LIMITED SECTORAL TRADING BETWEEN THE EU ETS AND CHINA

Claire GAVARD[1], **Niven WINCHESTER**[2], **Sergey PALTSEV**[2]
[1] Centre d'Economie de la Sorbonne, 106-112 Boulevard de l'Hôpital, Paris, France
[2] Joint Program on the Science and Policy of Global Change, Massachusetts Institute of Technology,
77 Massachusetts Avenue, E19-411, Cambridge, MA 02139-4307, USA
Claire.gavard@malix.univ-paris1.fr

(1) Overview

Carbon markets are developing around the world, as policy instruments to reduce greenhouse gases emissions. The European Union Emission Trading Scheme (EU ETS) has existed since 2005. As summarized in Trotignon *et al* (2011), national or subnational carbon markets are also operating in Australia, Japan, New Zealand and California. Interconnections between them may develop. So far Non-Annex I countries have been involved in carbon markets through the Clean Development Mechanism (CDM) defined in Article 12 of the Kyoto Protocol (United Nations, 1998). For each project approved by the CDM Executive Board, a certain amount of credits, called Certified Emission Reductions (CER) are issued. These CERs can be traded and sold in the carbon markets of Annex I countries. Among these carbon markets, the EU ETS is the largest one to accept CERs for compliance. Similarly under the Joint Implementation Mechanism (JI) defined in Article 6 of the Kyoto Protocol, Emissions Reduction Units (ERU) can be emitted for projects occurring in Annex B[1] countries and traded in other Annex B countries. The EU accepts ERUs and CERs for compliance in the EU ETS (EU, 2004). In the Phase II of the scheme (2008-2012), a limit was set on the amount of ERUs and CERs accepted into the ETS : the total volume of EUA and CERs used for compliance in the scheme should not exceed 13% of the total amount of European allowances (EUA). This limit was not reached.

In the negotiations of the United Nations Framework Convention on Climate Change (UNFCCC), new market mechanisms are now considered to have some Non Annex I countries involved in the carbon markets developed by some Annex I countries, beyond their current involvement through the Clean Development Mechanism (CDM). Sectoral trading is one such mechanism (European Union, 2009). It would consist in coupling one economic sector of a Non Annex I country, e.g. the Chinese electricity sector, with the carbon market of some Annex I countries, e.g. the European Union Emission Trading Scheme (EU ETS).

Previous research works analyzed the potential impacts of such a mechanism on emissions, carbon price, the electricity sector and the rest of the economy. Hamdi-Cherif *et al.* (2010) analyzed this policy if it were set between all developed and developing countries. Gavard *et al* (2011a) looked at the hypothetical US – China case. These studies showed that the transfer of permits induced by the mechanism induces carbon price equalization between the entities involved. A large part of the emissions reductions occurring in the annex I country when no sectoral trading is allowed are done in the emerging country when the coupling is open with the latter. Hence the carbon price decrease in the Annex I country involved leads to a partial cancellation of the technological changes induced by the carbon market in this country in the absence of sectoral trading. On the contrary, more technological change is observed in the emerging country. In Gavard *et al* (2011b), it is shown that the European carbon price would decrease by more than 75% if the mechanism were used without any limit between the EU ETS and Chinese or Indian electricity sector. These results suggest that a limit would be set on the amount of carbon permits that could be imported from the Non Annex I country to the Annex I carbon market should such a mechanism come into effect.

This paper quantifies the impacts of limited carbon permits trading between the EU ETS and Chinese electricity sector if the latter is constrained by an emissions reduction target.

(2) Methods

The analysis is done with the MIT Emissions Prediction and Policy Analysis (EPPA) model on the time period 2015-2030. The EPPA model is a recursive dynamic, multi-region computable general equilibrium model (Paltsev, 2005). It is designed to assess the impact of energy and environmental policies on emissions and economic activity. Version 5 of the model is calibrated to 2004 economic data and is solved through time by specifying exogenous population and labor productivity increases, for 2005 and for five-year increments thereafter. 15 individual countries or regions are represented. For each country or region, fourteen production sectors are defined. Version 5 of the EPPA model is calibrated using economic data from Version 7 of the Global Trade Analysis Project (GTAP) database and energy data from the International Energy Agency. The model is coded using the General Algebraic Modeling System (GAMS) and the Mathematical Programming System for General Equilibrium analysis (MPSGE) modeling language (Rutherford, 1995).

The limit on the amount of Chinese carbon permits that could be sold into the European carbon market is modeled through the introduction of a trade certificate system: for each time period a volume of certificates is produced

[1] The lists of Annex I and Non Annex I countries were defined in the Kyoto Protocol (United Nations, 1998). Annex B countries are Annex I countries with an emission reduction or a limitation commitment under the Kyoto Protocol.

as a fraction of the volume of European allowances defined by the European cap, and any Chinese carbon permit requires a certificate to be sold to Europe. The analysis takes account of the possibility to bank and borrow carbon allowances in the EU ETS. Aviation emissions are included as well as possible offsets through Clean Development Mechanism and Joint Implementation credits.

The emission reduction target imposed on the sectors covered by the EU ETS is 42% reduction by 2030 below 1990 levels. The constraint on Chinese electricity sector emissions is 10% reduction below business as usual levels by 2030.

(3) Results

We find that, while carbon prices in Europe and the Chinese electricity sector equalize at $10.2 per ton under unlimited sectoral trading, the carbon price reaches $25.9 per ton in Europe and $7.2 per ton in Chinese electricity sector when the amount of Chinese carbon permits imported into the EU cannot exceed 10% of the volume of EUA defined by the European constraint in each time period. In Europe, this represents a 34% decrease in carbon price compared to the situation in which there is no sectoral trading, while the European carbon price decreases by 74% when sectoral trading is not limited.

If the amount of Chinese permits that is accepted in the ETS is 5 or 20 % of the total volume of EUA allowances, the EU carbon price is respectively $31.4 per ton and $15.7 per ton. Aggregate emissions remain unchanged as this mechanism only induces transfers of emission.

We observe that, while unlimited sectoral trading enhances the technological changes induced by the emissions reduction constraint in Chinese electricity sector, this effect is absent under limited sectoral trading. In Europe, while unlimited sectoral trading partly cancels the changes initiated by the EU ETS in the electricity sector, a limit on this mechanism moderates this effect.

Welfare change in both regions involved depends on the way the revenue from the certificates is allocated: China is better off if Chinese households are endowed with the certificates than if European households are. We find that there exists a limit that makes both regions better off or at least one region as well off and the other better off than in the situation in which each region bears its own emissions reduction constraint and no trading is allowed between the two. In the analysis, this pareto superior situation is reached when the volume of Chinese permits imported to Europe cannot exceed 10% of the volume of EUA allowances defined by the European cap.

(4) Conclusions

Sectoral trading mechanism would allow some Non Annex I countries to get involved in the carbon market developed by some Annex I countries. If a limit is set on the amount of permits that can be traded, such a mechanism would not decrease carbon price in the Annex I country as much as it would if no limit were set. As a consequence, it would not cancel the changes initiated in the electricity sector of the Annex I country as much as unlimited sectoral trading would. In the case of sectoral trading between two countries only, if the revenue from the certificates is allocated to the Non Annex I country households, it is possible to find a limit that makes both regions involved better off compared to the case in which they have their own constraints and no trading is allowed between the two. This result might be particularly useful for negotiations between some Annex I countries and emerging countries.

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