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BORDER CARBON ADJUSTMENTS AND FREE ALLOWANCES IN THE STEEL SECTOR

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This document will be discussed under item 8 of the agenda.

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1 Introduction

1. Border carbon adjustments (BCAs) would apply a tax, or require the equivalent purchase of carbon emission allowances, on the import of products into a market with a carbon price. Rebates could also be applied to exports from this market. When applied as a tax, the mechanism is typically referred to as a 'border tax adjustment' (BTA).

2. BCAs are seen by many commentators in many countries considering implementing carbon policies and measures as an essential way to protect their industries from a loss in competitiveness and/or to prevent environmental leakage.[1] Some economies whose exporters would be subject to these BCAs have strongly expressed their opposition to them. During the UNFCCC COP-15 conference in Copenhagen in December 2009, the negotiating text included options which would have banned BCAs, allowed them under certain circumstances or explicitly removed their discussion.

3. Underlying the discussion is the assumption that a BCA would have a strong impact on non-regulated economies (those whose exports would be subject to the BCA). A strong impact would cause significant cost increases, and losses in profit, in non-regulated economies. It would also give an incentive for increased greenhouse gas abatement (*i.e.*, reductions in emissions) in non-regulated economies, which is often ventured as one of the reasons for implementing BCAs.

4. This paper tests the hypothesis that there would be a strong impact. The paper first reviews the BCA provisions we could potentially see in the United States (Waxman-Markey, Kerry-Boxer and subsequent bills) and the European Union (under the EU Emission Trading Scheme). These are the two economies where the possible implementation of BCAs has garnered most attention to date. The paper postulates what level of BCA could be charged, which would be a function of the carbon price in the market reduced by the value of any free allowances[2] allocated to industries considered at risk of leakage.

5. BCAs are not the only possible response to competitiveness and leakage concerns. The major alternative, which has been in place in the European Union since the start of its Emission Trading Scheme in 2005, is to grant free allowances. [3] The paper reviews the potential impacts of BCAs and free allowances, starting by reporting the results from a model specifically designed to assess the impacts of BCAs in non-regulated countries. Further sections then focus on what other models show, what are the key implementation issues, whether BCAs and free allowances would create incentives for abatement and,

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1 Leakage occurs when some or all of the emissions reduced in an economy regulated by a policy are offset by increased emissions in non-regulated economies.

2 Allowances to emit carbon and other greenhouse gases can either be granted for free to companies or must be purchased (at auction or on the carbon market).

3 Sectoral approaches are often discussed but would be unlikely to reduce competitiveness and leakage significantly unless they involved transnational trading of emission allowances. Such an option is highly unlikely in the short- or medium-term, and would be heavily resisted by certain countries.

without prejudging whether schemes should be implemented, what guidelines we can give to countries considering implementing BCAs and/or free allowances.

6. The analysis presented is principally economic, referring to changes in costs and prices. The paper focuses on the steel sector, one of the two sectors (with cement) generally considered to be most likely to receive the protection of any potential BCA. Steel is also a very significant source of world carbon dioxide emissions (approximately 5%) and its homogenous nature and relatively high value per unit weight make it highly traded internationally (approximately 40% of steel produced). The paper does not consider demand reduction or credits for downstream actions (such as carbon emission reductions resulting from the production of higher performance steel).

7. The paper builds on specific areas of what is now a wide literature. Box 1 highlights papers produced by the OECD which provide an excellent overview to the issues around competitiveness and leakage in general and BCA and free allowances in particular.

Box 1. Some OECD work

- "The economics of climate change mitigation: policies and options for global action beyond 2012" (OECD, 2009). Provides an overview of the full range of options countries have to mitigate their greenhouse gas emissions. Chapter 3 reviews issues and policy options when there is incomplete carbon price coverage, including specific analysis of carbon leakage competitiveness and leakage effects. For the full paper and its linked Policy Brief, see:
  http://www.oecd.org/document/56/0,3343,en_2649_34361_43705336_1_1_1_1,00.html
  http://www.oecd.org/dataoecd/1/40/43656443.pdf respectively.

- "The economics of climate change mitigation: how to build the necessary global action in a cost-effective manner". Economics Department Working Papers no. 701 (Burniaux et al, 2009). Gives further analysis on the impacts of policy options to reduce GHG emissions, individually and in combination. Carbon leakage rates and impacts on industrial output are highlighted throughout the report
  (for example figure 5.5, page 60). For download see:
  http://www.olis.oecd.org/olis/2009doc.nsf/LinkTo/NT00002E82/$FILE/JT03267346.PDF

- The OECD Round Table on Sustainable Development held its July 22-23 2009 meeting in Singapore on Competitiveness, Leakage and Border Adjustment. The two papers produced give a good introduction to the range of issues and options facing energy-intensive producers, with a focus on the politics (Stephenson and Upton, 2009) and the economic impacts (Wooders et al, 2009a). The papers - Competitiveness, Leakage and Border Adjustment: Climate Policy Distractions? and Border Carbon Adjustment and Free Allowances: Responding to Competitiveness and Leakage Concerns - can be downloaded at:
  http://www.oecd.org/dataoecd/23/20/43441650.pdf and
  http://www.oecd.org/dataoecd/49/17/43975050.pdf respectively.

2. Constraints arising from the need to comply with the trade and climate change regimes

8. Options to address competitiveness and leakage concerns need to take regard of international agreements governing trade and climate change. A simple analysis concludes that the issues can be boiled down to two key principles (Wooders et al, 2009a):

- *Climate change*: Within the UNFCCC[4], a key principle is that of, "common but differentiated responsibilities" (CBDR). Embedded throughout the Convention, and espoused in the Bali Action Plan of 2007, this allows countries to respond to reducing GHG emissions in line with their historical responsibility and their capacity to respond to GHG emissions. A BTA or other policy and measure (PAM) which applied an equal cost of carbon to production from all countries would appear to be at odds with this principle;[5]

- *Trade*: A key principle of WTO (World Trade Organisation) law is non-discrimination between "like" goods. The definition of "like" does not take account of how a good was produced, but GATT Article XX does allow for exceptions against a limited number of criteria, one of which is environmental benefit.[6] Whether this exception can be invoked for one or all of the options for responding to competitiveness and leakage impacts is not clear and depends on design specifics. What is clear is that there must be an environmental rationale: options which seek only to protect domestic producers for economic reasons will not be saved by this exception.

9. It is necessary to keep the general legal principles in mind as we go through the paper. One key conclusion for the design of schemes is that WTO rules are clear that it would not be possible to allocate allowances for free within a country and then require importers to pay for them. Proposals of this type have not been currently tabled under the European Union's Emission Trading Scheme (EU ETS), but have occasionally been voiced in the US debate. Section 5.1 reviews the legal issues in more detail.

3 Options under consideration

10. Whilst much discussed, there are no BCA schemes covering greenhouse gas emissions currently in place. Such schemes may be implemented in the future, but this is far from certain. What is more certain is that we are unlikely to see a BCA in at least the short-term.

11. In contrast, the EU ETS has been granting free allowances to the majority of its regulated producers since its inception in 2005 and has now committed to continuing to grant emissions to many producers during Phase 3 of the EU ETS (2013-2020, plus proposed allocation and other rules to 2027; see Council of the European Union, 2008). Within the EU ETS, free allowances can be regarded as the incumbent response to the issues of competitiveness and leakage.

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4 United Nations Framework Convention on Climate Change – the basis for international negotiations and agreements, including the commitments agreed on absolute emissions by most developed countries under the Kyoto Protocol and the Bali Action Plan which is part of the process for agreements to cover the post-2012 period.

5 Noting that both the design of options (for example using best available technology as the basis for a Border Tax Adjustment) and the possibility of compensatory measures (for example financial transfers) may allow an option to partially or fully respond to the principle of CBDR.

6 More precisely, exceptions refer when "necessary to protect human, animal or plant life or health" and to the "conservation of exhaustible natural resources" (see Section 4.1 for further discussion).

12. This paper aims to assess the possible impacts of BCA schemes if implemented, not to discuss whether they are likely to be implemented. As such it focuses on the possible range of charges that BCAs might result in. More detailed considerations of BCA and free allowance schemes, their provenance and prospects can be found in references such as Houser et al (2008) and Wooders, Reinaud and Cosbey (2009). These papers also consider what the provisions and impacts of other greenhouse gas policies and measures may be: this paper concentrates on BCAs and free allowances only, assuming that they will be applied in a country or region whose policies and measures have created a price for carbon.[7]

3.1 United States

13. The Waxman-Markey bill passed by the US House of Representatives in 2009[8] envisioned a cap-and-trade system for energy-intensive sectors including steel. Output-based rebates would be applicable, covering (in the last version of the Bill) 100% of direct and indirect incremental costs for sectors deemed to be at risk from competitiveness and leakage (considered to include steel).

14. The potential price of allowances on the market was projected to start at a relatively low level (of the order of $\$10/tCO_2$) before increasing to levels of up to $\$50/tCO_2$. But these prices should not be assumed to be what a BCA would be set at: Section 1 noted that WTO rules are clear that it would not be possible to allocate allowances for free within a country and then require importers to pay for them, and compensating affected firms through output-based rebates would seem to need also to apply to importers. In this case it can be argued that the compensation offered to US producers covers at least their incremental losses (noting that they may be able to pass certain costs through to final consumers) and that an appropriate level for the BCA would thus be zero.

15. Attempts to progress the Waxman-Markey bill through Senate have seen, and continue to see, a range of proposals. The latest Kerry-Graham-Lieberman proposals (April 2010) now envisage a cap-and-trade scheme covering only the power generation sector in the first phase (from 2013), with industrial sectors not joining such a scheme until at least 2016. Carbon prices in the market could be constrained within a collar of minimum and maximum values, with a proposed maximum of $\$28/tCO_2$ under discussion in late April 2010. Alternative policies and measures would thus be formulated for US industrial producers in steel and other sectors. These alternative policies would be likely to result in extra costs to US producers, but how large these extra costs are, or how they could lead to a BCA, is far from clear. Rather than granting free allowances, the scheme could see a "cap-and-dividend" scheme being introduced for sectors which could include steel, with all revenues from allowance sales being distributed to the population as a whole rather than to the regulated sectors.

16. It is difficult to conclude at this stage what the likely level of a BCA may be for steel, if new climate policy were introduced in the US leading to a carbon price or other carbon cost. The most likely level would appear to be low, at least in the near future. The prospect of a high level of BCA appears much less likely.

3.2 European Union

17. The European Union has decided to continue largely with free allowances to energy-intensive sectors in Phase 3 of its EU ETS (2013-2020, with rules extended to 2027), with auctioning being progressively phased in. EUA (EU allowances) have retailed in the range $€0\text{-}30/tCO_2$ ($US\$0\text{-}45/tCO_2$) in the period from the EU ETS' inception in 2005. BCAs would only be considered within Phase 3, and then only following a review.

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7 Typically through a GHG emission trading scheme, although a carbon tax would also work.

8 As the America Clean Energy and Security Act, HR 2454.

18. Current provisions setting the terms for calculating the number of free allowances due would give allowances at a level designed to be at the 'best available technology' in the sector (the provision sets the level of free allowances at the average level of the 10% of best European performers). It seems certain that steel produced by different methods (primary and secondary route) would be assessed separately. Looking forward, the number of free allowances granted under the scheme as a whole would decline by 1.74% per year in the period from its 2013 base value, which would almost certainly progressively reduce the level of free allowances below the average of the 10% best performers.

19. The level of BCA which could theoretically be applied to the steel sector would thus be likely to be relatively low in the short- to medium-term, during which period we would expect the steel sector to continue to receive free allowances covering the majority of its emissions in all but a few highly-inefficient plants. Given that the steel sector will be able to pass on at least some of its incremental costs to consumers, it may be possible to make the case that it will be fully compensated under the EU ETS Phase 3 and thus the applicable level of BCA should be zero.

3.3 A note on the politics

20. This paper does not assess the politics around BCAs but it is naïve to assume that demonstrating the economic case for their implementation would be sufficient to see them applied. China and India are among a list of countries which has publicly stated their complete opposition to BCAs and discussions on negotiating text at COP-15 in Copenhagen included the option that the UNFCCC should expressly preclude BCAs as a potential option. On the other side, the US and other developed countries have stated their desire to leave the option open as a possibility within the UNFCC negotiations. There if course remains the possibility that BCAs would be implemented unilaterally by the United States, European Union or another developed country or region.

3.4 Conclusions for the modeling

21. The analysis presented above concludes that BCAs would probably be at or close to a level of zero under proposals and schemes in place or being considered within the European Union and the United States.

22. This conclusion should be borne in mind when assessing the following section on modeling. Largely in order to demonstrate the potential impacts of BCAs on developing countries, BCA rates of \$25/tCO_2 and \$50/tCO_2 have been applied as scenarios to the European Union and the United States, singly and in combination. The choice of these values does not imply that BCAs are either likely to be implemented or that the values are the most likely to occur in practice if BCA schemes were implemented.

4 Economic impacts

23. This section reviews the potential economic impacts of BCA and free allowance schemes which could be implemented in conjunction with carbon pricing. It seeks to assess the economic impacts on markets, and hence on countries and companies, of these schemes. Section 4.1 describes the model specifically developed for this paper and the results obtained from it. Section 4.2 then highlights results from other models. There has been little empirical modeling of the impacts of free allowances: section 4.3 reviews the theory and evidence, for both short- and long-term effects.

4.1 Model developed for this study

Purpose and basic design

24. This paper contends that the impact of implementing carbon pricing and border carbon adjustment in developed countries may be relatively limited. To this end, a model of the world steel market has been developed for this study. The model is based on the model of the cement sector developed for the World Business Council for Sustainable Development's Cement Sustainability Initiative (WBCDS-CSI), developed by a team led by Environmental Resources Management.[9]

25. The model allows twelve economies to produce steel from a set of existing and new technologies, and then to trade this steel when cost-effective to do so. The model is of partial equilibrium design (*i.e.* does not include links to the wider economy). It runs annually from a base year of 2007 to 2030. Carbon prices, import and export taxes can be applied on an individual country or regional basis. 'Production possibility curves' are first generated, made up of the marginal costs of each country or region producing steel across a range of production levels from zero to double projected demand in the year in question. Comparing these curves, and subtracting out the costs of transport and any taxes on trade (including border tax adjustment), allows profitable trades to be simulated.

26. The twelve economies included in the model are: NAFTA, the European Union, Other Europe, CIS, Latin America, Middle East, Africa, China, India, a group consisting of Japan, Korea and Chinese Taipei, ASEAN 6 and Oceania.

27. Key assumptions and the scenarios run are detailed in Box 2.

[9] See http://www.wbcsdcement.org/pdf/CSI%20model%20scenarios%20and%20results%20overview_May09.pdf for full details.

Box 2. Model Key Assumptions and Scenarios Run

Key assumptions

The model is designed to be relatively simple but flexible in terms of the scenarios which can be run. It assumes there is one type of 'steel', with uniform properties and which is acceptable to all customers world-wide. However it is generally considered that importers need to offer better conditions than incumbent domestic producers in order to gain market share. This is modeled by assuming that importers must undercut domestic prices by a fixed margin.

Market prices in each country and region are simulated by stacking up technologies in ascending cost order, and then applying a margin to cover capital charges and profit. The model includes two vintages of blast furnaces (modern and non-obsolete), gas-fired and coal-fired DRI, Electric Arc Furnaces (EAF), obsolete plant and new plant. New plant is based on the primary route alone (i.e., uses iron ore rather than recycled scrap). It is assumed that all scrap collected in the future will be used within the country or region it is collected in; the model thus reduces projected demand by projected new scrap generated.

Each plant type has associated operating costs (US$/tonne) and carbon emissions (in terms of tonnes of carbon dioxide per tonne of steel produced). These factors can be varied by country and region. When generating the production possibility curves, any amount of new plant can be introduced. The simulated costs of this new plant include both its operating costs and a capital charge contributing to the repayment of the initial investment (calculated on a levelised basis across the economic lifetime of the investment). New plant is added in modules of a minimum size (assumed in the base case to be 1.5 million tonnes peryear capacity) until the point at which it is uneconomic to do so.

Scenarios run

A base data set was generated from the following principal data sources:

- Demand for steel: World Steel Association "World Steel in Figures" (for 2007 base year); IEA ETP 2050 and EITI publications;
- Carbon emissions and factors: IEA - on-line energy statistics, ETP 2050 and EITI publications;
- Operating costs: World Steel Dynamics;
- Market prices: World Steel Dynamics;
- Capital costs of new plant: World Steel Dynamics;
- Transport costs: World Steel Dynamics, HSBC (2007).

No import or export taxes were included and no trade quotas or other limits were set. The 'domestic producers' advantage' is assumed to be $25/tCO2 in all countries and regions. Levelised capital costs for new plant was calculated using a 10% real discount rate applied over a 15 year economic lifetime. Steady changes in steel demand from the 2007 data baseline are assumed, i.e. the major downturn following the financial crisis has not be modeled and nor have any other periods of volatility.

The 'base case' scenario includes no carbon prices. Combinations of carbon prices of $25/tCO2 and $50/tCO2 for the NAFTA and EU regions individually and jointly have been run. Two variants of these scenarios have been used: with, and without, border carbon adjustment. Comparing these variants allows the impact of border carbon adjustment to be simulated. Additionally, sensitivities of results to a 50% increase and decrease of transportation costs have been undertaken in comparison to the 'base case'.

Results

28. Results from comparing the 'with' and 'without' border carbon adjustment scenarios have been assessed against their impact on the overall costs of meeting world steel demand (the 'system cost'), the producer surplus within each country and region and how prices for steel change, again in each country and region.

29. The weighted average global price for steel in the years 2007, 2010, 2020 and 2030 is projected by the model to be around $700/tonne. The model projects that this global average would increase by up to $15/tonne if carbon prices were introduced in the NAFTA and EU regions, with the largest rise when $50/tCO$_2$ prices were introduced in both regions. The rise in the global average price is almost entirely driven by price rises within the EU and NAFTA regions themselves: prices in China and other developing countries are essentially unchanged. Applying border carbon adjustment does not fundamentally alter the picture: the model projects that price increases in developing countries due to the introduction of BCAs will be less than 1%. This result strongly suggests that the incentive from increased prices to reduce carbon dioxide emissions will be weak.

30. The model projects that introducing a BCA in NAFTA and/or the European Union will raise system costs (the cost of meeting demand for steel) by up to 1%. The highest increases would be experienced in the regions introducing the BCA and in China, where a 2.5% increase in the cost of meeting steel demand would be expected if BCAs were applied to $50/tCO$_2$ carbon prices in the NAFTA and EU regions.

31. The model calculates producer surplus for each country and region, defining it as the revenue from sales at home and abroad minus the costs of production and of transport and taxes. Introducing carbon prices in NAFTA and/or the European Union increases the producer surplus in China by $3-12 billion per year. Subsequently introducing a BCA reduces this gain to $0-5 billion per year. Similarly for other countries and regions outside those with carbon prices, producer surplus gains of $2-7 billion per year when carbon prices are introduced by NAFTA and/or the European Union are reduced when BCAs are applied.

32. The model does not project that introducing carbon prices, with or without BCA, would reduce the producer surplus of the world steel industry. This conclusion is partly explained by the model not taking account of the price elasticity of demand, *i.e.* demand is not reduced when prices rise (noting that price rises are most significant in the NAFTA and EU regions).

Transport costs

33. Transport costs are an important variable in steel sector modeling. The enormous increases in transport costs in the period up to the financial crisis in 2008, and major decreases since, fundamentally alter the economics of trading. The effects are two-fold: countries importing materials such as iron ore and coking coal will pay more for these inputs, and trade margins will also be squeezed by the increased cost of transporting exports. HSBC (2007) conclude that, "transport costs to/from Asia are now key", concluding that exports from China to the European Union were at risk of becoming uncompetitive in 2007. The model projects that a sensitivity of ±50% on transport costs would have a similar impact to the imposition of BCAs. This is an interesting result and shows that impacts from factors other than carbon prices and taxes may be at least as important.

Conclusions

34. The results show that, with carbon prices of \$25/tCO_2 and \$50/tCO_2 in the NAFTA and/or EU regions, applying border carbon adjustment will not have a significant impact in developing countries. BCAs would lead to only a minimal increase in the price of steel in developing countries; they would tend to erode the relatively small gains developing countries are projected to make from the imposition of carbon prices in developed countries.

4.2 Results from other models

35. Partial equilibrium models have tended to focus on the EU ETS, typically estimating carbon leakage impacts for sectors considered at significant risk. Steel and cement have been the most studied sectors, with aluminium and electricity following. The leakage rates projected are highly variable and should be seen as providing useful indications of relative, rather than absolute, results. The differences between models mean that it is difficult to compare their results on an absolute basis (Wooders et al, 2009a). Reinaud (2008) summarises that leakage rates could range from 0.5% to 70% in the iron and steel sector. A study by Gielen and Moriguchi (2002) on the steel sector in Japan and the EU-15 shows a doubling of the leakage rate from 35% to 70% when the carbon cost applied is increased from \$11/tCO_2 to \$42/tCO_2. We can conclude that some production tends to relocate to countries without carbon prices.

36. Applying a BCA yields interesting, if also tentative, results. Monjon and Quirion (2009), modeling the EU and its ETS, have assessed different forms of BTA. They find that applying a full border adjustment to steel (export rebates and import tariffs) can see a 40% leakage rate outside the EU reversed to a negative 25% leakage rate of carbon into the EU: the combination of export rebates and import tariffs allows EU producers to gain market share.

37. But it is global equilibrium models which are needed to give the picture across the economy. Whilst results are again tentative, and based on a series of assumptions, they, "cast doubt over the effectiveness of border adjustment for offsetting competitiveness and leakage" (Wooders et al, 2009a). Reviewing studies from the literature, the paper concludes that, "BTA may be useful for reducing costs facing carbon-intensive domestic industry, while the effect on reducing leakage is less clear and might only be modest. BTA is likely to be less useful for minimizing the overall costs of climate policy." Whilst highly divergent impacts are noted, the models all project that domestic welfare will be reduced. In general, they also show welfare decreases in the rest of the world.

38. McKibbin and Wilcoxen (2009), in a simulation of the effects of BTA in the United States, find that BTA reduces demand for US exports by lowering welfare in trading partners, more than offsetting the protective effects of BTA. Finally, BTAs are shown to increase the cost of carbon reductions; this comes about because abatement costs tend to be lower in sectors being considered for protection using BCAs than for other sectors of the economy.

39. All models are based on assumptions. In the short term, the potential for the movement of production between the existing set of plants can be reasonably well understood, noting that there remain the whole set of reasons driving Armington elasticity effects (the need for exporters to offer prices below domestic producers in order to gain market share). Industry also has the ability to defend itself, at least in the short term, by moving away from profit-maximising strategy and other measures (Jha, 2006 and Hufbauer and Goodrich, 2002 both highlight the number of cases of litigation that the US has taken against steel importers). For the longer term, assumptions must be made on the drivers of where new plants will be built. This is far more complex than the consideration of short-term production movements. Although investors will consider current and potential carbon policies and measures, they will also consider factors

such as how fast local markets are set to grow, labour costs, availability of raw materials, environmental regulations and likely transport costs of getting goods to the most valuable markets.

4.3 Economic impacts of free allowances

40. It is difficult in practice to categorise market structure and hence to work out how an increase in the costs of producers may be reflected in increased prices for consumers. This difficulty leads to a number of implications, including a consequent inability to calculate what level of free allowances should be given to industries if it is decided to compensate them for financial losses from the implementation of carbon policies and measures (see Wooders, Reinaud and Cosbey (2009) for a full discussion).

41. Free allowances are in place within the EU ETS and have either been considered under most US proposals or the economically very similar option of output-based rebates has been included. They are politically expedient in that they largely avoid discussions around international trade and climate change negotiations and agreements. But this does not imply that they are economically efficient.

42. In the short-term, economic theory clearly states that companies with caps on their absolute emissions should factor in the full carbon price as an opportunity cost, whether they are granted emissions allowances for free or not. Under an emissions reduction scheme based on output (for example output-based rebates or caps based on carbon intensity per unit output), Demailly and Quirion (2008) state that such schemes will be economically inefficient because they do not allow the full economic signal to be transmitted.

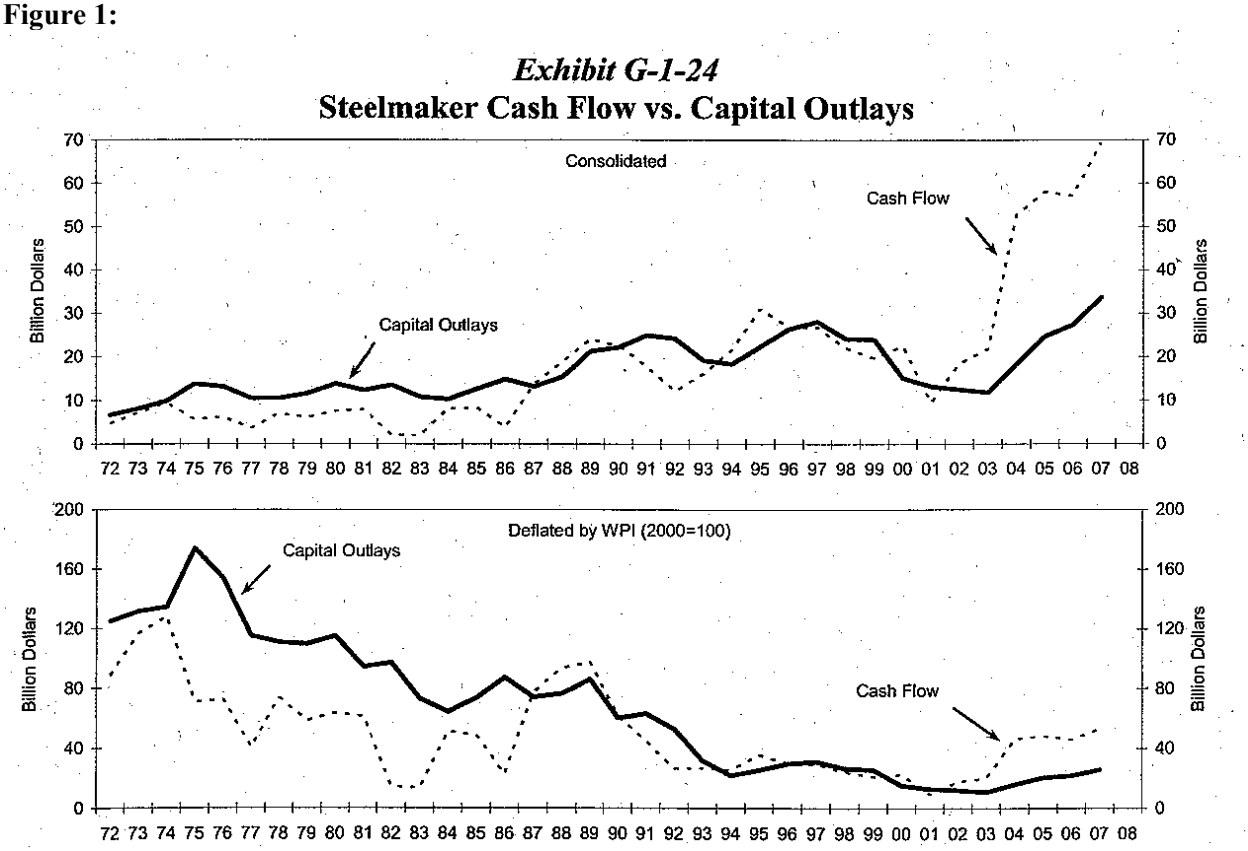
43. It is in the long-term where the key uncertainty lies. It is clear that a company which receives allowances for free will be better off financially than if it had to pay for them; it is less clear how the receipt of free allowances will lead the company to change its behaviour relative to if it had had to pay for them. Wooders et al (2009a) conclude, "we are not aware of any global equilibrium models which explicitly consider the use of free allowances to reduce competitiveness and leakage impacts".

44. Empirically, there is a very strong correlation between cash flow in the steel sector and its capital outlays. A 2008 study on capital outlays by World Steel Dynamics, a market research firm, concludes that cash flow tends to lead outlays by one to two years. Capital outlays tend to lie in the range $0-100/t production per year, but are highly variable (see Figure 1). WSD state that:

1. "Cash flow rose from a level of $12 billion in 1992 to $31 billion in 1995 and subsequently slipped to about $27 billion on 1996 and 1997. Cash flow fell to $9 billion on 2001 before rebounding to $53 billion on 2004, $58 billion in 2005, $57 billion in 2006 and $69 billion in 2007;

2. Capital outlays, in turn, rose from $18 billion in 1994, to $22 billion in 1995 and $28 billion on 1997. Capital outlays fell to $12 billion in 2003, before recovering to $18 billion in 2004, $25 billion in 2006 and $34 billion in 2007." WSD add that the surge in cash flow over the past few years has reversed a trend which had seen blast furnaces closing due to the costs of relining, rebuilding or meeting environmental standards.

Figure 1:



Source: World Steel Dynamics, 2008

45. Providing free allowances to companies subject to carbon prices in developed countries will clearly help their financial position compared to if they had not received them. It is not at all clear how free allowances granted to companies in the developed world might affect companies in developing countries. It seems obvious that, the more allowances they get for free, the more companies in developed countries will be competitive with those in developing countries. It is difficult to say much more beyond this. It is tentatively concluded that, unless companies in developed countries are being over-compensated[10], carbon pricing combined with free allowance schemes will probably make developed country companies less competitive relative to developing country ones, allowing developing country companies to increase their market share.

5 Implementation issues

There are two major implementation issues:

- Legality of proposals;
- Data availability and measurement.

These are now discussed, drawing in lessons from the implementation of previous schemes.

[10] *i.e.* receiving more free allowances than needed to compensate them for the increased costs under a carbon pricing scheme.

5.1 Legality of proposals

Border carbon adjustment

46. Section 1 noted the need for schemes to comply with both the UNFCCC principle of 'common but differentiated responsibility' (CBDR) and the WTO principle of equal treatment of all countries ('most-favoured nation'). This would seem to imply that schemes should treat countries' industries both differently and also the same, leading to a clear tension.

47. WTO Legal issues have been considered widely within the literature [see for example UNEP-WTO (2009]. It can be concluded that only a WTO Dispute Settlement Panel can definitively decide on a scheme's legality, and then only if a case is brought concerning a specific scheme which has been implemented. Nevertheless the analysis of the WTO's provisions and precedents does allow the range of possible schemes to be narrowed down. In summary:

- The 1970 GATT Working Party on BTA was inconclusive as to whether a border tax could be applied in the case of the energy used in the production of a good;

- Articles I and III of the GATT require "like" products to be treated the same, wherever they are produced. The debate continues as to whether goods produced using different "PPMs" (process and production methods) can be distinguished, *i.e.* are goods produced in a 'clean' way inherently unlike goods produced in a 'dirty' way?

- Article XX of the GATT may allow an environmental exception, mostly likely under paragraph (g). This allows for discrimination if the scheme relates to the conservation of natural resources;

- Article XX's "chapeau" provision requires that a measure does not represent a disguised restriction on trade. The language has been transposed directly into Article 3.5 of the UNFCCC, which requires (UNFCCC) Parties not to employ protectionist trade measures to achieve climate change objectives;

- Previous jurisprudence requires that it is the impacts of countries' policies and measures which must be compared, not the policies and measures themselves. Thus two very different sets of options leading to the same outcome would be equivalent under a WTO assessment: countries cannot require other countries to enact specific policies and measures;

- On the process side, prior consultation with countries outside the BCA implementer and the ability to challenge decisions made by the implementers of BCAs would be required.

48. We can conclude that BCAs may, if properly designed, be legal under WTO principles. There will almost certainly be a need to achieve consensus on climate policy if BCAs are to be introduced without legal challenge, with this consensus including leading emitters such as China. If there is a legal challenge to the WTO's Dispute Settlement process then it would be likely to cause serious harm to the UNFCCC and/or WTO. If the WTO Dispute Settlement Panel ruled that there had been no violation of WTO rules, then it would reduce the UNFCCC's legitimacy; if it ruled that there had been a violation, the climate change community might criticize the WTO for ruling on climate change issues. Section 7 provides further discussion of the guidelines under which BCA schemes should be designed, taking account of the legal requirements.

Free allowances

49. Free allowances appear to fulfill all the criteria of representing a subsidy. Article 1 of the World Trade Organisation's SCM (Subsidies and Countervailing Measures) agreement states that a subsidy must: (1) be a "financial contribution" by government; (2) confer a "benefit"; and (3) be "specific" to certain industries or sectors. Free allowances given to certain sectors of the economy appear to meet all these three criteria (Bordoff, 2009). Under WTO rules, if challenged and found to be trade-distorting, remedies could therefore be applied. Such a challenge is unlikely to happen in practice until there are at least two schemes granting free allowances, at which point the countries or regions could assess which scheme is the more generous and ask the WTO to consider that it therefore represents a trade-distorting subsidy.

5.2 Data availability and measurement

50. Studies on the economic effectiveness of BCAs tend to assume either that a simple average can be used to represent the embodied carbon content of imported steel, or that the embodied carbon content can be accurately measured as required. In reality, there appears to be a trade-off between the accuracy with which embodied carbon can be measured and the administrative cost. While it may be desirable for the embodied carbon content from individual plants and product lines to be known, setting up data collection and verification schemes, with agreed system boundaries and protocols, may be prohibitively expensive in terms of both financial costs and the time taken to set up such a scheme.

51. The range of embodied carbon in steel products is very wide, ranging from a typical value of 0.4 tCO_2/t steel for steel produced using an electric arc furnace to approximately 1.6 tCO_2/t steel for a modern blast furnace and then significantly higher for older, smaller plants.[11] There is also the possibility of introducing scrap and semi-finished products into processes and exporting these internationally.

52. The implication of these issues is that setting simple rules for calculating embodied carbon content may not work practically. Thus a national sector average for an exporting country, even if such data existed, would tend to radically under-estimate emissions from some plant and over-estimate it from others. A 'best available technology' approach would tend to set the level of embodied carbon far below the sector average, and would thus severely limit the effective BCA which could be levied and hence its effectiveness.

53. The World Steel Association's "CO_2 Emissions Data Collection" protocol and project[12] now has the majority of the world's large steel plant reporting their emissions to a standard protocol, although this information remains confidential. It may be possible to use the worldsteel Protocol as the basis for measuring embodied carbon under a BCA scheme, but this would require international agreement and it may take several years before all world producers are able to report data in such a manner. Legally, the WTO's decisions on unilateral labeling schemes imposed with any sort of government involvement in the process have generally concluded that such schemes tend to represent a technical barrier to trade and are hence illegal.

54. A workable method for assessing the embodied carbon content may therefore need to be something much simpler. A sector average emission factor, perhaps applied on a national basis, may offer a way forward. This scheme would have to allow individual producers to show that their emissions were below this average and thus to pay lower tax. The US "Superfund" case for oil and chemical products (US-Superfund, 1987) showed that a PPM-based BTA could be legal, provided it allowed for equal

11 See IEA (2008) for more information on emissions factors, and Wooders et al (2009) for a detailed review of the drivers of embodied carbon content.

12 http://www.worldsteel.org/climatechange/files/2/2/Data%20collection%20user%20guide.pdf.

treatment between exporters and domestic producers and that it allowed exporters to demonstrate if they were below the average embodied carbon levels assigned to them.

6 Would free allowances and BCA schemes incentivise abatement?

55. Increased costs of carbon will incentivize the abatement of emissions by producers, with higher costs providing higher incentives. But analysis suggests that, for carbon-intensive sectors such as steel, carbon prices alone are likely to be insufficient to incentivize significant abatement: they must be accompanied by complementary policies and measures. Table 1 shows the four major abatement categories for carbon reductions from the steel industry. For China, the table shows that policies and measures further to carbon prices alone will be needed for each of these four categories. The study makes similar conclusions for India, and the conclusions almost certainly hold for other developing countries. Coupled with the low impact on steel prices from carbon prices with or without BCAs (as discussed in Section 4), we can conclude that BCAs are unlikely to incentivize abatement in developing (exporting) countries to any significant degree.

56. Similar arguments can be applied for the incentivisation of abatement in developed countries implementing carbon pricing and BCAs. Section 4.1 indicated that carbon prices would be transferred into higher prices for steel, and hence there would be an incentive. Section 3.2 cast doubt on how much of these carbon prices may be transmitted to industry, with free allowances likely to considerably reduce the effective cost burden being faced by companies. As in developing countries, complementary policies and measures covering industrial policy and financing are also likely to be required.

Table 1. Specific policies and measures recommended for China

Abatement Category	Existing policies and support	Further policies and support	MRV Issues
1. The closure of inefficient, highly polluting plants	China already implementing policy	Make payments based on faster reduction in production than current policy	Definition of obsolete plant. Verified production figures. Baseline of planned reduction in production
2. Improving energy efficiency and carbon efficiency at existing, non-obsolete plants	Some investments being made under Chinese policy and CDM. Lack of investment capital	Project-based scheme (*e.g.* continuation of CDM). Supplemented by financial support scheme, ideally low cost capital	As per the CDM – baseline, methodology, additionality
3. Ensuring that new plant is built using best available technology	Believed that China is already building to best global standard	Consider partial investment credit (*e.g.* low cost capital) if new plant is best available technology	Need to audit plant on its completion. Ideally performance would also be verified at later date(s)
4. Increasing the use of recycled scrap	China recycling rate low by international standards – expected in a rapidly developing country	Make payments against increased rates of collection made, within China only (to avoid leakage)	Baseline of existing collection rate. Verified quantity collected. Verification sold to and used by Chinese steel plant

Source : Wooders et al, 2009b

57. Steel is not considered to have many ready substitutes and thus its price elasticity of demand is low, *i.e*. price changes do not strongly alter quantity demanded of steel.[13] Other key assumptions within models regard technology change and the spillover of new technologies to other regions. Almost all partial equilibrium models, and most global equilibrium models, fail to include technological change and spillovers (Grubb et al, 2002).[14]

58. It is also important to note that carbon policies and measures may prove to be beneficial for those economies and regions implementing them. If we consider that the move to a low carbon economy is an unavoidable one, then an early move may be less costly than a later one.[15] One of the rationales for the EU's ETS, and its limitations on offsets covering emission reductions outside the EU (Council of the European Union, 2008), is that it will encourage the EU to develop low carbon technologies. Recent economic stimulus packages in many countries have also sought to encourage the implementation of low carbon technologies. It is unclear at this stage how technology change, spillovers and the early adoption of low carbon technologies might incentivize abatement in countries with free allowances and BCA schemes and in those without, but stimulating early abatement may prove to be a good strategy.

59. This paper does not explicitly consider the potential for reductions in carbon emissions due to improved steel performance. IEA (2009) reviews some of the key options, concluding that steels with higher corrosion resistance, higher strength low-alloy steels, steels with improved heat resistance and electrical efficiency could all lead to significant emission reductions. The study also notes the difficulties in calculating these reductions.

7 Guidelines for implementing BCA and free allowance schemes

7.1 Border carbon adjustment

60. Without prejudging whether schemes should be implemented, what principles could we give to countries thinking about implementing them? This section looks only at the case if a country or region wished to implement a BCA unilaterally: it does not comment on whether that country or region should in practice do so, nor whether a BCA would be the most effective option to meet policy goals when compared to other alternatives. It should be noted that the first-best solution is an international agreement taking into account UNFCCC and WTO provisions (notably CBDR and MFN).

61. This section draws on a current initiative being undertaken by IISD and a series of collaborators to define guidelines for the best practice implementation of unilateral BCAs.[16] The aim of this initiative is that a BCA should be, "formulated and carried out in a manner that is minimally disruptive to trading partners, equitable in terms of impacts, effective in achieving its intended goals, and in line with the multilateral system of trade and the multilateral climate change regime."

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13 A figure of -0.2 is typically used, see analysis from IEA (2009) Energy Technology Transitions for Industry.

14 OECD analysis in the context of its work on climate change, based on modelling, suggests that addressing climate change will be considerably more costly in the absence of technological change. This work also recommends a combination of pricing policies (such as carbon taxes) with instruments to encourage more rapid technological change (see e.g. OECD, 2009).

15 Essentially the key conclusion of the "Stern Report", which advocates early action on greenhouse gas mitigation as economically preferable to later action.

16 Guidance on elaborating and applying border carbon adjustment measures: Draft Version (IISD et al (2010) forthcoming). .

62. The initiative gives recommendations under four main criteria:

1. *Governance structures for BCA*. Trading partners must be consulted at all stages, and given the right to appeal any decisions made within a transparent process. Factors and protocols applied should be reviewed on a regular, relatively short-term basis;

2. *Determining vulnerable sectors*. Protecting sectors which do not need such protection should be avoided. Proxy measures will be required to assess how exposed producers are to competition and their ability to pass-through cost increases to consumers. This assessment may vary within a country due to geographical factors;

3. *Determining country-level applicability (the "trigger")*. An attempt for there to be international dialogue aimed at resolving any underlying problem is an essential first step. If unsuccessful, best practice on country-level applicability is "largely determined by what the measures are designed to achieve". If this is to pressure other countries to enact more stringent climate policy, then UNFCCC principles of CDBR and exemptions for least developed countries are strongly indicated. If the aim is to prevent leakage and competitiveness impacts, such exemptions are not indicated;

4. *Determining the level of adjustment*. Free allowances or any other compensatory mechanisms should be subtracted from the level of adjustment due. Producers should be able to demonstrate their actual level of embodied carbon.

7.2 Free allowances

63. The key consideration when determining the level of free allowances offered is perhaps to avoid over-compensation. Sectors in general, and certain producers in particular, may not be as exposed to competition as simple considerations and analyses may suggest. It is also important to take into account why free allowances are being granted. If it is to protect a declining sector against the possibility of large job losses in the short-term, then perhaps other industrial and social policies would be more effective at achieving this aim and would be less distortionary to the wider climate change and trade regimes.

64. But it is also clear [see for example Wooders et al (2009a)] that calculating the 'correct' level of compensation to offer to producers using free allowances faces major uncertainties. Even with perfect data, we could not demonstrate how the competitiveness of a producer is affected by carbon prices alone to a high degree of certainty, nor on how granting it free allowances would change its behaviour going forward.

65. Free allowance schemes have the potential to become expensive to governments and difficult to reform. Clear, transparent procedures for determining vulnerable sectors and for calculating the level of compensation offered are indicated. Time limitations and/or phase-out may also be attractive if it is accepted that the producer should pay full carbon prices in the future but that imposing these costs in the short-term would cause a shock which would be difficult for the sector to deal with. As such, the EU ETS Phase 3 considerations (see Section 3.2) offer useful guidance.

8 Conclusions

66. The analysis and evidence presented in this paper strongly suggests that the impacts of BCA schemes implemented for the steel sector may be low. It is not considered that this is a definitive conclusion, and further work is indicated. However, sufficient confidence can be placed in this conclusion to imply that concerns that impacts may be high in developing countries appear to be misplaced. We can

also conclude that BCAs and free allowances are unlikely to significantly incentivize abatement in developing countries.

67. In practice, the impact of BCAs on developing countries is likely to be further reduced by a series of factors. First, countries and regions may well decide to compensate their industries using free allowances, which will reduce the BCA which can be levied on developing countries to 'level the playing field'. Second, legal considerations are likely to require a trade-off between the scheme's administrative cost and its effectiveness, *i.e.* it is likely that some part of the scheme's effectiveness will need to be sacrificed in order to implement a workable scheme. Third, and similarly, practical issues around data collection and interpretation are likely to see the practical level of carbon which can be taxed under a BCA being below the theoretical level. All three considerations will reduce the level of BCA which can be levied to below the carbon price in the country levying the BCA.

68. The conclusion that the impact on developing countries will be low is based on economic considerations alone, chiefly on the marginal changes we are likely to see in the prices of steel in developing country markets and in their producer surpluses (industry profitability). Other factors, notably political considerations around equity (for example the UNFCCC's common but differentiated responsibility principle), must also be taken into account.

69. Legal and practical considerations give us some guidance on how schemes should be designed and implemented such that they comply with trade and climate change regimes and will be as effective as is possible. For both BCAs and free allowances, an objective assessment of which sectors are really at risk of competitiveness and leakage impacts is required. Studies indicate that the steel sector appears to be one of those at risk. If compensation were to be provided using free allowances, then calculating how many to grant to the steel sector is subject to considerable uncertainty, and the temptation to over-compensate is a very real one to regulators.

70. This paper's principal conclusion, that BCAs are unlikely to lead to significant incentives to change behaviour in the steel sector in developing countries, is worthy of further investigation.

REFERENCES

Bordoff, Jason E. (2009). International Trade Law and the Economics of Climate Policy: Evaluating the legality and effectiveness of proposals to address competitiveness and leakage concerns. In Climate Change, Trade and Competitiveness: Is a Collision Inevitable? Brookings Global Economy and Deevlopment.

Burniaux, Jean-Marc, Jean Chateau, Rob Dellink, Romain Duval and Stéphanie Jamet (2009). "The economics of climate change mitigation: how to build the necessary global action in a cost-effective manner". *Economics Department Working Papers* no. 701. ECO/WKP(2009)42. 26 June 2009. Paris, France.

Council of the European Union (2008). "Energy and climate change – elements of the final compromise". *17215/08. POLGEN 142 ENER 472 ENV 101017215/08*. Brussels, 12 December 2008.

Demailly, Damien and Philiipe Quirion (2008). "Changing the Allocation Rules in the EU ETS: Impact on Competitiveness and Economic Efficiency". *Climate Change Modelling and Policy*, Fondazione Eni Enrico Mattei.

Gielen, D. and Y.Moriguchi (2002). "CO2 in the Iron and Steel Industry: An Analysis of Japanese Emission Reduction Potentials". *Energy policy*, 30: 849-863.

Grubb, M., J. Köhler and D. Anderson (2002). "Induced technical change: Evidence and implications for energy-environmental modeling and policy". *Annual Review of Energy and Environment*, 27, pp. 271-308.

Houser, Trevor et al (2008). Levelling the Carbon Playing Field: International Competition and US Climate Policy Design". Peterson Institute for International Economics and World Resources Institute: Washington DC, US. http://www.wri.org/publication/leveling-the-carbon-playing-field

HSBC (2007). HSBC Global Research Flashnote on Global Steel, 30 August 2007. Alan Coats and Daniel Kang.

Hufbauer, Gary and Ben Goodrich (2002). "Import Restrictions on Steel: Doubtful Benefits, High Costs." *Report to Emergency Committee for American Trade*, January 2002.

IEA(2009). Energy Technology Transitions for Industry. IEA, Paris.

IEA (2008). Energy Technology Perspectives 2008: *Scenarios and Strategies to 2050*. IEA, Paris.

IEA On-Line Energy Statistics. http://data.iea.org/ieastore/statslisting.asp.

Jha, Veena, James Nedumpara and Tanuka Endow. Dealing with Trade Distortions in the Steel Industry. Co-publication of UNCTAD and Macmillian India Ltd.

McKibbin, W. and P. Wilcoxen (2009). The Economic and Environmental Effects of Border Tax Adjustment. Working Papers in International Economics, No. 109, February 2009, Lowry Institute for International Policy.

Monjon, Stéphanie and Philippe Quirion (2009). Addressing Leakage in the EU ETS: Results from the CASE II Model. Climate Strategies Working Paper. Cambridge, UK.

OECD (2009). The economics of climate change mitigation: policies and options for global action beyond 2012. ISBN 978-92-64-05606-0. Paris, France.

Reinaud, Julia (2008). "Issues behind Competitiveness and Carbon Leakage: Focus on Heavy Industry. IEA Information Paper, OECD/IEA, Paris.

Stephenson, John and Simon Upton (2009). "Competitiveness, Leakage and Border Adjustment: Climate Policy Distractions?" *OECD Round Table on Sustainable Development*. 22-23 July 20009, Singapore. SG/SD/RT(2009)3.

UNEP-WTO (2009). "Trade and Climate Change". WTO, Geneva, Switzerland, 2009.

US-Superfund (1987). "United States-Taxes on Petroleum and Certain Imported Substances", Panel Report, adopted 17 June 1987. L-6175, 2.1.

Wooders, Peter, Aaron Cosbey, John Stephenson and Simon Upton (2009a). "Border Carbon Adjustment and Free Allowances: Responding to Competitiveness and Leakage Concerns". *OECD Round Table on Sustainable Development*. 23 July 20009, Singapore. SG/SD/RT(2009)8.

Wooders, Peter et al (2009b). "The Role of Sectoral Approaches and Agreements: Focus on the Steel Sector in China and India". *Climate Strategies*. Cambridge, UK.

Wooders, Peter, Julia Reinaud and Aaron Cosbey (2009). "Options for Policy-Makers: Addressing Competitiveness", *Leakage and Climate Change*. IISD. Winnipeg, Canada.

World Steel Association (2008, 2009). *World Steel in Figures*. http://www.worldsteel.org/pictures/publicationfiles/WSIF09.pdf.

World Steel Dynamics. Various publications. http://www.worldsteeldynamics.com/.