

## Beyond Carbon Leakage: Off-Shoring of Employment and GDP in Decarbonizing International Supply Chains

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### Introduction

Industrial decarbonisation is a major challenge in terms of both emissions reduction and the “just transition” element of the 2015 Paris Agreement. It raises issues of potential carbon leakage and associated off-shoring of jobs and economic value if carbon reduction policies impact the location decisions of industry. We use IO multipliers to help quantify the extent of these potential displacement effects. Focussing on cement production as a particular decarbonisation challenge, we consider the following research question: how might displacement of currently EU-based production activity impact jobs, GDP and CO<sub>2</sub> emissions at national and global levels?

We propose that economic multiplier metrics can help quantify the extent of these potential displacement effects. Using interregional input out methods, applied using the World Input-Output Database, we focus on cement production as a particular decarbonisation challenge, to consider the potential impacts of displacing currently EU-based production activity to other countries.

### Key results

We use “economic multipliers” to consider the extent to which emissions, jobs and value-added currently generated both within existing national EU-based industry and upstream supply chains may be displaced across borders and potentially increase if production were to relocate. We use German cement production as a case study.

We reviewed the direct and supply chain emissions of cement industries in a range of countries, including one other large cement-producing EU nation, Italy.

We found that Germany and Italy have very similar emissions “footprints” per \$1m of final demand (respectively 0.91 and 0.94 kilotonnes of CO<sub>2</sub> produced throughout the global economy per \$1m of final demand served by the national industry). We also considered three examples of non-EU cement producing nations: Turkey, USA and China. For these countries, emissions per \$1m of final demand tend to be higher. The multiplier value is 1.33 kilotonnes (kt) for the US, 1.79kt for China, although with Turkey more in line with Germany and Italy at 1.0kt (and lower than other EU nations such as Spain and Poland).

The first key insight that can be drawn is that relocating cement production outside of the EU is likely to generate a spatial displacement of CO<sub>2</sub> emissions and an overall increase in global CO<sub>2</sub> emissions.

A second key result can be drawn from considering comparable multiplier results for GDP and jobs. Here we find that off-shoring of emissions is likely to be accompanied by displacement of GDP generation overseas. This may be associated with a net increase in global employment. Turkey and China have significantly higher numbers of direct and supply chain jobs associated with each \$1m of final demand than do Germany, Italy and the USA. On the other hand, the wider GDP value of each job is lower. If we are interested not only in the level but also the quality of employment, we might be concerned at this potential consequence of off-shoring cement production.

A third key result is the importance of domestic supply chain employment associated with cement production. In particular, we analysed the breakdown of supply chain jobs located within Germany itself for German cement production and found that 38% of these are in the services sectors.

Finally, we analysed cross-border linkages between German cement production and supply chains

in other EU states. We found that, because of the interconnectedness of EU members' economies, the wider EU supply chain GDP associated with German cement production is substantial, in particular for the Netherlands.

### Conclusions

Our paper presents an example of the type of broader economy analysis that is essential to inform policy consideration of the full range of impacts of potential decarbonisation solutions in terms of actions that may induce retention or relocation of industry activity.

More generally, our analysis highlights the importance of considering how shifting locations for manufacturing processes (such as cement production) from their current locations to ones with less strict environmental regulations may lead not only to an increase in global CO<sub>2</sub> emissions but an off-shoring of jobs and GDP that may violate the "just transition" imperative of the Paris Agreement. In particular, multiplier analyses permit consideration of how jobs and GDP off-shoring will impact not only in the industry itself or be limited to the original host region through a chain of upstream supply chain impacts.

This focuses attention on the need to decarbonise industrial activities in their current locations, by means that do not negatively impact key performance indicators for both industry and the wider economy, such as competitiveness.