CLIMATE POLICY ANALYSIS WITH SECTORAL TARGETS FOR THE STEEL SECTOR

Vicki Duscha, Fraunhofer ISI, Breslauer Straße 48, 76139 Karlsruhe, Germany
Phone: +49 (0) 721 6809 226, Fax: + 49 (0) 721 6809 272, e-mail: vicki.duscha@fraunhofer.isi.de
Everett Peterson, Virginia Tech, Blacksburg USA
Joachim Schleich, Grenoble Ecole de Management, Grenoble, France
Katja Schumacher, Öko Institut, Berlin, Germany.

Overview

Sectoral approaches have been proposed as a means to address competitiveness and leakage concerns arising from asymmetric climate policy, where emission targets across countries and regions differ in terms of their environmental stringency or economic effects (e.g. Baron et al. 2008, 2009; Fujiwara 2010, Center for Clean Air Policy 2010). Such approaches may involve linking of multi-sector emissions trading systems (ETS) across countries and regions or transnational approaches for individual energy-intensive sectors, as proposed for the cement, steel or electricity sectors, or land transportation. Previous research of sectoral approaches mainly involves qualitative approaches (e.g. Fujiwara 2010; Baron et al. 2008, 2009) or quantitative analyses for individual sectors based on partial equilibrium models (e.g. Meunier and Ponssard 2012), exceptions include Voigt et al. (2011).

This paper explores the effects of sectoral targets in international climate policy in a macroeconomic framework, their interaction with the EU emissions Trading System (EU ETS), and to which extent sectoral targets can address the concerns of competitiveness. We assume that a global binding agreement exists between the steel sector and governments. The steel sector seems particularly suited for a sectoral targets approach because it is relatively CO_2-intensive (3-5% of global CO_2-emissions) and also trade intensive (approximately 20% of the value of steel output is traded). Steel may be produced using two different technologies: a basic oxygen furnace (BOF) which produces steel from virgin raw materials or an electric arc furnace (EAF) which produces steel from recycled metal products. The percentage of steel produced by each process varies significantly across regions. BOF production is mainly associated with direct CO_2 emissions, while EAF causes primarily indirect emissions via electricity use. While most engineering-economic bottom-up models distinguish between different production technologies, this is typically not the case for econometrically estimated (macro)economic models or computable general equilibrium (CGE) models.

Methods

The analyses rely on a multi-country, multi-sector, recursive dynamic CGE model (DYE-CLIP), developed by Peterson et al. (2011), which utilizes the GTAP 7 database, and also includes domestic trade and transport margins. The model consists of 32 countries/regions and 18 sectors. To better reflect technological realities, the GTAP sector ferrous metals (i_s) is disaggregated into two industries (BOF and EAF) based on production data (worldsteel), trade data (UN COMTRADE) and data on cost shares for steel production processes. The model simulations target at the year 2020 and include the forecast run and three climate policy scenarios. These differ by the number of sectors within and across countries facing emission targets, and to which extent trading of emission certificates is allowed between the sectoral targets sector (steel) and other sectors subject to emissions trading. For all Annex I countries, we assume that national CO_2 emissions in 2020 need to be reduced by 30% below 1990 levels. For all non-Annex I countries, the level of ambition is set to 15% below baseline levels in 2020. This set of targets is considered to be consistent with the 2°C target. Reduction targets between the ETS and non-ETS sectors are split as in the EU ETS, i.e. the ETS sectors account for 60% of the emission reductions. The *base case* serves as a benchmark, where certificate trading is only allowed in the EU ETS. For the *sectoral targets* and the *linking* scenarios, emission targets for the steel sector in 2020 are defined as a reduction of 10% below baseline for all countries. The reduction targets for the remaining ETS sectors (ETS^{-s}) and the non-ETS sectors are then determined such that the national ambition level is met. In *sectoral targets*, only the steel sectors are allowed to trade certificates (apart from EU ETS), while *linked markets* allows for a global ETS including the steel sector and the ETS^{-S} sectors.

Results

Different CO_2 certificate prices reflect that, at the margin, the level of ambition of the emission targets implemented differ significantly between countries and are particularly lenient for China and India, and particularly ambitious for Japan and the USA. Compared to the *base case, sectoral targets* and *linked markets* lead to much lower certificate prices for the steel sector, in particular for Japan and the US (~1/10), but also for the EU 27 (~1/5), Brazil (~1/4), and to a lesser extent for Russia (~1/3). In contrast, steel companies in China and India face slightly higher certificate prices than in the *base case* (+30%). Linking ETS markets (and sector targets markets) globally leads to higher certificate pricies in the trading sectors in China and India compared to the *sectoral targets* scenario, but lowers the certificates prices for the steel sector, because marginal abatement costs tend to be higher in the steel sector than in the remaining ETS sectors (ETS^{-s}). Global output in both, BOF and EAF steel production, decreases in all policy scenarios. Analysis on a country level shows that output effects vary by country and are caused by different drivers. For example, the effects from higher CO_2-prices (for BOF mainly from direct CO_2-emissions and for EAF also indirectly from higher electricity prices) are dominant in China and India resulting in lower steel production in the climate policy scenarios compared to the forecast ("carbon price effect"). Because of this carbon price effect, BOF production in Russia is higher in *sectoral targets* and *linked markets* compared to the *base case*. In particular, changes in international competitiveness compared to the *base case* result in export losses for China and India, and gains for Russia ("trade effect"). Further, high steel price increases have a reinforcing effect due to the high amount of scrap used in in EAF (but also in BOF) steel production ("own consumption effect"), as is the case in South Korea in *sectoral targets*. The results also indicate that strong impacts on other industry sectors due to higher (lower) carbon prices in the ETS sectors significantly affect the steel sectors ability to cope with the carbon price effects in the steel sector due to lower (higher) demand for steel products ("demand effect"), as is the case in China and India in *linked markets*. For the countries with the highest CO_2 prices in the *base case*, i.e. Japan, USA, and EU, *sectoral targets* make up for about 25% (14%) and *linked markets* for about 77% (155%) of the production losses for BOF (EAF) of these countries in the *base case*. For BOF and EAF combined the figures are 21% for *sectoral targets* and 105% for *linked markets*.

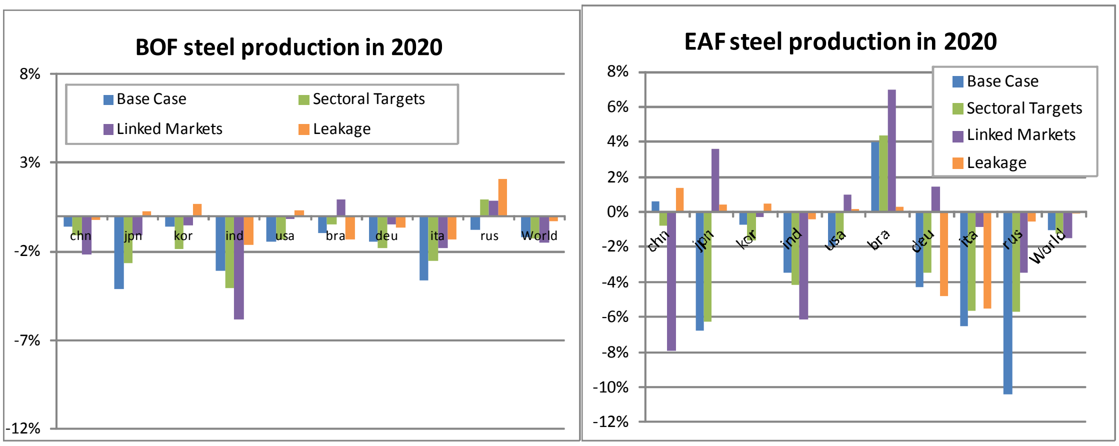

Figure 1: Changes in BOF and EAF steel production in base case and policy scenarios compared to forecast (in %)

Conclusions

Our findings suggest that sectoral approaches like sectoral targets and linking ETS may effectively counter the (negative) output effects of asymmetric climate policy. For the scenarios implemented, linking ETS is substantially more effective than sectoral targets. The findings differ, hower, by country and steel production technology. In comparison to the base case, allowing for global trading on the steel market on the one hand and the linked global emissions market on the other, improves the competitiveness of steel production in Annex I countries with their stringent targets and relatively high marginal abatement costs. For these countries, carbon prices for steel are lower in *sectoral targets* and even more so in *linked markets* so that production costs are lower and output higher. This effect is reinforced by a reduction in production in China and India which hold large global shares in steel production and face cost increases in response to the trading schemes compared to the *base case*. The effects are more pronounced in the *linked markets scenario* for EAF steel production as production costs are affected by both the direct and indirect carbon price, among others. In comparison to other countries, India and China suffer from increased carbon prices both for the steel and the ETS^{-s} sectors compared to the base case resulting in decreased production and a rise of global steel prices which further strengthens other countries' competitiveness. In general, these results illustrate that differentiating industrial technologies in a CGE framework allows to gain additional insights into major economic effects. In this study, we treated EAF and BOF steel as separate products which cannot be substituted for each other. Future modelling could incorporate the increasing substitutability of EAF and BOF steel products due to technological progress, and thus allow for shifts between those processes in response to climate policy.

References

Baron, R., I. Barnsley, and J. Ellis (2008): Options for integrating sectoral ap-proaches into the UNFCCC.

Baron, R., B. Buchner, and J. Ellis (2009): Sectoral Approaches and the Carbon Market. IEA/OECD paper for the Annex I Expert Group on the UNFCCC, OECD/IEA, Paris.

Center for Clean Air Policy (2010), Global Sectoral Study: Final Report, May.

Fujiwara N. (2010): Sectoral Approaches to Climate Change. What can industry contribute? Center for European Policy Studies, Special Report.

Meunier G., and J.-P. Ponssard (2012): A Sectoral Approach Balancing Global Efficiency and Equity. Environmental and Resource Economics 53, 533-552.

Peterson, E.B., J. Schleich, and V. Duscha (2011). “Environmental and Economic Effects of the Copenhagen Pledges and More Ambitious Emission Reduction Targets.” Energy Policy 39 (2011): 3697-3708.

Voigt, S., Alexeeva-Talebi, V. and Löschel, A. (2011): Macroeconomic Impacts of Sectoral Approaches: The Role of the Cement Sector in China, Mexico and Brazil, 34th IAEE International Conference, Stockholm, 22 June, 2011.