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Memo

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"Carbon Leakage prospects under Phase III of the EU ETS and beyond" prepared by Vivid Economics for DECC

Peer Review Report

Summary

The report "Carbon Leakage prospects under Phase III of the EU ETS and beyond" is a valuable summary of the previous debate on carbon leakage with regard to the EU ETS and makes some useful contributions to the emerging debates on the risks of carbon leakage and the options to prevent ETS-driven relocations of production and investments. The literature review gives an up-to-date and comprehensive overview of the recent body of evidence and analysis of the topic from different perspectives and with different methodological approaches. The report provides additional insights as a result of conducting its own modelling for a selection of industrial sectors. The results are not always in line with many previous modelling exercises, which indicates that the results should be placed more in perspective or that at least the most significant differences to other research should be discussed in more detail if the modelling results shall be used as a robust foundation for policy decisions. The discussion of the criteria for assessing the risk of carbon leakage used for the EU ETS as well as the mechanisms for combating carbon leakage under the EU ETS provides a comprehensive overview of the existing debate. However, new perspectives seem to be needed for the design of criteria (e.g. not only to assess the risk of carbon leakage but also the appropriateness of certain mechanisms to combat carbon leakage) as well as to move to less generic and more tailor-made mechanisms for specific leakage routes and sectors to deal with the challenge of carbon leakage in a world of different, explicit and/or implicit carbon prices.

1 Introduction

DECC commissioned Vivid Economics along with Ecofys to prepare a report on "Carbon Leakage prospects under Phase III of the EU ETS and beyond", which should present analysis on four topics:

- a comprehensive review of the existing literature on carbon leakage under the EU ETS;
- its own modelling exercise;
- an analysis of the criteria recently used to identify sectors facing a significant problem of carbon leakage; and
- an assessment of the policy options for mitigating carbon leakage within the framework of the EU ETS.

Carbon leakage – i.e. offsetting emission reductions with a certain regulatory mechanism by emissions outside the mechanisms caused by relocation of economic activities – is a complex issue and relevant in the case of various mechanisms. The analysis focuses on two channels: the relocation of economic activities as a result of short-term competiveness issues and the more medium-term relocation of investments. Two other long-term or more aggregate mechanisms – the potential decrease of global fuel prices as a result of ambitious greenhouse gas reductions in a subset of regions as well as potential technological spill-overs (reverse leakage) – are not addressed in the analysis, probably because the study has been designed to draw practical conclusions on future improvements within the framework of the European Union Emissions Trading Scheme (EU ETS). One should, however, bear in mind that the issue of technology-spill-overs is linked not only to transformational abatement measures ("breakthrough options", which will rarely be driven by carbon prices alone, e.g. solar photovoltaics or carbon capture and storage) but also to a range of incremental abatement measures (e.g. emission reductions for industrial gases as a more or less exclusive result of carbon pricing policies), which is often underestimated within the scope of the debate on carbon leakage.

The study is comprehensive, precise and straight forward in its conclusions, even if one may not necessarily agree with the full set of conclusions and recommendations.

2 Review of existing literature

The study provides a unique overview of the existing literature on carbon leakage, which is probably the most comprehensive of the relevant literature to date. It:

- contains studies from 2000 to 2013, which show an ongoing and increasing interest in the issue of carbon leakage;

- reflects a wide range of methodological approaches, ranging from modelling with Computable General Equilibrium (CGE) via partial equilibrium models to econometric analysis and surveys or case studies; and
- covers the full range of analysis, academic and non-academic literature. In this context it is striking that the broad range of CGE modelling and the more narrow range of econometric analysis seems to be an exclusive domain of academic research while partial equilibrium modelling as well as case studies are the domain of more non-academic analysis (which incidentally raises again questions about the robustness and the micro-foundation of macro-modelling for practical policy designs).

The broad and almost complete overview of the body of literature and its analyses underlines the findings which have also been derived in earlier, less comprehensive and up-to-date comparisons:

- The empirical literature based on ex-post analysis, benefiting mostly from more specific sector details or knowledge, but relying on rather short time series and lacking economy-wide interactions and endeavouring to differentiate between the carbon price effect itself and the existing regulatory counter measures, does not show (significant) carbon leakage effects to date (the study identifies a range of leakage rates of 0-5%);
- The ex-ante modelling shows significant or at least higher carbon-leakage effects (typically 5-15%) but mostly suffers from a lack of appropriate reflection of sector disaggregation and reactions in terms of abatement or regulatory counter measures to increasing carbon costs, which might lead to lower exposure to carbon leakage. If and how far these disadvantages are offset by the main advantages of macro modelling, the consistent reflection of economy-wide interactions and the longer-term perspectives, remains an open question.

Two important points of the findings from the literature overview would be worth highlighting more in the analysis (e.g. by reflecting them in the summary). Firstly, carbon leakage is a non-linear phenomenon, i.e. the risk of carbon leakage increases more than the respective carbon price on the one hand and there are tipping points if the carbon price exceeds certain (and widely unknown) thresholds. In other words: The challenge of carbon leakage must be considered differently if the differential of (implicit) carbon prices to other regions of the world is in the order of 15 or 50 Euros per metric ton of carbon dioxide. Secondly, an appropriate analysis of carbon leakage within the framework of the EU ETS requires a certain minimum level of granularity of the analysis.

The existing literature provides evidence on certain findings or ranges of findings but it also indicates that further gap filling of the analysis is needed. On the one hand, the role of non-direct, or differently designed, pricing policies seems to grow in jurisdictions outside of the EU. The issue of how implicit carbon pricing policies (regulations in the US, NAMA policies in other regions) should be reflected in the leakage analysis and the respective reflection of these policies is clearly an emerging challenge. On the oth-

er hand, most of the analysis is based on the (modelling) assumption that the EU ETS is not a multi-period ETS with significant implicit updating components (new entrant allocation, plant closure provisions, updated ex-ante allocation for each phase), which will decrease the challenges arising from the investment channel of carbon leakage. However, these important issues that probably lead to an overestimation of carbon leakage effects go beyond the scope of the study, which is designed to contribute to the more conventional analysis of carbon leakage issues.

3 Modelling of carbon leakage

In addition to the very comprehensive literature overview the study presents new modelling with VividEconomics' modelling toolbox (FIMM and RIMM). The modelling approach is complex but sufficient to reflect specifics of different sectors and markets at an appropriate level of granularity.

The strength of the analysis is clearly the complex and comprehensive modelling toolbox as well the significant efforts to explore and harmonize data from many different sources as an input to the modelling. This effort alone provides an enormous added value to a quantitatively well-founded leakage debate in the future.

The key weaknesses of the modelling exercise are clear:

- emission abatement measures at the regulated firms are not included as a potential option to react to higher carbon prices, which inevitably overstates the leakage effects; and
- uncertainties on future trade exposure are significant and cumulate with the assumption that the explicit or even implicit price of carbon is zero outside the EU ETS (in the long run).

A systematic challenge for the kind of analysis presented in the study is that it presents a case where no counter measures such as free allocation were considered. In other words: The modelling results present a case on whether and to what extent counter measures should be taken to prevent carbon leakage potentially triggered by the EU ETS, reflecting the caveats above. In order to assess the suitability of counter measures (free allocation of allowances to incumbents as well as new entrants, direct compensation measures), an important area for future analysis could be a modelling case which would reflect these different types of provisions to prevent carbon leakage in a multi-period ETS.

A rough comparison with the findings of other studies shows various aspects:

- The consequences of carbon price shocks in terms of their ratio to the existing profit margins are most significant for sectors with previously low profit margins (e.g. different paper sectors), significantly lower but nevertheless noteworthy for some sectors with previously higher profit margins (e.g. not surprisingly the steel sector) and some sectors where the level of the price shock exceeds the previous profit margins (e.g. cement, lime, nitrogen fertilizers).

These results underline, at least in principle, the findings of other major studies. However, the pass-through rates for the cement industry is surprisingly low when compared with the existing literature; this might be a specific issue of the UK focus (in other European regions the regional variations and the related pass-through rates for the cement products are very high, given the high costs for inland transportation);

- The impact of different carbon price levels shows unsurprising patterns in general, i.e. higher sensitivities of some sectors with massively increasing CO_2 prices (15 - 30 - 50 €/t CO_2). However, in the light of the empirical evidence from longer periods of CO_2 prices amounting to approx. 15 €/t CO_2 and other analytical studies, the level of the decrease of outputs is surprising (30% for the cement sector at 15 €/t CO_2, 100% at 30 €/t CO_2, 15 to 20% for the steel sectors at 15 €/t CO_2 and up to 40% at 30€/t CO_2 or 40 to 50% at 50 €/t CO_2). Nevertheless, the long-term changes in output are, even with the modelling assumptions of the study, higher than 10% for only 14 of 25 sectors even under relatively high carbon prices;
- The related leakage rates are consequently comparatively high and range from 40 to more than 100 percent for most sectors;
- A range of sensitivity analyses provide some valuable insights on modelling mechanisms and sector or regional specifics but do not change the general patterns of the results;
- Not surprising in general but based here on numerical analysis, the pass-through rates of carbon costs relate to the inside market shares of the firms.

The modelling results are interesting but could probably not create a stand-alone or robust basis for practical ways for dealing with carbon leakage without:

- including the option of emission abatement measures in the different sectors; and
- providing complementary model runs which reflect the effect of potential counter measures.

Last but not least, the results of the modelling exercise should urgently be compared and set in context with results from other existing analyses in the necessary depth.

4 Carbon leakage criteria used within the EU ETS

The European Union uses two indicators to assess the eligibility of sectors or undertakings to compensation measures related to the EU ETS (basically free allocation and direct compensation for indirect costs resulting from the pass-through of carbon costs to the electricity prices):

- the trade intensity,

- the (carbon) costs intensity as share of carbon costs in gross value added, and
- a combination of both.

These indicators were first identified and discussed in the carbon leakage debate as of 2006-2008 and have found their way into other regulatory frameworks (e.g. the recent draft guidelines for environment and energy state aid for 2014 to 2020).

With regard to the indicators, there is and has been consensus in the research community on two points:

- the trade intensity as a stand-alone indicator is not an appropriate criterion to assess the exposure to carbon leakage; and
- profit margins would be a much better denominator to assess carbon (or other) cost increase than gross value added (which essentially includes labour costs and profits).

Discussion about the inclusion of a stand-alone trade intensity parameter in the EU ETS has been of a purely political nature and has never been backed up by solid research. Therefore, the finding and the recommendation of the study that this criterion should be removed in future revisions of the EU ETS directive should be underlined.

However, the study raises other solid issues related to the use and the practical implementation of the recently used indicators (market definition, GVA as an appropriate denominator to calculate carbon cost intensity, carbon content in electricity prices, data source problems). Some of the issues are of a technical nature but some have a more relevant background. One of these issues is that a careful distinction must be made regarding relocation of production within the EU, which is an internal market and not a leakage issue. Against this background, the use of differentiated criteria within the EU (e.g. for the carbon content of electricity) seems to be not appropriate, even if such differentiation has recently only been applied with regard to the compensation of indirect costs from the EU ETS. Furthermore, the reflection of carbon intensities of production within and outside the EU is probably questionable if the carbon intensity is not zero outside the EU: In a system with a fixed cap any carbon price-driven relocation outside the EU ETS regulated area leads to higher emissions from a global perspective if the carbon intensity at the target region of relocation is more than zero. As a result, these relocations must be considered as carbon leakage.

Although none of the arguments made in the study are very new, some proposals on re-definition of the indicators for assessing the eligibility for compensation measures merit further debate. However, some proposals seem to be somewhat arbitrary (why should, for example, revenues be a better approximation of profit rates than gross value added?).

The study excludes another important and emerging use of the EU ETS leakage indicator: How could these indicators support a pre-assessment of options to combat carbon leakage and help to find the appropriate level of compensations measures as free allocation? The use of carbon cost metrics with consideration of free allocation is likely

to be an interesting way of checking certain measures with regard to their effectiveness.

Last but not least, there are some proposals on complementary or alternative criteria to the established set of criteria and thresholds, e.g. historical sectorial price elasticities as potential metrics to assess the exposure to carbon leakage. These new proposals are certainly far from perfect (as the incumbent indicators are) but should be seriously discussed in terms of obviousness, practicalities, compatibility, etc.

5 Options to mitigate leakage

The fourth part of the analysis is a standard-type discussion of the options for dealing with the exposure to carbon leakage. The main lines of this (reducing the effective carbon price, compensation, levelling the playing field, exemptions) have been subject to wide and in-depth discussions. The study presents a state-of-the-art discussion of the theoretical concepts and practical experiences along the criteria of effectiveness, economic efficiency, feasibility and administrative costs. The results are not surprising:

- border carbon adjustments appear to be the most effective option but for the practical and political feasibility one should remember the failed inclusion of international aviation in the EU ETS as a pilot attempt to establish a mechanism which is close to border adjustments; and
- free allocation seems to be the second-best option, depending on the frequency of updating, which must always be assessed against the erosion of the carbon price signal due to updating.

The finding that the assessment of different pathways for dealing with carbon leakage might change is unsurprising if the carbon price (difference) evolves to more significant levels over time. Based on the detailed sector analysis presented in the study, one might wonder whether the discussion on counter measures should focus on a single mechanism. Given the different exposure for different sectors and the two different leakage channels of relocation of production versus relocation of investments, it may be worthwhile undertaking more in-depth research of more tailor-made or sector-specific hybrid-mechanisms to combat carbon leakage (as many ETSs worldwide are themselves tending to emerge as hybrid mechanisms, e.g. with price corridors, market stability reserves). This falls, however, outside the scope of the study.