the reduction target is challenging and abatement efforts are required.

[57] *See* Richard Starkey, *Personal Carbon Trading: A Critical Survey Part 2: Efficiency and Effectiveness*, 73 ECOLOGICAL ECONOMICS 19 (2012), at 19.

market price and thus on the degree of scarcity. Moreover, in the long run scarcity is consistently increased in the EU (annually decreased by 1.74% except in aviation sector), a sufficiently high and stable price could incentivize consistent carbon abatement, safeguarding static efficiency and environmental effectiveness.

However, with uncertain economic growth, the scarcity of allowances cannot be automatically guaranteed by the absolute cap even if its environmental target is met.

When economic growth drops below what has been anticipated, the demand for allowances declines and an over-supply of allowances might arise. Accordingly, the carbon price may decline significantly, and covered entities may not be incentivized to abate. What is worse, as a result of such price declines covered entities may not form long-term abatement strategies since they cannot reliably predict investment risks in such a regulatory environment,[58] thus jeopardizing dynamic efficiency and dynamic environmental effectiveness. This is currently the case in the EU ETS: surplus allowances were accumulated as a result of an economic downturn in phase 2. Hence, the Market Stability Reserve is intended to adjust the supply-demand imbalances[59] by reducing short term supply of allowances.

When the economy grows more than expected, covered entities may face too much abatement pressure under a trajectory of annually decreasing caps. They may have to abate emissions rapidly by investing in the currently available low-carbon technology without being given enough time to develop more efficient abatement[60] (dynamic efficiency losses in case of an unexpected economic upturn). Given the current surplus in the EU ETS, this scenario of 'unexpected and sudden demand shocks' appears remotely possible in the short term.

4.2   A Law & Economics analysis of the national cap in China

Covered entities must be well informed of the 'shape of the regulatory regime' (*i.e.* future trajectory of caps) to form compliance strategies.[61] The likely undisclosed 'cap' (short term) and the absence of future caps (long term) in China may jeopardize the predictability and credibility of the price signal, thus undermining the environmental effectiveness and efficiency within China ETS.

---

[58] *See* WEISHAAR, *supra* note 6, at 46.

[59] *See* William Acworth, Nils May & Karsten Neuhoff, *The Market Stability Reserve: Is Europe Serious about the Energy Union?* DIW BERLIN GERMAN INSTITUTE FOR ECONOMIC RESEARCH SERIES PAPER 59 (2015).

[60] *See* WEISHAAR, *supra* note 6, at 54.

[61] *See id*.

With an 'intensity-based cap' and ex-post adjustment, the scarcity of allowances in the China ETS is jointly created by the intensity target and GDP. When the economic growth is known with certainty, provided the stringency of target is guaranteed and increased steadily (a binding cap), scarcity and thus abatement incentives can be continuously generated when the intensity target has been met (static efficiency and environmental effectiveness safeguarded).

With economic uncertainty, however, the 'intensity-based cap' can neither ensure scarcity nor the desired environmental outcomes (*i.e.* no fixed abatement). In the case of unexpected economic growth, allowance prices may rise and additional allowances will be released ex post for the year considered. Scarcity cannot be ensured even if the intensity target has been met.[62] This also puts the attainment of dynamic environmental effectiveness and efficiency into doubt. What's worse, net emissions could rise even as carbon intensity falls.[63] Moreover, carbon prices will not easily increase if the public expects that more allowances will be released.

In the case of an unexpected economic downturn, a portion of allowances must be withdrawn, resulting in a more stringent 'intensity-based cap' and increasing allowance prices. Accordingly, some of covered entities have to reinforce their abatement efforts, adding to their short-term compliance costs (dynamic efficiency losses in case of an unexpected economic downturn).

In light of the above, in the case of economic certainty, both cap-designs have identical static environmental effectiveness and efficiency properties.[64] When the economy contracts unexpectedly, an absolute cap may not generate

---

[62] The reason for this is that a limit is often set on the overall amount of supplementary allowances.

For instance, in Shenzhen ETS, allowances added (except for the new-entrants) should not exceed the allowances withdrawn. *See* Shenzhen DRC, Shenzhen Carbon Trading Regulation (Mar. 28, 2015), art. 19. Further, allowances can be adjusted upward, by no more than 10%, or downward, with no limit, in any year (*see* Munnings *et al.*, *supra* note 7, at 18). On entity level, within the adjustment limit, it can be roughly summarized as follows: allowances surplus (after compliance) = intensity target * actual output (or added-value) - actual intensity * actual output (or added-value). Therefore, when the pre-determined target has been met (i.e. actual intensity ≤ intensity target): if the amount of supplementary allowances does not exceed the limit, there will be a surplus; if it does, no more extra allowances will be issued and there may be a shortage of allowances in this case.

[63] *See* Benwell, *supra* note 54, at 555. The amount of carbon allowances could be roughly calculated from the following formula: overall allowances = carbon intensity * actual GDP. With economic uncertainty, when GDP grows fast enough, even if the intensity declines, it remains possible that the amount of overall emissions rises.

[64] It has been generally believed that absolute cap and intensity targets have identical effects in the absence of uncertainty (*see* Ellerman, *supra* note 5; *see also* Sue Wing et al., *supra* note 5). This paper adds to the literature the impacts of the absolute cap and 'intensity-based cap', particularly, from a Law & Economics perspective.

scarcity in the market but will still safeguard the attainment of the environmental objective. It will therefore be efficient in the short run as it works as an 'economic stabilizer'. In the long run, however, it may not be dynamically efficient since covered entities are not incentivized to invest in abatement and hence may have to invest more as time and global warming proceed. In case of an unexpected economic contraction in China, the 'intensity-based cap' cannot safeguard environmental effectiveness as abatement actions may have to be undertaken quickly. Rapid action to meet compliance obligations may also increase overall compliance costs for entities.

In case of unexpected economic growth, the EU cap design works as an 'economic stabilizer' in the sense that allowance prices will increase as economic activity increases and thereby helps to prevent an overheating of the economy (absolute cap working anti-cyclically). The absolute cap will therefore safeguard the environmental effectiveness and incentivizes investments in abatement technology. In the case of unexpected economic growth, the Chinese cap design better accommodates economic growth by preventing the carbon price from increasing too much (ex-post adjustments working cyclically). This helps to keep compliance costs down but does not ensure additional investments in abatement when companies are prospering – the relative environmental target will, however, be attained.

It can therefore be concluded that the two cap designs fare very differently in case of unexpected economic up or downturns.

5.   Implications of Linking the EU ETS to the Chinese National ETS: A Qualitative Cost-Benefit Analysis

This section applies a qualitative cost-benefit analysis [65] to examine environmental effectiveness and efficiency implications (static and dynamic) of a direct bilateral and comprehensive linkage[66] between the EU ETS and China ETS.

---

[65] In the standard partial equilibrium analysis, linking cap-and-trade systems could lead to significant efficiency gains when allowance prices (marginal abatement costs) across schemes are equalized. *See* Ottmar Edenhofer, Christian Flachsland & Robert Marschinski, *Towards a Global CO2 Market: An Economic Analysis*, *in* POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH (2007); *see also* Christian Flachsland, Robert Marschinski & Ottmar Edenhofer, *To Link or Not to Link: Benefits and Disadvantages of Linking Cap-and-Trade Systems*, 9 CLIMATE POLICY 358 (2009), at 7.

However, in the case of linking the EU ETS to the China ETS, with great pre-link differences in the cap, imperfect knowledge (*e.g.* lack of transparency in China) and economic uncertainty, implications of linking cannot be fully comprehended only if a holistic view is taken.

The linking literature observes the potential benefits of linking along with considerable negative side effects.[67] Further, in the case of linking the EU ETS to the China ETS, two-fold results are produced with the convergence of allowance prices (a price decrease in the EU and an increase in China[68]). For one thing, potential gains from the linkage may serve to enhance efficiency in the linked ETSs. Large benefits can be reaped by 'shifting emission reductions between linked systems'[69] if the systems are 'asymmetric'[70] in the sense that they have different marginal abatement costs or different allowance prices. Specifically, linking enables the EU to take advantage of China's low abatement costs by

---

[66] For the definition of 'direct bilateral' or 'comprehensive' linkage, *see* ERIK HAITES & FIONA MULLINS, LINKING DOMESTIC AND INDUSTRY GREENHOUSE GAS EMISSION TRADING SYSTEMS (2001); *see also* Wolfgang Sterk, Marcel Braun, Constanze Haug, Katarina Korytarova & Anja Scholten, *Ready to Link Up? Implications of Design Differences for Linking Emissions Trading Schemes*, *in* WUPPERTAL INSTITUTE JET-SET WORKING PAPER, I/06 (2006); *see also* Alexander Roßnagel, *Evaluating Links between Emissions Trading Schemes: An Analytical Framework*, CARBON & CLIMATE L. Rev. 394 (2008), at 396; *see also* Andreas Tuerk, Michael Mehling, Christian Flachsland & Wolfgang Sterk, *Linking Carbon Markets: Concepts, Case Studies and Pathways*, 9 CLIMATE POLICY 341 (2009), at 343.

[67] *See* William Blyth & Martina Bosi, *Linking Non-EU Domestic Emissions Trading Schemes with the EU Emissions Trading Scheme*, *in* IEA/OECD INFORMATION PAPER (2004); *see also* Niels Anger, *Emissions Trading Beyond Europe: Linking Schemes in a Post-Kyoto World*, 30 ENERGY ECONOMICS 2028 (2008); *see also* Warwick J. McKibbin, Adele C. Morris & Peter J. Wilcoxen, *Expecting the Unexpected: Macroeconomic Volatility and Climate policy*, *in* BROOKINGS GLOBAL ECONOMY AND DEVELOPMENT WORKING PAPER, 28 (2008); *see also* Jared C. Carbone, Carsten Helm & Thomas F. Rutherford, *The Case for International Emission Trade in the Absence of Cooperative Climate Policy*, 58 J. OF ENVIRONMENTAL ECONOMICS AND MANAGEMENT 266 (2009); *see also* Flachsland *et al.*, *supra* note 65, at 10; *see also* Judson Jaffe, Matthew Ranson & Robert N. Stavins, *Linking Tradable Permit Systems: A Key Element of Emerging International Climate Policy Architecture*, 36 ECOLOGY LQ 789 (2009); *see also* Frank Jotzo & Regina Betz, *Australia's Emissions Trading Scheme: Opportunities and Obstacles for Linking*, 9 CLIMATE POLICY 402 (2009), at 409; *see also* ANDREAS TUERK, LINKING EMISSIONS TRADING SCHEMES (2009); *see also* Tuerk *et al.*, *supra* note 66; *see also* Lars Zetterberg, *Linking the Emissions Trading Systems in EU and California*, SWEDISH ENVIRONMENTAL RESEARCH INSTITUTE PAPER (2012), at 6; *see also* WEISHAAR, *supra* note 6, at 191-193.

[68] Different allowances (*e.g.* allowances issued in different years) may be transacted at different prices, which we generically refer to as 'carbon price' in this paper. Before linking, the abatement cost and thus carbon price in the EU are higher than in China (*see* Carbone *et al.*, *supra* note 67). With a direct and comprehensive linking, carbon prices in both systems will thus converge in a uniform linked market.

[69] *See* Jaffe *et al., supra* note 67, at 799.

[70] *See* Carbone *et al.*, *supra* note 67; *see also* Gilbert E. Metcalf & David Weisbach, *Linking Policies When Tastes Differ: Global Climate Policy in a Heterogeneous World*, REV. OF ENVIRONMENTAL ECONOMICS AND POLICY rer021 (2011), at 5.

purchasing cheaper allowances from China[71] and China can benefit financially by selling allowances at a higher price than in a purely domestic system. For another, an allowance price decline in the EU would discourage abatement incentives while the price increase in China may incentivize abatement.

This section examines the costs and benefits of different ways in cap setting and the implications they have for linking. But it is possible to link trading schemes with absolute targets to those with intensity targets.[72] A qualitative cost–benefit analysis is applied to examine how differences in cap setting affect stakeholders (namely covered entities, government and investors[73]) in case of linking. Incentives for abatement investment (and thus environmental effectiveness and efficiency) will be assessed as well. In doing so we follow the cap elements identified in section 3.

5.1   Duration and transparency of the cap

Covered entities, investors and government in the linked systems may face higher information costs and investment risks when searching, acquiring and analyzing information from a more complex market after linking. Further, linking in this regard may affect the EU and China differently. On the one hand, the transparency in the EU ETS and thus the price signal may be compromised by the potentially opaque 'cap' (short term) and absence of future caps (long term) in China (environmental effectiveness and efficiency undermined). Accordingly, the EU has to shoulder higher information costs and investment risks compared to the pre-linking scenario. On the other, linking negotiations are very likely to impose strict conditions on a future improvement in the transparency of cap in China and thus benefit Chinese covered entities and investors.

5.2   Absolute/relative emissions limit and ex-post adjustment

It has been analyzed in section IV that with economic certainty, the absolute cap and 'intensity-based cap' have identical static effects. Differences in cap-design as such do not affect linking in such a context. But with uncertain output, different dynamic impacts will be resulted. Building on section IV, this section analyzes how a system will be affected by its linking partner's economic uncertainties so as to examine dynamic implications of linking. We examine economic uncertainty in either country and then jointly.

---

[71] *See* Carbone *et al.*, *supra* note 67.

[72] *See* Ellis and Tirpak, *supra* note 6, at 22.

[73] 'Investors' refers to individual and institutional investors as well as the financial service institutions.

5.2.1 With economic uncertainty in China

When China's economy prospers unexpectedly, the EU may benefit from more 'cheaper allowances' in the carbon market and new investment opportunities in a boomed market. However, if China's economic growth drops unexpectedly, a 'sudden and unexpected sharpening' of the allowance market in China may raise 'abatement costs' to EU covered entities and increase the price volatility. As a result, with economic uncertainty in China, predictability and credibility of the price signal in the EU ETS will be compromised by the ex-post adjustment in China: the EU ETS may benefit from higher liquidity (lower abatement costs) or bear higher abatement costs and investment risks.

5.2.2 With economic uncertainty in the EU

Economic uncertainty in the EU may affect China firms' abatement benefits. An unexpected economic boom in the EU will generate excess demand while Chinese sellers will benefit from the increased carbon market price. Meanwhile, entities in China that purchase allowances will pay higher abatement costs.[74] Linking therefore generates abatement incentives[75] and positively affects dynamic environmental effectiveness in China.

5.2.3 With economic uncertainty in both economies

If the economy in both systems prospers unexpectedly, supplementary allowances released in China via ex-post adjustment would be leaking into the EU ETS, thereby reducing compliance costs (dynamic efficiency gains). Compared to a pre-linking scenario, the allowance price would be lower in both jurisdictions. This may discourage abatement incentives in the EU and undermine the dynamic environmental effectiveness.

However, an unexpected economic downturn in both economies would potentially revert the allowance flows. This is because there would be less demand in the EU (economic stabilizer working anti-cyclically and putting pressure on the allowance price), while in China allowance prices could increase as abatement requirements are strengthened by taking allowances off the market (ex-post adjustments working cyclically and potentially inflating allowance prices). Linking would positively affect the dynamic environmental effectiveness in the EU if the low EU allowance prices are inflated due to demand from China. In China less abatement activities may occur since allowances flow

---

[74] Theoretically, if the increased allowance price is higher than the penalties for defaulting in China, some China firms may fail to comply. But this remains a remote possibility in the near future considering the fact that the China ETS is double the size of the EU ETS.

[75] For China firms who have surplus allowances after compliance, whether they will be incentivized further (compared to the pre-linking scenario) depends on whether they can gain 'net revenue' from further abatement, i.e. the potential revenue from more allowances sales outweighs further abatement costs.

into the country; this would give rise to the additional benefit of alleviating the pressure on China's firms to suddenly abate more – compliance costs in China would therefore be lower.

When the economic growth turns lower than expected in China and higher in the EU, the carbon price in the systems rises and abatement incentives will be generated. By contrast, when the EU's economy drops but China's prospers both unexpectedly, the surplus in the EU and supplementary allowances issued in China may both lead to a carbon price decrease in the linked ETSs. Consequently, abatement incentives in a linked system would be impaired (dynamic environmental effectiveness and efficiency undermined in the ETSs).

5.3   (Consistent) stringency of the cap[76]

Mutual commitments of the linked partners and potential gains after linking help to maintain the (consistent) stringency of cap. For one thing, mutual pressure between linking partners renders linked systems 'less prone to the lure of discretionary policy' than systems in autarky.[77] Adjusting caps relative to 'announced trajectories' in China may be expected to be more difficult in a linked scheme. Further, the linking negotiations are likely to lay down conditions on maintaining the stringency of cap. Linking can thus serve as a 'government commitment device' to establish a more credible price signal and lower the market volatility and investment risks.[78]

For another, potential gains from linking helps to enhance, or, at the very least, maintain the stringency of the cap and then the scarcity in the systems. For the system that commits to more stringent caps (here, the EU ETS), linking reduces the abatement costs by allowing firms to purchase less expensive emission reductions from its linking partner.[79] For China, potential gains from the allowances sales helps to maintain a stringent trajectory of caps. Helm (2003) and Zetterberg (2012) p.6 suggest that linking creates incentive for allowances-sellers (here, the China ETS) to relax the cap to sell more. But with China's notable 'intensity-based cap', ad-hoc adjustment to the 'cap' relative to

---

[76] The 'relative stringency 'of targets is one critical 'compatibility issue' when systems consider linkage, and it may be a precondition for linking that the systems involved have 'comparable effort' (*see* Tuerk *et al.*, *supra* note 66, at 347). Paradoxically, a difference in abatement costs (greatly affected by different stringency of caps) is a crucial 'economic motive' for linking but also pose a significant barrier (*see* Zetterberg, *supra* note 67, at 8). The 'relative stringency' of targets will not be discussed here because the cap in China has yet to be determined.

[77] *See* Flachsland *et al.*, *supra* note 65, at 4.

[78] *See id.*; *see also* Tuerk *et al.*, *supra* note 66, at 344.

[79] *See* Jaffe *et al., supra* note 67.

'announced trajectories' tends to be rather difficult. Further, China may increase the revenue from allowances sales by strategically tightening the cap, there by selling allowances at a higher price.[80]

As a result, linking serves to maintain the (consistent) stringency of caps to generate consistent abatement incentives, thus enhancing environmental effectiveness and efficiency in the linked ETS.

6.   Conclusions

In this paper we set out to examine the linking implications of different cap designs between the China national ETS (intensity based cap) and the EU ETS (absolute cap). Admittedly, our study cannot be conclusive because the full details of the national Chinese ETS are not yet known. Given that the Chinese national ETS declared to be based upon the Chinese ETS pilots, we were able to provide preliminary insights of how cap design would affect a theoretical link between China and the EU. To our knowledge there is no comparable attempt in the literature.

 In the presence of economic certainty we found that an 'absolute cap' and an 'intensity-based cap' have identical properties in a static environment, giving rise to no significant linking implications.

Allowing for economic uncertainty, however, different dynamic effects that can impede linking may be resulted. Economic uncertainty in China would jeopardize the price signal in the EU ETS, while economic uncertainty in the EU would affect abatement benefits of firms in China.

Also, economic uncertainty occurring in both jurisdictions generates the following linking implications. An unexpected economic upturn in both economies gives rise to dynamic efficiency gains in the linked ETSs, while dynamic environmental effectiveness is undermined in the EU. An unexpected economic downturn in the linked ETSs would positively affect the dynamic environmental effectiveness in the EU and dynamic efficiency in China. In the case of an unexpected economic growth in the EU and an unexpected economic contraction in China, the dynamic environmental effectiveness will then be enhanced in both systems. The reverse situation, unforeseen decline in the EU and growth in China, would lead to a declining carbon price in the linked ETSs and could jeopardize the dynamic environmental effectiveness and efficiency.

---

[80] It bears mentioning that whether China will gain revenue by tightening the cap will largely depend upon the elasticity of allowances from the EU.

Appendix 1. List of referencing normative documents in the China ETSs[81]

	Referencing normative documents[82]
National official documents	1. China's National Climate Change Program issued on 2007-6-11 2. The Outline of the Twelfth Five-Year-Plan (FYP) for National Economic and Social Development (2011-2015) 3. Comprehensive working plan for energy conservation and emission reduction for the 12th FYP period 4. Working plan for greenhouse gas control under the 12th FYP issued by State Council on 2011-12-1 5. National Climate Change Plan issued by NDRC approved by State Council on 2014-9 6. U.S.-China Joint Announcement on Climate Change, issued on 2014-11-12 7. Interim administrative measures for carbon emissions trading issued by NDRC on 2014-12-10 8. Enhanced actions on climate change: China's intended nationally determined contributions submit by NDRC to UNFCCC on 2015-6-30 9. Notice on launching the national carbon emissions trading market issued on 2016-1-11 10. Carbon Emissions Regulation expected to be issued in 2016 by State Council
Shenzhen ETS	1. Some Provisions of Carbon Emissions Management in Shenzhen Special Economic Zone issued by municipal congress on 2012-10-30 (Amendment draft is in municipal congressional review) 2. Shenzhen Carbon Trading Regulation issued on 2014-03- 28
Shanghai ETS	1. Opinions of municipal government on launching carbon ETS in Shanghai issued on 2012-7-3 2. Shanghai Carbon Trading Regulation issued on 2013-11-6 3. Shanghai Allocation Plan (2013-2015) issued on 2013-11-22
Guangdong ETS	1. Guangdong Carbon Trading Regulation issued on 2013-12-19 2. Guangdong Allocation Plan 2015 issued on 2015-7-10 (in replacement of Guangdong Allocation Plan 2013/2014) 3. Allowances management regulation by Guangdong Provincial DRC issued on 2015-2-26
Tianjin ETS	1. Working plan on launching Tianjin carbon ETS issued on 2013-2-5 2. Tianjin Carbon Trading Regulation issued on 2013-12-20 3. Notice on launching carbon emissions trading by municipal DRC issued on 2013-12-24 4. Tianjin Allocation plan (Trial) issued on 2013-12-24
Beijing ETS	1. Beijing Allocation Plan (Trial) issued on 2013-11-20 2. Notice on launching Beijing carbon ETS issued by Beijing Municipal DRC on 2013-11-22 3. Decisions of Launching Beijing Carbon ETS under the Premise of Strictly Controlling Aggregate Carbon Emissions issued by municipal congress on 2013-12-30 4. Beijing Carbon Trading Regulation (Trial) issued on 2014-5-28 5. Notice on carbon emissions verification and other relevant work issued on 2014-3-7 6. Allowances Adjustment Plan 7. Allowances Application for New Installations 8. Application for Allowances Adjustment 9. Notice on carbon emissions trading pilot in 2016 by Beijing Municipal DRC, respectively issued on 2015-12-24 and on 2016-1-25
Hubei ETS	1. Hubei Carbon Trading Regulation issued on 2014-3-17 2. Hubei Allocation Plan 2015 issued on 2015-11 (in replacement of Hubei Allocation Plan issued on 2014-3-26)
Chongqing ETS	1. Chongqing Carbon Trading Regulation issued on 2014-4-26 2. Chongqing Allowances Management Regulation issued on 2014-5-28 3. Notice on 2013 allowances by Chongqing Municipal DRC issued on 2014-05-29

---

[81] Last updated on Jan. 28th, 2016.

[82] In the absence of official English translations for most documents, translations for the titles of documents are provided merely for purpose of differentiation.

Appendix 2. Ex-post adjustment rules in the Chinese pilots

	Start date	Compliance date	Allocation date	Adjustment date	Adjustment basis	Adjustment rules
Shenzhen ETS	2013-06	• Before June 30th (see SZ2,[83] Article 36, hereafter 'A36')	• In the first quarter every three year (SZ2, A17)	• Before May 20th (to adjust allowances for last year). (SZ2, A19)	• Actual output /industrial added-value (SZ2, A19)	• In the single product industry: actual allowances = actual output * intensity target. • In other industries: actual allowances = actual industrial added-value * intensity target. • Notes: allowances added cannot exceed the allowances withdrawn (except for new-entrants). (SZ2, A19)
Shanghai ETS	2013-11	• June 1st - June 30th (SH2, A16)	N/A PS: 2013-2015 allowances allocated up front and at once (SH3, section 3).	• Before the compliance date (for last year). (SH3, section 3)	• Actual business volume. (SH3, section 3)	• Only adjusting allowances (issued in limited sectors and when benchmarking allocation method applied). (SH3, section 3)
Beijing ETS	2013-11	• June 15th (BJ2)	• Before June 20th (for existing installations); • Before the surrender date in the year after for new installations. (BJ1)	• Before the compliance date (for last year). (BJ1, section 5) • For 2013 allowances before April 30th 2014. (BJ5)	• Actual emissions in 2013 and sectorial advanced intensity for new installations. (BJ1, section 5; BJ7) •	• Adjustment principles mentioned (see BJ4, A12 and BJ1, section 5). • For existing installations only when there existed abnormal changes in historical data or the simple arithmetic average cannot reflect the actual emissions (see BJ6). PS: Specific requirements and procedures for existing installations, see BJ6-8.
Guangdong ETS	2013-12	• Before June 20th (GD1, A18)	• July 1st. (GD1, A14) •2014 allowances was allocated during 2014/08/18-2014/08/22. (GD2)	N/A	• The 'output correction factor' (a ratio of 2014 actual output to 2013 output) to adjust 2014 allowances, since 2014 allowances pre-allocated based on 2013 output (GD2, section 4)	• Only adjusting allowances (issued in limited sectors and when benchmarking allocation method applied).
Tianjin ETS	2013-12	• Before May 31st (TJ2, A9)	• 2013 allowances allocated in December 2013; • 2014/2015 allowances are issued after the compliance date (to cover 2013/2014 emissions). (TJ4)	• During the compliance period (for last year) (TJ4, section 3).	• Actual generating capacity in sectors of electricity and heating; no details announced officially in other sectors. (TJ4, section 4)	N/A PS: allowances at existing and new installations adjusted. (TJ4, section 3)
Hubei ETS	2014-04	• Before the last working day in May. (HB1, A19)	• The last working day in June. (HB1, A13)	N/A	• Actual emissions (HB1, A17)	• When actual emissions deviated from pre-allocated allowances by more than 20% or 200,000 tCO2, due to output changes and etc. • Supplemental allowances = actual emissions - ex-ante allowances - ex-ante allowances*20% (or 200,000 t) • Withdrawn allowances = ex-ante allowances – actual emissions - ex-ante allowances*20% (or 200,000 t) (HB1,A17; HB2)
Chongqing ETS	2014-06	• Before June 20th(CQ2, A18)	• 22 working days after covered entities forecast and report their emissions. (CQ2, A8, 11)	• Before April 20th (for last year). (CQ2, A14)	• Actual emissions (CQ2, A12)	• Allowances adjusted when emissions reported (by covered entities) deviated from actual emissions by no less than 8%. (CQ2, A12)

---

[83] 'SZ2' refers to the 2nd document (for Shenzhen ETS) listed in Appendix 1.

Appendix 3. Clarity and transparency of cap setting in the Chinese pilots

	Legal Clarity of caps[84]	Transparency of caps in practice
Shenzhen ETS	• ETS's emissions controlling target determined based on binding targets, economic development (industrial development policy, sectorial development), abatement potential and etc. (SZ2, A10,14) • Overall allowances include the allowances for pre-allocation, (ex-post) adjustment, new entrants, auction and reserve for price stability. (SZ2, A15)	• The cap during 2013-2015 (about 100 million tonnes) disclosed officially prior to the ETS launching date on 2013-5-21. See Wu (2015). •The 2013 adjusted cap announced on 2014-5-29 (decreased from 2013 ex-ante cap by around 9%).[85]
Shanghai ETS	• The total amount of allowances set based on binding targets, economic development targets and energy consumption targets. (SH2, A6) • Overall allowances controlled based on economic development (2011-2015), intensity targets and the share of emissions covered by ETS. (SH3, section 1)	• Not announced officially.
Beijing ETS	• The total amount of allowances set to ensure the achievement of intensity targets. (BJ3, A1) • Overall emissions controlling target and overall allowances set pursuant to intensity targets in national/municipal economic and social development plans. (BJ4, A5) •Overall allowances include allowances issued at the existing/new installations and allowances for (ex-post) adjustment. (BJ1, sections 2-5)	• Not announced officially.
Guangdong ETS	• The total amount of allowances set based on GHG targets (*i.e.* intensity targets), industrial development planning and energy consumption targets. • Overall allowances include the allowances issued and the reserved (for new programs/firms and for adjustment). (GD1, A11)	• The cap during 2013-2015 announced officially in Allocation Plan (respectively about 388/408/408 million tonnes) on 2013-11-27, 2014-8-18 and 2015-7-10).
Tianjin ETS	• The total amount of allowances (2013-2015) set based on GHG targets (*i.e.* intensity targets), national industrial policy, municipal industrial development planning, covered industries and historical emissions of covered entities. (TJ4, section 2)	• Not announced officially.
Hubei ETS	•Within the limit of emissions binding targets, the total amount of allowances set according to provincial economic development, industrial restructuring and etc. (HB1, A11) •Overall allowances include the pre-allocated allowances and the reserved (for new entrants and by government). (HB2, section 3)	• The 2014 cap (about 324 million tonnes) announced officially in Allocation Plan on 2014-3-26 (HB2, section 3) • Cap in 2015 not announced officially.
Chongqing ETS	• The total amount of allowances set within the framework of energy conservation targets and abatement targets based on historical emissions of covered firms, industrial abatement and etc.(CQ2, A7) • Before 2015, the upper limit of overall allowances decreased annually by 4.13%; after 2015, the Overall allowances set according to abatement targets set by the nation. (CQ2, A7)	• The 2013 cap (125197019tonnes) announced officially on 2014-05-29 (CQ3)

---

[84] In this column, information is gathered and translated from the normative documents (listed in Appendix 1).

[85]*See Shenzhen Adjusted 2013 Allowances of Covered Entities* (in Chinese), *TANGONGYE* (Jun. 3, 2014), available at: http://www.tangongye.com/CarbonAsset/NewShow.aspx?id=6642.