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CARBON, TRADE POLICY, AND CARBON FREE TRADE AREAS[①]

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中文简介：全球气候变化正在逐渐成为影响各国政治、经济发展的一个重大国际问题，在后巴厘时代，如何用贸易政策来解决气候变化问题是一个新的研究方向。本文的创新之处体现在以下几个方面，在政策层面，认为以改变贸易结构为目标的贸易政策并不是降低温室气体排放的最有效的政策手段，同时，本文提出了三种可能的低碳自由贸易区的构想，对其具体模式，效应，实施中可能的问题做出了政策性判断。在理论层面上，本文拓展了传统的关税同盟理论中的福利判断标准，认为在效应函数中考虑气候变化的影响后，传统的贸易创造增加福利，贸易转移降低福利的结论不再成立。在后续研究中，作者采用数值一般均衡模拟技术，测算了不同类型的贸易政策对温室气体排放的影响，得出的结果支持了本文中的主要观点[②]。

ABSTRACT

This paper discusses both the potential contribution that trade policy initiatives can make towards the achievement of significant global carbon emissions reduction and the potential impacts of proposals now circulating for carbon reduction motivated geographical trade arrangements, including carbon free trade areas. We first suggest that trade policy is likely to be a relatively minor consideration in climate change containment. The dominant influence on carbon emissions globally for next several decades will be growth more so than trade and its composition, and in turn, the size of trade seemingly matters more than its composition given differences in emission intensity between tradables and nontradables. We also note that differences in emissions intensity across countries are larger than across products or sectors and so issues of country discrimination in trade policy (and violations of MFN) arises.

We next discuss both unilateral and regional carbon motivated trade policy arrangements, including three potential variants of carbon emission reduction based free trade area

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② Dong Y. & J. Whalley (2008) “Carbon Motivated Regional Trade Arrangements: Analytics and Simulations” (unpublished).

arrangements. One is regional trade agreements with varying types of trade preferences towards low carbon intensive products, low carbon new technologies and inputs to low carbon processes. A second is the use of joint border measures against third parties to counteract anti-competitive effects from groups of countries taking on deeper emission reduction commitments. A third is third country trade barriers along with free trade or other regional trade agreements as penalty mechanisms to pressure other countries to join emission reducing environmental agreements. We differentiate among the objectives, forms and possible impacts of each variant. We also speculate as to how the world trading system may evolve in the next few decades as trade policy potentially becomes increasingly dominated by environmental concerns. We suggest that the future evolution of the trading system will likely be with environmentally motivated arrangements acting as an overlay on prevailing trade and financial arrangements in the WTO and IMF, and eventually movement to linked global trade and environmental policy bargaining.

1. Introduction

This paper discusses both the potential contribution that trade policy can make towards significant global carbon emissions reduction and the potential impacts of proposals for both unilateral and regional carbon emission reduction motivated trade policy arrangements now circulating, including carbon free trade areas proposals.

The background to our discussion is the present global negotiating situation regarding global carbon emissions reduction initiatives, both in the Bali /post Kyoto UNFCCC negotiating process (out to Copenhagen 2009 and beyond), and also in debate on possible unilateral measures by various entities around the world (and especially in the EU). In Europe the view is that individual countries (or a group of countries)going faster and father than other countries in terms of emissions reduction commitments inevitably face issues of linkage to the trade regime if offsets are to be provided to anti-competitive effects on domestic producers within countries flowing from environmental commitments.

The combination of the Post Bali road map discussion following the recent UNFCCC Bali Meeting (Dec 2007) and the EU commitments in their 2020 programme (20% emissions reductions by 2020, and 20% use of renewables by the same date) has lead to increased discussion as to how trade and environment regimes may need to be more closely linked in a post Kyoto world. The future, as seen in Europe, is for Europe to lead the world with deeper emissions reduction commitments than elsewhere. But while others lag new trade measures may be needed. Such measures may well eventually involve fellow travelers in new carbon driven regional trade arrangements.

We first highlight the seemingly much larger role to be played by economic growth rather than trade in fuelling growing carbon emissions and whose containment is more likely to significantly reduce emissions than trade policy interventions. We also suggest that since much of global merchandise trade is in emissions intensive manufactures, the more critical

issue may be the level of trade relative to non-traded services than the product and country composition of trade, which trade policy proposals largely address. Having said this, however, we also note the large differences in emissions intensities across countries and hence the potential role for (non-MFN) country discrimination in trade policy.

We suggest that discussion of unilateral carbon motivated border measures and carbon motivated regional trade arrangements is likely to grow in significance as global negotiations on climate change intensify. This will occur especially as the impacts of such initiatives on the size and pattern of trade become more apparent, and trade measures to support climate change initiatives are explored. Unilateral carbon motivated border measures could involve either or both of tariffs on high carbon imports and subsidies on low carbon exports.

At a trade policy level, we also discuss emerging ideas and proposals for carbon emission reduction motivated free trade areas, and accompanying border measures when carbon reduction initiatives are implemented. We differentiate both objective and form in such proposals, emphasizing how such measures can in some cases serve to increase rather than reduce carbon emissions.

In their simplest form, carbon free trade areas would involve free trade in low carbon containing products among countries jointly committing to significant emissions reductions or renewable commitments, and also with external trade barriers against third countries that do not follow. Discussion of both their form and impact is related to the long studied customs union issue originally analyzed by Viner(1950), but now the impacts of carbon pricing/reduction policies on emissions is the focus.

We discuss three different forms of possible trade arrangements. One is regional trade agreements with varying types of trade preferences towards low carbon intensive products, low carbon new technologies and inputs to low carbon processes to stimulate trade (and hence consumption) in low carbon intensive products, and in this way are designed to contribute directly to emissions reduction through changed trade patterns. A weakness of this approach is that seemingly there is more differentiation in emissions intensity by country than by product. Also, this discussion does not focus on the external trade arrangements of the group of countries entering into such an agreement.

A second type focuses on the anti-competitive effects on domestic producers when significant joint emissions reduction commitments are made which others do not follow. Such commitments raise costs for domestic producers and whether there should be offsets for these relative cost effects compared to third country producers operating outside of such arrangements is an issue, as well as the form they should take. This perceived need for border tax adjustment has already arisen in Europe (see Lockwood &Whalley (2008)).

Hence, if various entities within the OECD, such as, the US and the EU were to jointly agree on carbon emission reduction initiatives, some forms of joint border measures against third parties might be used to counteract the anti-competitive effects on domestic producers from the joint environmental commitment. These could take the form of common or country

differentiated external barriers against third parties.

A third type of arrangement could be where countries enter into free trade or other regional trade agreements and use joint and discriminatory carbon motivated trade barriers against third parties as a way of pressuring countries to join their joint environmental agreement. This form of trade arrangement is similar to that contained in the Montreal Protocol of 1987.

We discuss what may be involved in each of these, and also in the wider use of trade policies to achieve global carbon limitation objectives. We note in passing that similar ideas to those now surrounding carbon motivated trade policies could be discussed for a wide range of policy related areas and their interaction with trade, quite besides climate change. Joint or unilateral trade policies could be argued for countries with, say, a high level of provision of social programs, high labor standards, high minimum wages and other policy features. We thus suggest, including in the carbon emissions case, that the motivation for these types of trade arrangements and their forms and impacts should be discussed as separate issues.

We also discuss the potential systemic impacts of such arrangements and how the world trading system may evolve in the next few decades in light of the likely growing interface between trade and environmental policies. International agreements are critical for countries whose policy objectives are to avoid destructive policy retaliation and gain common benefits from cooperation. We suggest that the Bretton Woods 1944 Conference yielded a global trade and monetary order whose main aim was to rebuild the international economy after World War II, but the resulting system only focused on trade and finance, not physical interactions between countries. Today, given concerns over global warming, the future evolution of the trading system may well be that environmentally motivated arrangements act as an overlay prevailing trade and financial arrangements in the WTO and the IMF. The world of global policy coordination may thus move beyond WTO trade negotiations to linked trade and environmental policy bargaining.

2. Carbon and Trade

The central issue this paper discusses is the use of trade policy either unilaterally or through international coordination as an instrument for achieving significant reductions in carbon emissions. We also discuss the potential use of carbon-linked trade policies by countries. A number of broad ranging issues have to be addressed first before specific carbon motivated trade policy interventions can be discussed.

First is the general issue of linkage between trade on one hand and carbon emissions on the other. Negotiated carbon emissions reductions seek to address the lack of internalization of global externalities assorted with emissions and climate change. Whether or not and how trade policies can be productively used as for the supportive internalization mechanisms and whether they are effective or other instruments are more appropriate to use in achieving internalization objectives is the follow on issue.

At first sight, the uses of trade policy for these purposes would only seem indirect, and even clumsy, since it is economic growth more so than trade and its composition that seemingly fuels growing emissions. Recognition of the political pressures to use trade policy to compensate loses and effectively operates as a system of supporting side payments to new arrangements as part of carbon policy regimes seems more comprehensible. Whether trade policies can be effectively used as penalty or enforcement mechanisms to achieve and underpin environment cooperation is a further issue. This bears on the border tax adjustment and external trade barrier issues for regional agreements which we touch on later in the paper.

On casual inspection, trade policy as a mechanism to reduce carbon emissions would seem to be an ineffective tool and only offer quantitatively small and indirect effects. This is principally because the largest contributor to the growth of carbon emissions over the next 30 to 40 years will almost certainly be economic growth rather than the growth of trade. China has been growing at approximately 10-11% a year. Real income per capita in China has increased by a factor of 8 since 1978. If this growth rate prevails out to 2050, real income per capita in China will increase by a factor of 30 between 2000 and 2050. This growth will inevitably generate large increases in carbon emissions, and quantitatively, the effect of growth would seem to swamp by many orders of magnitude anything which may be achieved by the use of trade policies. As such, compared to reductions in the size of the national economies by constraints imposed on growth, trade policies would seemingly only offer second order effects.

In addition, since much of international trade in industrial products is in manufactures and because manufactures are relatively carbon intensive compared to services and non-manufactures, the size of trade relative to non-trade activity seems more important than the product composition of trade which trade policies may influence. In OECD economies, around 70% of national income originates in service-related activities, and manufacturing activity in terms of value added is only a small portion of GDP, in the range 15-25%. If trade policy interventions are largely focused on changing the composition of trade ,then this would seem to be a third order effect on carbon emissions relative to the two bigger effects of growth and the relative size of trade and non-trade activities.

But the ways in which trade policy interventions can affect carbon emissions are a little more subtle .An important consideration is that there are large differences in emissions intensity of production by country. This especially the case when comparing high and low wage economies, such as China and the OECD. Indeed, one can persuasively argue that differences in emissions intensity are larger across countries than they are across products or sectors.

In Table 1, we report data on carbon emissions intensity by product by country reported by Ahmad & Wyckoff (2003). These data clearly show large differences in emissions intensity across countries, and suggest that for certain pairs of countries, differences in emissions intensity across countries are larger than across products or sectors. China, in

particular, exhibits sharply higher emissions intensities than in OECD countries.

And even within countries, there are large variations in emissions intensity depending upon location. In some countries (China is such a case), there can be small localized high emitting power plants which are used for electricity generation, and relocation of production from one region of a country to another can also generate significant reductions in emissions. It is thus unclear whether trade policy interventions should be more focused on discrimination across and within countries rather than discrimination across products.

There are also other trade policy effects to be taken into account. One is on relocation of production and on component slices of larger production chains more so than on individual product production. It is now common in some countries to use R&D tax credits focused on particular component of activities, such as design and product innovation, rather than the whole production process to induce production mobility. Mobility effects stemming from both different emissions reductions intensities by country and carbon motivated trade policy intervention thus also come into play.

At a crude level, therefore, the intuition would seem to be that trade policies which affect the composition of trade may only provide a third order effect on the overall level of carbon emissions. But, a more nuanced approach to trade policy which goes beyond conventional product based differentiation in trade policy, and focuses on country or region within country differentiation may have larger effects.

Policies which focus on differences in emissions intensities of production for similar products across countries, and even differences in emissions intensity across locations within countries seemingly also suggest a sharply different form of trade policy intervention than in conventional trade policy discussions. This is because if there are un-internalized externalities, the degree of internalization that might be sought through trade policies will be a function of the relative differences in emissions, as well as the overall size of the emissions involved. If emissions intensities are higher in one country than in another (as in the case of China and the OECD), then the argument would be that trade policy should sharply discriminate by country more so than by product, with higher barriers against those countries which are the source of high emissions. This direction for policy is obviously in sharp conflict with non-discrimination in the WTO.

This discussion also has the implication that if trade policies to support efforts to achieve carbon emissions reduction targets are to be used in a discriminatory manor to achieve internalization of externalities, then the discrimination should be targeted directly towards the largest differences in emissions intensity. Discrimination in trade policies will presumably by product and country, and the data we present above suggest that country discrimination will quantatively dominate product discrimination.

This also suggests that in any regional trade agreements scheming to achieve emissions reductions, discrimination should be targeted in a combined border based system reflecting differential emissions intensities across supplying countries. If one region with a range of

higher emissions intensities by product trades with other region with a range of low emissions intensities, and all in the region take on significant carbon emissions commitments, rather than having common external trade barriers against non-participants, and zero barriers within the region, they should use a gradation of third country barriers. There would be both in region and across third country barriers which are more preferential within the region and less preferential outside the region, with discrimination among suppliers to the region from outside. Thus, in the carbon case, what is at issue are not common external trade barriers against third parties, and zero barriers within regions, as in conventional customs union and free trade area literature , but different gradations of barriers within and without which focus on correction for differential severity of externality inflicted damage through trade measures.

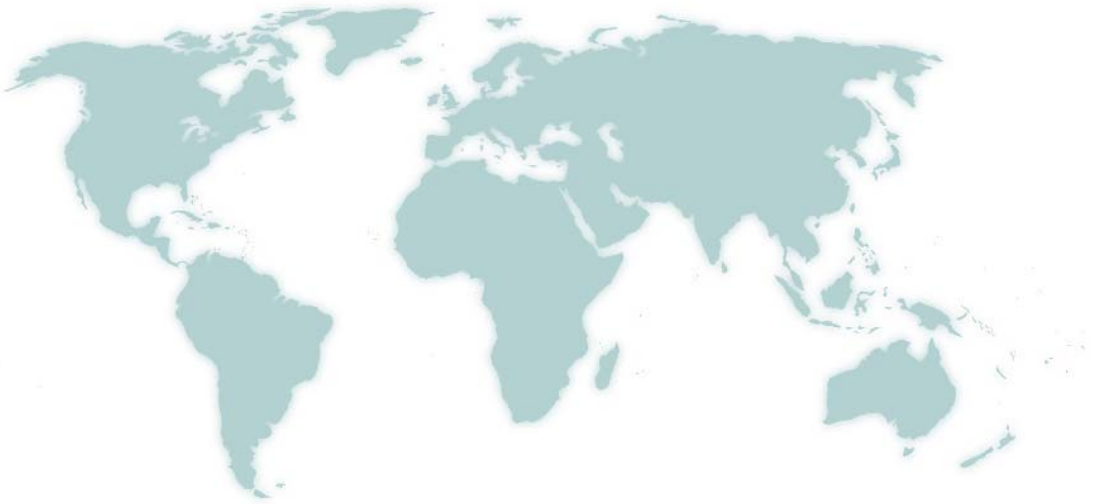

Table 1: Emission Intensity by Country by Product – Embodied (Direct + Indirect) CO2 Emissions per US Dollar of GDP by Country by Industry –Kg CO2 per US Dollar of GDP (1995)

INDUSTRY	AUSTR-IALIA	CANADA	CZECH REP	DEN-MARK	FIN-LIND	FRANCE	GER-MANY	GREECE	HUN-GARY	ITALY	JAPAN	KOREA
Agriculture, etc.	0.6	0.7	1.5	0.6	0.4	0.2	0.3	0.5	0.9	0.3	0.3	0.4
Mining, Extraction, Refining	1.0	1.8	2.1	1.0	1.5	1.0	1.1	1.9	3.1	0.6	0.9	1.1
Food, Beverages, Tobacco	0.6	0.4	1.3	0.5	0.5	0.2	0.3	0.5	0.9	0.3	0.2	0.4
Textiles, Leather, Footwear	0.5	0.3	1.3	0.4	0.4	0.2	0.4	0.5	0.7	0.3	0.2	0.6
Wood, Products of wood, & Cork	0.5	0.5	1.3	0.3	0.5	0.2	0.2	0.7	0.9	0.2	0.2	0.5
Pulp, Paper Printing, and Publishing	0.5	0.8	1.5	0.2	0.7	0.2	0.3	0.8	0.8	0.3	0.2	0.6
Chemicals	1.0	1.6	2.2	0.4	0.9	0.5	0.6	0.9	1.8	0.7	0.5	1.3
Other Non-Metallic Mineral	1.6	1.2	3.2	1.1	1.7	0.6	0.7	4.3	2.7	0.8	0.6	1.5
Iron & Steel	2.3	1.6	4.1	0.8	2.1	1.5	1.1	2.9	3.0	0.9	0.9	1.2
Non-Ferrous Metals	3.0	n/a	2.0	0.3	1.0	0.5	n/a	n/a	n/a	n/a	0.7	1.5
Other Metal Products, Machinery Eqpt	0.7	0.5	1.5	0.3	0.3	0.2	0.3	1.4	0.5	0.3	0.1	0.4
Motor Vehicles, Trains, Ships Planes.	0.6	0.7	1.3	0.4	0.4	0.2	0.3	0.3	0.4	0.3	0.3	0.5
Other Manufacturing & Recycling	0.5	0.7	n/a	0.3	0.4	0.3	0.3	1.0	0.7	0.3	0.2	0.8
Electricity, Gas, Water	9.0	4.4	10.7	6.3	4.4	0.5	3.3	7.0	8.4	2.2	1.7	4.9

(Table 1 continued)

INDUSTRY	NETHER-LAND	NOR-WAY	NEW Z'LAND	PO-LAND	SPAIN	SWEDEN	UK	US	BRAZIL	INDIA	CHINA	RUSSIA
Agriculture, etc.	0.7	0.2	0.5	1.9	0.3	0.4	0.3	**0.5**	0.3	**0.7**	**1.3**	1.9
Mining, Extraction, Refining	1.2	0.9	0.5	3.0	1.6	1.0	0.9	**1.9**	0.7	**2.9**	**4.5**	1.5
Food, Beverages, Tobacco	0.4	0.2	0.3	1.7	0.4	0.4	0.4	**0.5**	0.3	**1.2**	**1.8**	1.7
Textiles, Leather, Footwear	0.3	0.3	0.2	1.6	0.4	0.3	0.4	**0.5**	0.2	**2.2**	**1.7**	*n/a*
Wood, Products of wood, & Cork	0.2	0.2	0.3	2.2	0.3	0.4	0.3	**0.5**	0.2	**1.0**	**2.5**	3.0
Pulp, Paper Printing, and Publishing	0.2	0.2	0.2	1.8	0.4	0.7	0.3	**0.4**	0.4	**3.1**	**3.0**	*n/a*
Chemicals	0.8	1.3	0.6	3.2	0.8	0.8	0.7	**1.0**	0.7	**3.9**	**4.9**	6.6
Other Non-Metallic Mineral	0.6	0.2	0.8	4.4	1.0	0.7	0.7	**1.3**	1.0	**6.9**	**6.1**	5.8
Iron & Steel	1.4	1.5	2.3	5.1	1.1	0.8	1.6	**1.6**	1.7	**9.2**	**9.2**	10.1
Non-Ferrous Metals	*n/a*	*n/a*	0.6	*n/a*	*n/a*	*n/a)*	0.8	**0.9**	1.0	**3.2**	**4.9**	2.9
Other Metal Products, Machinery Eqpt	0.3	0.4	0.3	2.2	0.4	0.4	0.4	**0.4**	0.4	**3.4**	**2.9**	3.4
Motor Vehicles, Trains, Ships Planes.	0.3	0.3	0.3	2.0	0.4	0.3	0.3	**0.4**	0.4	**4.9**	**3.0**	n/a
Other Manufacturing & Recycling	0.3	1.0	0.2	1.6	0.4	0.4	0.4	**0.3**	0.3	**4.3**	**2.4**	2.2
Electricity, Gas, Water	3.2	0.9	0.1	18.0	3.1	1.3	4.1	**6.8**	0.4	**21.0**	**24.2**	19.4

Source: Ahmad N. and A. Wyckoff (2003), "*Carbon Dioxide Emissions Embodied in International Trade of Goods*", OECD Science, Technology and Industry Working Papers. with No. 2003/15.

3. Possible Carbon Motivated Regional Trade Agreements

The uses of trade policies to support emissions reduction initiatives cover not only unilateral actions individually by countries, but also joint actions by groups of countries. Such arrangements typically centre on three distinct forms, each reflecting different objectives for trade policies. One involves lowering trade barriers on both low carbon products and products central to low carbon new technologies as well as products that are inputs to low carbon processes. The aim is to change the composition of trade in ways which lower global carbon emissions. Here given differences in emissions intensities by country, country discrimination may also enter.

Another use of trade policies is as a protective device to provide offsets to domestic producers adversely affected relative to foreign competition by the cost implications of own country emissions reduction initiatives. A third uses trade policies as a sanctioning mechanism against other countries in an effort to force them to adopt emission reduction initiatives comparable to own country or within group actions. The last of these is typically to be employed by a sub group of countries rather than on a single country basis.

As far as own country actions are involved two issues arise. The first is the potential effectiveness of new trade policy preferences towards low carbon products. If these were designed to be WTO compatible they would involve product selective non discriminatory reductions in tariff rates among partners to agreements, more so than tariff rate increases. Here the key determinations of effectiveness are the preexisting dispersion in tariff rates across the high-low carbon divide, and the differences in carbon intensity by product or sector.

The WTO compatibility of such arrangements raises two key issues. The first is that they would need to be non discriminatory, and selective actions against high emitting countries would be ruled out. The second concerns WTO provisions regarding regional agreements under Article 24 of GATT (1994). Even though Article 24 disciplines are notoriously lax in their application, they do require that regional agreements cover substantially all trade, and not the sector or product specific. A case could be made that Article 20 exceptions which justify trade measures that deal with threats to animals, humans or plant life would provide WTO cover given damage from global warming. But Article 24 would seemingly mean that carbon motivated regional arrangements to be GATT / WTO comparable would best be additions to or extensions of existing regional agreements, rather those de novo arrangements.

One clear weakness in using refocused WTO compatible tariff structures reoriented towards low carbon products to achieve significant impacts on emissions is that tariff rates on most major industrial products are already low in the OECD countries and also bound in preexisting WTO commitments. Table 2 reports both bound and MFN applied tariff rates by product by

country from WTO Tariff Profiles 2006 data. Higher rates are in clothing and textiles, and (in Australia and New Zealand) transport equipment. Also the largest sources of emissions lie in the power generation and transportation sectors, which do not correspond to traded products as in national tariff schedules.

In Table 3, data for the EU also suggest that 50% of carbon emissions occur in power generation, transportation, steel, aluminum and cement. These sectors then are used to produce items which are traded and discrimination in tariff rates among traded goods may yield less discrimination among emissions intensities.

Outside of these sectors, the highest OECD tariffs remain in clothing and textiles, and they are also heavily produced outside of the OECD and so production effects of OECD tariffs are correspondingly reduced. This all suggests that the room for achieving significant emissions reductions using WTO comparable low carbon regional tariff reductions may be limited.

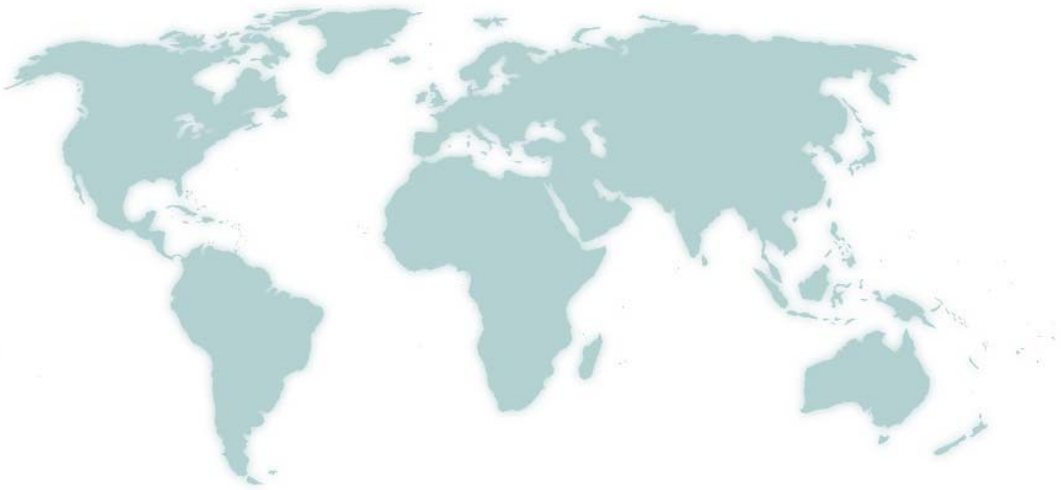

Table 2: Non Agricultural Product Tariff Rates in OECD Countries for 2006 (%)

		Fish & fish products	Minerals metals	Petro-leum	Chemi-cals	wood, paper, etc	Tex-tiles	Cloth-ing	Leather, footwear, etc.	Non-electrical machinery	Electrical machinery	Transport equipment	Manu-fatures, n.e.s
Australia	Final Bound	0.8	6.7	0.0	9.0	7.0	18.3	41.1	14.4	8.2	10.3	12.6	6.3
	MFN applied	0.0	2.7	0.0	1.8	3.4	6.8	15.4	5.6	3.0	3.0	6.2	1.4
Canada	Final Bound	1.2	2.7	6.9	4.4	1.4	10.6	17.2	7.6	3.4	4.3	5.6	4.0
	MFN applied	1.0	1.7	2.7	2.8	1.1	6.9	17.0	5.6	1.5	2.4	5.8	2.8
EU	Final Bound	11.2	2.0	2.0	4.6	0.9	6.5	11.5	4.2	1.7	2.4	4.1	2.5
	MFN applied	10.3	1.9	2.7	4.6	1.1	6.6	11.5	4.2	1.7	2.5	4.1	2.4
Japan	Final Bound	5.0	1.0	76.1	2.0	0.9	5.4	9.2	17.7	0.0	0.2	0.0	1.0
	MFN applied	5.7	1.0	0.7	2.5	0.9	5.5	9.2	15.0	0.0	0.2	0.0	1.1
Korea	Final Bound	15.0	7.6	12.3	5.8	2.8	15.9	28.3	12.2	9.5	9.0	8.2	10.1
	MFN applied	16.1	4.8	5.1	5.8	2.4	9.2	12.6	7.9	6.0	6.0	5.4	6.4
New Zealand	Final Bound	1.7	8.6	2.9	4.1	4.9	10.5	32.6	16.5	15.1	11.4	15.6	10.2
	MFN applied	0.6	2.2	0.3	1.0	1.6	3.0	16.2	4.8	4.1	3.4	4.6	2.3
USA	Final Bound	1.2	1.7	7.3	2.9	0.4	7.7	11.4	4.6	1.2	1.6	3.1	2.2
	MFN applied	1.1	1.7	2.1	2.8	0.4	7.9	11.5	4.3	1.2	1.7	3.1	2.1

Source: World Tariff Profiles 2006, WTO 2007.

In the Doha Round WTO negotiations, there has been a side negotiation underway on tariff liberalization in environmentally sensitive goods and services (ICTSD, 2007). It has, however, become embodied in definition of problems as to what constitutes an environmental goods or service. An indicative list of 43 such goods (including windmills and bicycles) from the US has circulated in Geneva. This has, however been opposed by several countries for not including key potential exports by them of what they regard as environmental goods. A key area is ethanol exports by Brazil to the EU for which the effective tariff rate on what the EU regard as in agricultural good not an environmental good is around 70%. This case highlights the definitional problems as to what environmental goods and services actually are. In the later stages of the Doha negotiations, Brazil went so far as to suggest a request and offer basic negotiation on nomenclature as a way of reaching agreements on definition of such goods (Mahesh, 2004).

Table 4 reports World Bank data on maximum and applied tariff rates on the same 43 select climate friendly product and technologies across both high and low income countries. High-income WTO members already have low tariff rates on these items, and while low and middle income WTO members higher tariff rates on these goods and technologies and these is little trade in these among them. Trade liberalization in developing countries will give countries access to these technologies and reduce global emissions, but the starting point in terms of trade volumes is low. Tariff reductions on products that are inputs to low carbon process will also contribute to emissions reductions, but again among developing countries, such trade is small. There are isolated large barriers which offer potentially larger effects, such as in Brazil, as data from Wikipedia, where bioelectricity from sugarcane currently accounts for 4% of Brazilian electricity use and is expected to reach 15% by 2015 and the EU tariff on ethanol is high. As noted above, this has been excluded from the WTO EGS negotiation on the grounds that sugarcane is an agricultural product, not an environmental good and has been sharply contested by Brazil.

That large portion of emissions are associated with a small number of high emitting sectors where outputs are little traded directly, but traded indirectly embodied in produced goods is a father central difficulty for carbon motivated regional trade initiatives. Table 3 reports data on emissions by sector by country that suggest that power generation is the largest of these (accounting for nearly 50% of emissions in some OECD countries), and transportation is the second (25% in some countries),also iron and steel, and extractive industries. Also, as Table 1 suggests, among traded higher stage fabricated products, the differences in direct emissions intensity are relatively small compared the differences across production of basic commodities (electricity, steel, etc). This seemingly greatly weakens the potential impacts on emissions of any WTO compatible tariff based measures.

Table3: Direct CO2 Emissions from Fossil Fuel Combustion by Sector as a Percentage of Total Emissions by Country (1995)

(% of country totals)

INDUSTRY	AUSTRALIA	CANADA	CZECH REP	DENMARK	FINLAND	FRANCE	GERMANY	GREECE	HUNGARY	ITALY	JAPAN	KOREA
Agriculture, etc.	1.4	2.0	2.6	3.9	3.1	2.4	0.7	3.8	2.9	2.0	3.0	2.2
Mining, Extraction, Refining	**6.6**	**12.7**	**1.8**	**4.0**	**3.1**	**5.4**	**3.6**	**3.6**	**3.8**	**4.7**	**5.1**	**2.9**
Food, Beverages, Tobacco	1.1	0.0	1.3	2.7	1.1	2.1	1.0	1.3	1.5	1.2	0.7	1.1
Textiles, Leather, Footwear	0.2	0.0	1.0	0.1	0.2	0.4	0.2	0.5	0.2	0.9	0.6	1.4
Wood, Products of wood, & Cork	0.1	0.2	0.2	0.1	0.7	0.0	0.1	0.0	0.1	0.0	0.0	0.1
Pulp, Paper Printing, and Publishing	0.6	2.4	0.9	0.3	5.3	1.3	0.9	0.3	0.4	0.9	1.4	1.1
Chemicals	1.5	4.2	1.7	0.6	2.0	5.8	4.3	0.5	3.8	5.8	3.5	5.6
Other Non-Metallic Mineral	1.8	0.8	2.7	2.7	3.7	2.4	2.4	6.1	2.6	4.8	3.2	4.7
Iron & Steel	**3.6**	**2.9**	**8.9**	**0.2**	**6.7**	**5.5**	**3.7**	**0.5**	**3.5**	**3.4**	**6.5**	**1.3**
Non-Ferrous Metals	4.6	0.6	0.1	0. 0	0.2	0.5	0.3	1.6	0.4	0.2	0.6	0.2
Other Metal Products, Machinery Eqpt	0.2	0.0	1.3	0.7	0.5	1.3	0.8	0.0	0.7	1.6	0.8	0.7
Motor Vehicles, Trains, Ships Planes.	0.1	0.0	0.5	0.1	0.2	0.1	0.4	0.0	0.2	0.0	0.0	0.4
Other Manufacturing & Recycling	0.0	4.2	8.8	0.4	0.1	2.2	0.5	1.1	0.1	0.5	3.2	2.8
Electricity, Gas, Water	**46.4**	**21.5**	**41.8**	**51.9**	**36.0**	**5.4**	**32.3**	**49.8**	**41.0**	**25.7**	**28.6**	**20.9**
Total Industrial Production	**68.3**	**51.5**	**73.5**	**67.8**	**62.9**	**34.6**	**51.4**	**69.0**	**61.3**	**51.8**	**57.4**	**45.3**
Construction	1.1	0.6	1.6	0.8	0.2	0.7	0.3	0.1	0.1	0.1	1.5	0.3
Transport Use	**24.1**	**29.3**	**6.0**	**20.5**	**20.3**	**35.4**	**19.5**	**23.1**	**14.8**	**26.1**	**21.4**	**21.5**
Non-Transport Services	1.2	7.6	2.0	1.6	0.1	9.3	5.7	0.8	7.1	0.0	6.0	12.4
Non-Transport Residential	2.3	8.9	9.0	8.5	11.0	14.8	14.8	6.3	14.4	17.0	6.6	5.7
Auto-Producers Non-Specified	1.7	0.9	5.3	0.7	4.3	4.5	6.7	0.6	1.1	4.3	6.3	12.5
Other Non-Specified	**1.4**	**1.2**	**2.5**	**0.1**	**1.2**	**0.7**	**1.7**	**0.2**	**1.3**	**0.8**	**0.9**	**2.3**

(Table3 continued)

INDUSTRY	NETHER LANDS	NEW Z'LAND	NOR WAY	PO LAND	SPAIN	SWE DEN	UK	US	BRA ZIL	IN DIA	CHI NA	RU SSIA	WO RLD
Agriculture, etc.	5.4	2.6	6.0	4.0	2.3	2.8	0.5	**0.9**	5.3	0.2	**2.7**	1.4	**1.9**
Mining, Extraction, Refining	**9.2**	**5.1**	**36.4**	**4.2**	**5.9**	**4.3**	**7.3**	**5.0**	**8.5**	**3.0**	**5.1**	**3.3**	**5.6**
Food, Beverages, Tobacco	1.8	0.3	1.4	2.4	1.9	1.5	1.4	**1.0**	1.7	0.4	**2.0**	0.5	**1.1**
Textiles, Leather, Footwear	0.2	0.0	0.1	0.7	0.8	0.2	0.4	**0.2**	0.6	0.9	**1.3**	0.0	**0.6**
Wood, Products of wood, & Cork	0.0	0.0	0.2	0.3	0.1	0.2	0.0	**0.2**	0.0	0.0	**0.2**	0.1	**0.1**
Pulp, Paper Printing, and Publishing	0.5	0.0	2.0	0.7	1.1	3.2	1.0	**0.9**	1.5	0.8	**1.0**	0.0	**0.9**
Chemicals	8.6	7.7	4.3	3.6	4.7	3.8	3.5	**3.2**	6.4	5.3	**6.2**	2.7	**4.5**
Other Non-Metallic Mineral	1.0	0.0	3.4	3.2	5.0	2.2	1.1	**1.1**	3.7	3.9	**8.5**	0.9	**3.0**
Iron & Steel	**3.5**	**5.8**	**7.3**	**5.2**	**3.7**	**5.4**	**2.9**	**1.6**	**8.8**	**10.6**	**9.3**	**6.5**	**4.7**
Non-Ferrous Metals	0.1	0.0	0.6	0.4	0.4	0.5	0.3	**0.4**	2.2	0.1	**0.9**	0.7	**0.5**
Other Metal Products, Machinery Eqpt	0.6	0.0	0.4	0.9	0.5	0.8	0.6	**0.5**	0.0	0.2	**1.9**	0.4	**0.7**
Motor Vehicles, Trains, Ships Planes.	0.1	0.0	0.2	0.4	0.4	0.5	0.5	**0.3**	0.0	0.0	**0.5**	0.0	**0.2**
Other Manufacturing & Recycling	0.2	12.6	0.1	0.0	0.6	1.1	1.6	**0.2**	1.9	8.2	**1.0**	0.4	**0.4**
Electricity, Gas, Water	**26.4**	**11.3**	**0.6**	**47.5**	**28.9**	**15.0**	**32.8**	**36.7**	**3.8**	**40.2**	**38.6**	**34.7**	**32.1**
Total Industrial Production	**57.7**	**45.5**	**62.7**	**73.5**	**56.2**	**41.6**	**53.9**	**52.3**	**44.4**	**73.7**	**79.1**	**51.8**	**56.2**
Construction	0.4	1.0	0.3	0.3	0.1	0.0	0.4	**0.0**	0.0	0.0	**0.4**	0.2	**0.4**
Transport Use	**16.9**	**43.9**	**36.6**	**6.9**	**31.0**	**40.5**	**23.5**	**29.6**	**43.2**	**13.3**	**5.8**	**12.7**	**20.2**
Non-Transport Services	1.6	5.2	3.0	2.0	2.2	7.1	4.6	**4.2**	1.2	0.0	**2.0**	0.6	**3.2**
Non-Transport Residential	11.8	1.8	3.0	12.6	5.9	7.9	14.2	**6.9**	6.4	6.0	**9.0**	9.3	**8.8**
Auto-Producers Non-Specified	3.2	1.5	0.8	4.3	3.1	2.0	1.4	**5.8**	2.6	6.3	**0.7**	24.2	**9.7**
Other Non-Specified	8.4	1.0	-6.3	0.5	1.6	0.8	1.9	**1.3**	2.3	0.6	**2.9**	1.1	**1.1**

Source: Ahmad N. and A. Wyckoff (2003), "*Carbon Dioxide Emissions Embodied in International Trade of Goods*", OECD Science, Technology and Industry Working Papers.

Finally and as already noted in Table 1, we return to the point that there are considerably larger differences in emissions intensities between countries (and even across regions within countries) than there are across sectors or products produced within countries. As we note above, this suggests potentially sharp differentiation in tariff rates across supplying countries for any use of trade policies that is to be effective in reducing carbon emissions. Accompanying these would be considerably more complex rules of origin than currently used in existing regional agreements.

The central problems however ,with this latter approach is that it is diametrically opposed to the central principle of MFN/ non discrimination in Article 1 of GATT 1944, the key element in the charter of the WTO. As such, there is seemingly a central and critical conflict between the idea of using non discrimination (MFN) in trade arrangements in the WTO to spread the benefits of any bilaterally negotiated trade liberalization more broadly across all countries, and more costly country discrimination in trade, as an objective of global environmental policies. If the latter aim to internalize external effects, and if the country of the original source of damage associated with the externality differs greatly across countries, seemingly on global efficiency grounds discrimination by country seems called for. Remedying location varying externalities through geographically discriminatory measures thus might seem logical to environmental economists, but the idea also strikes at the heart of the post war GATT/WTO based trading system which is so close to the heart of trade economists.

Turning to group wide uses of trade policies to support emissions reductions initiatives, there are a variety of potential forms that carbon motivated free trade area or regional arrangements could be. These range across the different forms and permutations.

One idea which has attracted recent attention is that either existing or newly negotiated bilateral or regional trade arrangements directly reflect emissions reduction objectives shared by pairs of countries or groups of countries in the agreements reached. A recent Chatham House study (Lee & Froggatt, 2007) proposed a version of this idea, when discussing a possible EU-China bilateral agreement. The Chatham House explicitly suggests the use of trade preferences in favor of low carbon products in such an agreement, with the objective of lowering emissions from the two participating entities by encouraging switching of both production and consumption in the two countries into relatively low carbon products. Whether or not global emissions necessarily fall as a result of such agreements is, however, not clear as it depends on the relative emissions intensities of productions inside and outside of the regional agreement countries. Some existing free trade agreements already have added environmental context, such as in US-Chile free trade agreements, which include elimination of tariff and non-tariff barriers on environmental goods and services (USTR,2003) , and NAFTA which has special dispute settlement rules for environmental cases, and establishes a trilateral US-Mexico-Canada

commission to evaluate environmental impacts of the agreement. The latter arrangements are not climate change focused however.

This discussion of carbon free trade agreements therefore focuses on possible ways in which regional trade agreements can contribute directly to emissions reduction through changes in the composition of trade among member countries in such agreements. They would potentially depart from classical free trade areas as simply zero tariffs within a geographical zone, by using product specific arrangements which embody larger or tiered preferences toward low carbon products as a way of encouraging both consumption and productions switching towards low emission products.

It is generally thought that these types of carbon free trade agreements would be relatively easy to implement as an overlay on existing customs unions/ free trade areas since they would basically depart from conventional arrangements only by using product specific low carbon tariff rates. There is the added issue of potential new and more complex rules of origin which would be involved, but such agreements are believed to be easily negotiable. It is their effectiveness that is the more central issue.

Table 4: World Bank Data on Maximum and Applied Tariff Rates on 43 Climate-Friendly Products and Technologies

HS Code	Product Description	Low- and Middle-Income WTO Members		High -Income WTO Members	
		Maximum Average Bound Tariffs	Average Applied Tariff Rates	Maximum Average Bound Tariffs	Average Applied Tariff Rates
392010	PVC or polyethylene plastic membrane systems to provide and impermeable base for landfill sites and protect soil under gas stations , oil refineries, etc. from infiltration by pollutants and for reinforcement of soil	30	13	15	5
560314	Nonwovens, whether or not impregnated, coated, covered or laminated: of manmade filaments; weighing more than 150 g/m^2 for filtering wastewater	33	14	16	4
701931	Thin sheet (voiles), webs, mats, mattresses, boards, and similar nonwoven products.	34	13	17	4
730820	Towers and lattice masts for wind turbine	28	10	16	3
730900	Containers of any material, of any form, for liquid or solid waste, including for municipal or dangerous waste	32	12	17	4
732111	Solar driven stoves, ranges, grates, cookers(including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances and parts thereof, of iron or steel	36	18	15	5
732190	Stoves, ranges, grates, cookers(including those with subsidiary boilers for central heating),barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel-Parts	36	14	15	4
732490	Water saving shower	28	19	17	4
761100	Aluminum reservoirs, tanks, vats and similar containers for any material (specifically tanks or vats for anaerobic	31	11	16	4

	digesters for biomass gasification)				
761290	Containers of any material, of any form, for liquid or solid waste, including for municipal or dangerous waste	31	13	14	4
840219	Vapor generating boilers, not elsewhere specified or included hybrid	24	5	15	4
840290	Super-heated water boilers and parts of steam generating boilers	21	5	15	4
840410	Auxiliary plant for steam, water, and central boiler	25	5	15	3
840490	Parts for auxiliary plant for boilers, condensers for steam, vapor power unit	25	4	16	3
840510	Producer gas or water gas generators, wit or without purifiers	24	5	13	2
840681	Turbines, steam and other vapor, over 40 MW, not elsewhere specified or included	28	5	13	3
841011	Hydraulic turbines and water wheels of a power not exceeding 1,000 kW	24	4	15	3
841090	Hydraulic turbines and water wheels of; parts, including regulators	24	4	15	3
841181	Gas turbines of a power not exceeding 5,000 kW	20	5	13	2
841182	Gas turbines of a power exceeding 5,000kW	20	5	13	2
841581	Compression type refrigerating, freezing equipment incorporating a valve for reversal of cooling/heating cycles (reverse heat pumps)	29	13	16	4
841861	Compression type refrigerating, freezing equipment incorporating a valve for reversal of cooling/heating cycles (reverse heat pumps)	21	7	17	4
841869	Compression type refrigerating, freezing equipment incorporating a valve for reversal of cooling/heating cycles (reverse heat pumps)	21	7	16	4
841919	Solar boiler (water heater)	27	10	17	4
841940	Distilling or rectifying plant	23	4	15	3
841950	Solar collector and solar sy6stem controller, heat exchanger	24	5	15	3
841989	Machinery, 8plant or laboratory equipment whether or not electrically heated (excluding furnaces, ovens etc.) for treatment of materials by a process involving a change of temperature such a heating, cooking, roasting, distilling, rectifying, sterilizing, steaming, drying, evaporating, vaporizing, condensing or cooling.	25	6	12	3
841990	Medical, surgical or laboratory stabilizers	24	6	12	2
848340	Gears and gearing and other speed changers (specifically for wind turbines)	22	8	16	3
848360	Clutches and universal joints (specifically for wind turbines)	23	9	15	3
850161	AC generators not exceeding 75kVA (specifically for all electricity generating renewable energy plants)	27	7	15	3
850162	AC generators exceeding 75kVA but not 375 kVA(specifically for all electricity generating renewable energy plants)	26	7	16	3
850163	AC generators exceeding 75kVA but not 375 kVA(specifically for all electricity generating renewable energy plants)	26	5	16	3
850164	AC generators exceeding 750kVA (specifically for all electricity generating renewable energy plants)	28	5	16	3
850231	Electric generating sets and rotary converters; wind-powered	26	5	16	3
850680	Fuel cells use hydrogen or hydrogen-containing fuels such as methane to produce an electric current, through an electrochemical process rather than combustion	25	18	16	3
850720	Other lead acid accumulators	24	16	16	5
853710	Photovoltaic system controller	26	10	17	3
854140	Photosensitive semiconductor devices, including	21	4	9	1

	photovoltaic cells whether or not assembled in modules or made up into panels; light-emitting diodes				
900190	Mirrors of other that glass (specifically for solar concentrator systems)	30	7	16	3
900290	Mirrors of glass (specifically for solar concentrator systems)	29	12	18	3
903210	Thermostats	33	7	14	3
903220	Manostats	33	6	13	2

Source: World Bank (2008) *International Trade and Climate Change*, Washington, DC

A second type of carbon free trade agreement would go farther by also embodying offsets to the perceived anti-competitive effects potentially generated against domestic producers from significant carbon emissions reductions .The issue is the cost increases they face from own country emissions reductions relative to smaller impacts abroad if others do not match the emissions reductions. This issue has come up centrally in the European debate on unilateral European emissions reductions, and is further discussed in Ismer & Neuhoff (2007), and Lockwood & Whalley(2008).

In the EU case it has been not only the prospective use of carbon emission reductions in a single region not matched by other countries but also the prospective changes post 2012 in the European Carbon Emissions Trading Scheme with less dependence on cap and trade arrangements and more reliance on auctioning of emissions quotas. Under a cap and trade scheme, existing products receive agreed allocations of quota and must buy more. Under quota auctions they must buy the full amount. A related concern in such arrangements is also to reduce carbon leakage effects through potentially increased emissions by non participants.

The offsets proposals take the form of border tax adjustments and as noted by Lockwood & Whalley (2008) there are two ways those that have been advanced to offset the leakage and cost effects involved. One is that imported goods would be taxed at the border in ways which reflect the cost of the emissions trading were they to be produced in the home market they are entering. This would involve border tax adjustments between countries. Another alternative approach to BTAs which has been suggested is to use tax equivalents based on enforcement of emissions allowance trading for all importers. US debate has focused on this approach. Under this, any importer of products would need to buy emissions rights domestically to meet required offsets, and exporters could sell some of their emissions permits acquired for production to gain offset.

These schemes however, face a number of issues. At a conceptual level, a key issue is whether such border adjustments would have the offsetting effects which are claimed in the proposals made. It has long been argued in analytical literature on border tax adjustments at the time of the introduction of the value added tax in Europe going back to the late 1960's and

early 1970's, that in a uniform tax case no effects on trade will be generated from such measures. If imports are taxed while exports receive equal rate tax rebates, there would be no real effects from such measures because they would simply induce changes in exchange rates or price levels which would offset the border tax adjustments. Put another way, a border tax adjustment is simply a movement between a consumption to a production based tax and vice versa and has no effects on relative prices and hence no real effects on trade or production. Hence there is a need to clearly specify what the potential offset effects actually might be in practice from such arrangements.

Also, and as emphasized in Lockwood & Whalley (2008), the motivation for such border measures should be seen as a separate matter from the impacts of the measures themselves. Thus, the motivation for the use of border measures should be put on one side once the impacts of such measures become the issue since their impacts on trade are independently of the motivation. As Lockwood & Whalley (2008) also note, such border adjustments could also be rationalized based on differences in labor costs, labor standards or other policy elements.

There is also the issue of the administrative complexity of implementing such measures. Calculating the carbon content involved in products is difficult. Not only is there the direct carbon content of production involved, but also the indirect carbon content – the amount of carbon involved in producing the steel which goes into a car. Equally problematic is that international sourcing involves products which have components with origins in multiple countries. Indeed, in many production processes within countries component origins are often not kept track of in detailed ways and this makes the calculation of carbon content even more difficult. Rules of origin associated with such arrangements would thus be complex and considerably more difficult to administer than rules of origin in conventional trade arrangements.

On top of these complications, the form of such arrangements is a further issue since different countries may be adopting emission reductions commitments at different speeds and in different ways. Country discrimination in such agreements becomes difficult to calculate and administer if they involve groups of countries who are going farther and faster than other countries in their emissions reduction commitments. And if the border tax adjustments being discussed in the EU are instead applied by groups of countries, the structure would no longer be one of complete free trade between integrating members and common external barriers towards third parties as in a customs union or a free trade area. Instead a gradation of trade arrangements, both among members within countries and members outside would seemingly be needed .These would involve differentiated trade preferences based on different carbon reduction commitments and varying carbon contents of production by county. These arrangements thus would face many difficulties in implementation, which would also complicate assessment of

their impacts and add to administrative complexity.

A third type of carbon free trade arrangement would revolve around groups of countries who jointly commit to emissions reductions ,but who either threaten or actually discriminatorily use trade arrangements as a penalty mechanism against non-participants to force them to join in the emissions reduction. As mentioned earlier, this is the structure embodied in the 1987 Montreal Protocol, which involves the use of trade barrier threats to force non signatories to the agreement to eliminate use and production of hydro carbons and other ozone depleting substances to join the original agreements struck by a sub coalition of countries (Werksman, 2006).

Here, there are difficulties with the potential size of penalties which might be required, as well as that their penalties would likely violate tariff bindings in the WTO, This would seemingly inevitably occur in some arrangements if the threats were to be strong enough to enforce compliance by heavy and large emitters such as India and China. Under this type of carbon free trade agreement the conflicts between environmental arrangements using trade policies and the existing WTO commitments embodied in preexisting trade policy structure would be greatly elevated.

Who would be involved in such arrangements is also a central issue, especially as the major differences in global environmental negotiations is now lying between the OECD and the rapidly growing large population low wage economies (Brazil, China, and India) who took no commitments under Kyoto and who were granted special treatment under the principle of Common But Differentiated Responsibilities. Lack of satisfactory progress in global climate change negotiations could thus well fuel the pressures for trade action across the same decade.

This then indicates the types of trade arrangements that might be involved in the form of regional trade initiatives undertaken in the name of supporting significant carbon emission reductions. They range from WTO compatible low carbon product trade pacts, to country discrimination that would undermine the MFN non discrimination in the WTO, and from cooperative offset mechanism to unilateral commitments. Trade policy sanctions by groups of countries or parties in agreements could also be used to force compliance by non participants. The growing links between global climate change and trade arrangements would seemingly likely intensify with increasing severity of climate related damage.

4. Potential Impacts and Systemic Implications of Carbon Motivated Trade Policies

What are potential impacts of carbon motivated trade policies on emission levels, and how significant might they be? What is the size of the potential barriers involved? Are there potential reversals of trade flows and what would be the impact generally on global trade flows? Would the trade threats involved be strong enough to induce environmental compliance by major entities? And how might the trading system evolve under a scenario of growing severity of climate related damage?

On the emissions front, the general presumption as noted earlier is that growth has seemingly much more impact on emission levels than trade, and it is the level of trade more so than the composition of trade that matters. For carbon free trade areas of the first type, involving tariff preferences towards low carbon intensive products, there could be some reductions in emission levels, but these effects would likely to be small. And even the sign of the effect is ambiguous.

An important variable in determining the emissions outcome is the relative emissions intensity of production in these industrialized products (characterized as low carbon) across third countries outside of the agreement and those countries within the agreement. If third countries have lower emissions levels in production then members of the regional agreement with trade diversion effect away from third parties , it is possible that emissions levels could rise as a result of the agreement, even though low carbon trade within there countries (and consumption and production) is stimulated. If more emission intensive production inside the region displaces lower emission intensive production outside the region, emission levels will still be high, even though there is more consumption and production globally of low carbon intensive productions. Hence impacts of regional agreements on emissions are not clear.

The effects on emissions can also be influenced by the reactions of those outside the agreement. If third countries with lower emission intensive production join the carbon motivated FTA to gain market access, or relocate plants from outside the region to inside the region, and in the process produce with lower emissions levels than original members and regain market share, emission levels can fall due to these effects. Thus investment diversion effects can make carbon motivated FTA's emissions reducing. The net effect of all these possibilities will require numerical simulation analysis to get exact estimates of possible net effects, or export decomposition to separate out FTA influences from other changes impacting trading relationship.

With the second form of regional agreement where there is use of border measures for offsets to anti-competitive effects on domestic producers, again the relative emissions intensity

of production inside and outside the region will be important assuming that real effects occur. Lockwood & Whalley(2008) have recently discussed carbon motivated border tax adjustments in light of earlier border tax literature on the value added tax in Europe in the 1960s (see Krauss & Johnson(1972), Shibata(1967), and Whalley (1979)). They note the earlier emphasis on neutrality of border tax changes and discuss scenarios under which similar outcomes could occur with carbon motivated border adjustments. They highlight the need to separately consider price level and relative price effect like more broadly border adjustments occur.

Similar considerations come into play in appraising the possible effects of threat driven agreements. Again strategic response matters. If countries with higher emission levels are not induced to join the agreement then increases in emissions can occur. One also needs to consider the combined effects of the three kinds of carbon motivated regional trade agreements, when carbons FTAs are designed as penalty mechanisms. If they induce high emission countries to join the agreement, then they can tend to reduce global emissions.

Finally, there is also the size of the threatened measures involved under the third type of regional carbon motivated trade measures that might be needed to induce compliance. There has been speculation that for larger economies such as India and China, who are rapidly growing and have large internal markets, that the potential costs for them of meeting global environmental commitments requested of them could be so large as to dissuade them from participating in environmental agreement and even trade threats pushing them all the way to autarky might not be sufficient to generate their compliance. The severity of the threats involved will depend on the severity of the anticipated damage from elevated global warming, but even if very high trade barriers were in effective to induce compliance, conflicts would inherently intensify on other fronts.

If these forms of carbon motivated regional trade agreements grow over time (say over the next 5-10 years) and if the potential severity of global warming issues is viewed as worsening, trade measures associated with the environmental component of global trade arrangements will also likely grow in profile. Were that to happen, carbon regional agreements could potentially involve large barriers against parties outside them. If carbon prices in the region of 50 or 100 – 200 dollars/ tonne were needed to appropriately price out the global externalities associated with carbon, the barriers involved and also the potential competitive offsets involved with border measures could be very large. The same would be true for threats needed to induce compliance.

As a result, progressively over time, the environmentally based component of global trade arrangements could come to dominate the conventional component of trade policy in terms of relative size. In turn, these heightened trade barriers would increasingly likely generate violations of tariff bindings committed to the WTO under Article 2 and generate a series of

dispute settlement cases in the WTO. The prospect that the levels of the environmentally motivated trade protection could increase sharply over the next few decades is a major difficulty for the WTO rule based trading system, with substantial pressure potentially being placed on the trading system from the quarters in the years ahead.

Another set of issues are the potential trade impacts of such trade policy initiatives. Results from an earlier modeling piece by Piggott, Whalley & Wigle (1993) suggested that significant global emissions commitments could have the effect of sharply reducing global trade volumes. This reflected the relative price effects between energy and other inputs feeding through the global economy onto the price of manufactures and from these to nontrade services given that manufactures are sharply more energy intensive than services. Some of their model simulations showed reductions in the level of world trade in the region of 25% from significant carbon motivated initiatives and their results suggested that global climate initiatives potentially have large impacts on global trade flows. They would operate in the opposite direction to the trade effects of liberalization that have driven the system under the GATT and the WTO since 1947.

Along with changes in trade patterns, the modeling work by Piggott et al also suggested that some large economies, such as Japan which are large exporters of manufactures could become net importers of manufactures due to energy price effects. Their results thus suggest that there could be major impacts on global trading patterns from climate actions taken globally. Not only are trade impacts from high barriers involved, but the impacts applied to global trade flows themselves could reverse the direction of trade in some cases.

A further potential effect of climate motivated trade policy is to fuel linkage of trade policy to other areas and objectives. Since the 1940's trade policy has been viewed generally as a direct and separate policy subsystem, whose objectives were in part to achieve global cooperation to prevent retaliatory closing of the global economy as in the 1930's, and to fuel global growth by progressive move to policy. Only have recently with the debate in the WTO on trade and environment has linkage to non trade areas arisen in a significant way. With climate motivated areas of trade policies, similar issues and uses of trade policy potentially arise in many other areas. Trade policies could be stimulated to offset competitive disadvantages from minimum wages, social programs, tax policies, equality regimes, and many other forms of initiatives. They would be used by regions to force other countries to adopt policies they wish to perceive. Uses of trade policy for emissions reduction thus potentially sharply elevate the strategic interactions among countries, and the actual impacts of polices introduced need to be separated from their motivation.

This discussion of carbon motivated trade policies adopted either unilaterally or by groups of countries also raises issues as to what the future might be for the trading system in a world

where both climate change concerns and physical manifestation of climate change progressively grow over time. Can the GATT/WTO based system of the post war years as we have come to know it survive and continue to operate?

We see the future evolution of the trading system as one where potentially the environmentally motivated component of trade arrangements increasingly acts as an overlay on conventional trade arrangements involving rules and disciplines under the WTO along with growing and spreading regional trade agreements. The growths of the latter have been extensively discussed in recent literature (Whalley, 2008a). Environmental agreements, in turn, are likely to grow in significance and trade interventions motivated by new climate agreements will grow. Under a severe global warming scenario climate related considerations could eventually come to dominate the evolution of the trading system.

In this world, linkage and the interface of trade and the climate then will likely be different from that which has the focus of debate in the WTO for the last 10 – 15 years. The focus has largely been on whether or not countries should have rights to use trade restricting measures on environmental grounds, not the trade implications of environmental measures, most of which would arise from developments operates outside of the framework of the WTO. These developments would trigger disputes within the WTO for violation of tariff bindings, and in this way could become dominant part of global trade debate, but the WTO could not directly control the underlying climate related actions.

If this trend was to occur (and it would likely depend on the severity of climate changes) the prospect would be for global environmental negotiations to progressively grow in profile to the point that they dominated trade negotiations in perceived significance. Trade policy bargaining would then more and more have to take into account links to global environmental negotiations to the point that the present WTO becomes a global bargaining entity which progressively moves beyond trade. As evolution from the WTO to a World Bargaining Organization (as discussed in Whalley (2008b)) could be the outcome.

The size and speed of institutional modification that might be associated with more severe global warming scenarios suggests major global change ahead. Increased use of carbon motivated trade policies may be only one manifestation. The post Doha WTO might evolve as an entity heavily dealing with trade linkage to higher profile climate change. Negotiation in the WTO both in tariff barriers and in MFN could come under pressure to resuspend. The pressure to formally link trade negotiations to higher profile global environmental negotiations could grow.

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