The Double Bubble: Definition, Available Literature and Estimated Impacts

*By Paul Monfils**

This note briefly examines the concept of the "double bubble" in the context of international emissions trading. The double bubble is defined and the policy context of its development is given. References to recent literature are provided, in particular, studies which estimate its economic impact.

Definition

On the path leading to the Kyoto Protocol and its aftermath, the "double bubble" was proposed as a potential trading regime within the boundaries of Annex I. Under the double bubble, Annex I countries meet their commitment under two separate trading groups: the European Union (EU) and the rest of Annex I, hence the name "double bubble".

IPolicy Context

Article 4 of the Kyoto Protocol allows Annex I countries to fulfill their quantified emission limitation and reduction commitments jointly (i.e., to form a bubble).

The EU has formed a bubble and adopted an overall target of 92 percent of its 1990 emission levels. As per its burden sharing agreement, the EU has defined country-specific targets varying from 72 to 127 percent of 1990 levels. The EU bubble implies that European countries are working together to meet the overall EU target and that significant "trading" of emission credits will take place, at least implicitly, among EU countries. More recently, the EU has taken a policy position in favour of restricting the use of 'hot air' and, in an attempt to quantify the "supplementarity" provision of the Protocol, it proposed a formula by which the use of the Kyoto Mechanisms would be capped.

In consideration of these factors, countries of the so-called Umbrella Group, namely, the United States, Canada, Japan, New Zealand, Australia, Norway, Iceland, Russia and Ukraine, have suggested a double bubble concept as a possible trading regime. The creation of a second bubble would ensure unrestrained trading among its participants (i.e., the non-EU Annex I countries).

Available Literature

The Energy Modeling Forum (EMF) held a series of workshops in 1998 leading to the EMF-16 exercise. The goal was to compare results from various models on the cost of implementing the Kyoto Protocol. Thirteen modeling teams participated to EMF-16. The modeling teams were asked to run a common set of abatement scenarios to serve as a basis for comparison of their results. This extensive research is reproduced in a 1999 Special Issue of *The Energy Journal*, entitled *The Costs of the Kyoto Protocol: A Multi-Model Evaluation*, published by the International Association for Energy Economics.

Although the double bubble was <u>not</u> part of the four "core" scenarios (i.e., Reference case, No trading of emission rights, Full Annex I trading and Full Global Trading), it was analyzed by five modeling teams. Their key findings are summarized below. The price of international credits under double bubble as compared to estimates for full Annex I trading are shown in Table 1.

Double Bubble: Its Economic Impact

A country's take-up of international credits is primarily a function of the difference between its domestic cost of abatement and the international price of emission credits. The larger the difference, on a per tonne basis, the larger the incentive for a country to acquire international credits for meeting its target.

Under the double bubble, the EU is removed from Annex I trading. Since the EU is a net purchaser of international credits under a full Annex I trading regime, its removal from the international market is expected to reduce the demand for credits. This would reduce the international price of credits, assuming there is no change in the international supply which would originate, for the most part, from the former Soviet Union[1]. Consequently, countries on the international market, facing a lower price, have the incentive to acquire a larger amount of credits. Effectively, as shown in Table 1, the double bubble results in two prices for tradable credits within the Annex I region: one price for the EU, and another one for the rest of Annex I (i.e., Umbrella Group countries).

Table 1

Price of Tradable Credits: Double Bubble vs Full Annex I Trading
EMF-16 Double Bubble Modelling Results

Model	Price of International Credits in 2010 (1995US$ per metric tonne[2])		
	Double Bubble Trading		Full Annex I Trading
	EU Price	Umbrella Group Price	Intl. Price
SGM (Second Generation Model) Batelle Pacific Northwest Laboratory	$140	$69	$79
AIM (Asian-Pacific Integrated Model) National Institute for Environmental Studies (NIES-Japan), Kyoto University	$216	$50	$70
GTEM (Global Trade Environment Model), Australian Bureau of Agriculture & Resource Economics	$190[a]	$117	$123
G-Cubed (Global General Equilibrium Growth Model), Australian National University, Univ. of Texas & US EPA	$261	$32[b]	$61
Oxford Model (Oxford Economic Forecasting)	$906[c]	$163	$213

Notes: please see Annex A for footnotes a, b, and c.

- When removed from the Annex I trading bloc, under a double bubble, the EU is left to meet its obligations independently. The necessary carbon taxes and energy impacts are generally the same as under a <u>no trading</u> case, the EU facing a permit price that is roughly twice the amount than under full Annex I trading.
- EU's departure reduces the demand for international cred-

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[1] See footnotes at end of text

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its. Given a constant supply of credits from the former Soviet Union/Eastern Europe (FSU/EE) region, this results in a lower permit price than under full Annex I competitive trading.

- Countries of the Umbrella Group achieve a higher percentage of their target through trading and reduce their domestic carbon price for the share to be achieved domestically.
- While the double bubble has no benefit for the EU, it is advantageous to Umbrella Group countries.

In these five analyses, Canada is not identified as a region by itself but rather included as part of a larger trading entity including also Australia and New Zealand (i.e., the "CANZ" region). NRCan's own estimate, calculated with Charles River Associates (CRA) Multi-Sector Multi-Region Trade (MS-MRT) model is provided in the next section. MS-MRT model was also part of EMF-16. The analysis prepared by Paul Bernstein, David Montgomery and Gui-Fang Yang, of CRA, and Thomas Rutherford, of the University of Colorado, focused on different aspects of emission trading and did not address the impact of the double bubble.

MS-MRT Model Estimates

In general, the findings of other modeling teams are confirmed by our runs of MS-MRT, which are displayed in Table 2 and Figure 1 below[3]. The international price of emission credits is lower under a double bubble trading scheme compared to unrestrained Annex I trading. A non-trading EU reduces the demand for and the price of international credits.

Table 2
MS-MRT Model Estimates
International Prices and Percent of Obligation Met Through Trading

	International Trading Regime		
		Double Bubble	Full Annex I Trading
	EU Price	Umbrella Group Price	Intl. Price
Int'l Carbon Price (US1995$/tonne of c.)	$180	$69	$83

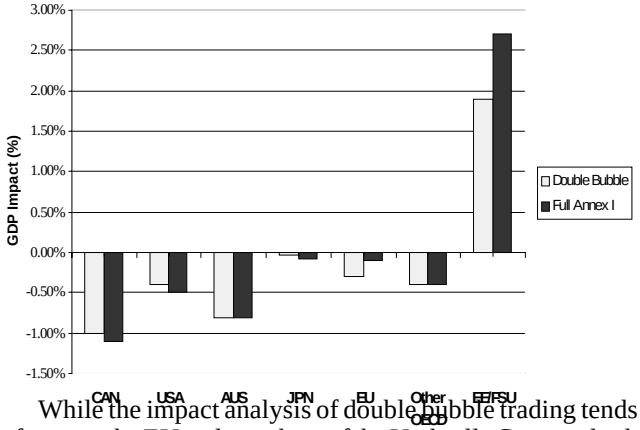
Region	Percentage of Obligation Met Through Trading	
	Double Bubble	Full Annex I Trading
CAN	70%	64%
USA	60%	52%
AUS	6%	no purchase
JPN	70%	64%
EU	Outside Umbrella Group	44%
Other OECD	86%	82%

In the double bubble case, Canada would have the incentive to achieve a larger share of its obligation through international credit purchases (70 percent rather than 64 percent under full Annex I trading). This is due to a lower permit price of 1995US$69 per tonne of carbon compared to $83.

The lower permit price implies that Canada would face a lower domestic cost of abatement for the share of its obligation to be achieved domestically. Instead of undertaking 36 percent of its obligation under full Annex I trading, Canada would only achieve 30 percent of its obligation domestically. As shown in Figure 1, a lower cost per tonne also explains the reduction in the cost estimate to 0.95 per cent of GDP by 2010, under double bubble versus 1.08 percent under full Annex I trading.

Not only Canada gains under a double bubble but also the USA and Japan. The EU, by contrast, faces a GDP cost which is nearly three times the cost under full Annex I trading.

Figure 1
GDP Cost Estimates - MS-MRT Model



While the impact analysis of double bubble trading tends to focus on the EU and members of the Umbrella Group, a look at the impact on FSU/EE is of interest. As a supplier of permits, the gains for the FSU/EE are reduced with the double bubble (+1.9 percent above business-as-usual GDP rather than +2.7 percent under full Annex I trading). This is thought to be due mostly to the decline in both the price and the quantity (i.e., 35 Mt of carbon, or 7.5 percent, less) of the international credits they sell. This may provide an incentive to that region, especially Russia, to exercise market power to raise its selling price to avoid such potential loss.

Concluding Remark

Analyses show that under a double bubble, the EU loses and FSU=s benefits from permits sales are reduced while other Annex I countries, including Canada, are better off.

A question that arises is whether the magnitude of the permit price differential among OECD countries, under a double bubble, is sustainable. Facing a permit price which would be twice that for other Annex I countries, the EU would face possibilities of leakage, not only to the benefit of non-Annex I countries, but also other OECD economies. International firms operating in Europe may not view this situation with equanimity.

Although a double bubble may not be currently subject to intense negotiations, it remains a strategic element that can help counterbalance EU's stance towards restricting international trading of emission credits.

Footnotes

[1] The question of whether the Eastern Europe (EE) region would be part of the double bubble group remains unclear because it would be negotiated primarily by the members of the Umbrella Group, which only includes Russia and Ukraine from the FSU/EE region. In general, the double bubble assumes that the whole FSU/EE region participates in a double bubble. GTEM applies a different geographic definition and its impact is detailed in Annex A (footnote a). EE represents about 5% of the 'hot air' that would be available by 2010, according to U.S. DOE Energy Information Administration 1999 forecast.

[2] U.S. GDP deflator used to bring published values into U.S.

1995 dollar.

[3] In terms of international carbon prices, MS-MRT estimates are at mid-point of the values generated by the other models, for each of the scenarios.

Annex A
EMF-16 Modelling Results on the Double bubble

Model	Key Result on Double Bubble Scenario Analysis
SGM (Second Generation Model) Batelle Pacific Northwest Laboratory	"In the "Double Bubble" case, the Western Europe region is removed from the Annex I trading bloc, leaving it to meet its obligations independently. For Western Europe, the necessary carbon taxes and energy impacts are the same as under its no trading case. But for the remaining regions in the permit market, the departure of Western Europe results in a 2010 permit price that is lower than in full Annex I competitive trading - $64 [1992 US $] per tonne as compared to $73 under full Annex I trading". (Op. Cit., p. 55)
AIM (Asian-Pacific Integrated Model) National Institute for Environmental Studies (NIES-Japan), Kyoto University	"The GDP loss of the EU in the double bubble case is larger that in the no trading case. This is because the EU has access to relatively low cost emission rights from EEFSU in the Annex I trading case, but loses access to that "hot air" in the double bubble case. Therefore, the double bubble scenario has no merit for the EU." (Op. Cit., p. 219)
GTEM (Global Trade Environment Model), Australian Bureau of Agriculture & Resource Economics	"Under the double bubble, the carbon emission penalty in the European bubble is substantially higher than the emission penalty under full Annex I trading. This is because the EU no longer has access to low cost emission abatement opportunities in the former Soviet Union. Instead it must purchase more expensive emission quotas from eastern Europe where pre-trade carbon emission penalties (marginal abatement costs) are higher than for the former Soviet Union. The change in carbon emission penalty for the umbrella group is relatively small because the removal of the EU's demand for quotas (which would tend to reduce quota prices) is offset to some extent by the removal of a similar quantity of quota supply by eastern Europe. The net effect is a small decrease in quota price for the umbrella group relative to full Annex I trading". Union (Op. Cit., p. 271) [This represents a slightly different definition of the double bubble, as the EU still acquire some credits from Eastern Europe.](a.)
G-Cubed (Global General Equilibrium Growth Model), Australian National University, Univ. of Texas & U.S. EPA	"The key difference between this scenario and full Annex I trading is that ROECD no longer buys...permits from the former Soviet Bloc. As a result, the effects on ROECD look much like the no-trading case and abatement costs in the rest of Annex I [i.e., USA, Japan and Australia as per G-Cubed definition] fall substantially. Permit prices fall to $32 (1995 US $) in 2010 [compared to a price of $61 under full Annex I]." (Op. Cit. p. 312). (b.)
Oxford Model (Oxford Economic Forecasting)	"In this case, the EU countries have to introduce carbon taxes effectively equivalent to those in the no trading case. In contrast, non-EU countries benefit from a lower international permit price (since, with the EU out of the market, the demand for permits is lower) - $170 (1997 US $) mmt in 2010 compared with $222 under full Annex I trading." (Op. Cit., p. 357) (c.)

Notes:
1. GTEM defines the double bubble scenario in a slightly different fashion than used by other modeling teams. Although the EU no longer has access to low cost emission abatement opportunities in the former Soviet Union (FSU), it, however, maintain access to some of the low cost emission credits from eastern Europe where pre-trade carbon emission prices are higher than for the FSU. GTEM estimates the permit price for the EU under the double bubble to be 1995US$190, higher than the price under full Annex I trading, but lower than EU 'no trade' price estimate (of $771), contrarily to other analyses.
2. G-Cubed applies a different, more aggregated, definition of OECD countries. G-Cubed defines Annex I regions as composed of the USA, Japan, Australia, FSU and Rest of OECD countries (i.e., ROECD). ROECD aggregates the EU and non-EU regions like Canada and New-Zealand into a single region. When running the double bubble with such aggregation of regions, all of ROECD countries are removed access from FSU permits, which results in a further reduced demand and a lower international (i.e., Umbrella Group) price than would be otherwise (i.e., if only the EU was removed from Annex I trading).
3. Oxford defines the EU as EU-4 comprising Germany, France, Italy and UK.