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Carbon leakage and the future of Old Industrial Regions[1]

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CO2 prices will continue to differ from one country to another even if a global post-Kyoto agreement is achieved. This may decrease the competitiveness of some industries. One of most exposed industries in Europe is iron and steel, as it is highly CO2-intensive and relatively open to international trade. Most studies estimate for this sector a level of relocation ranging from 1.5% to 35%. This might seem a relatively small macroeconomic impact if measured at country or EU level. However, the picture may be quite different if the analysis is conducted at sub-national level. Most of the studies conducted are applied to a large geographical scale when the fact is that in Europe this industry is highly concentrated in certain specific region, i.e.,. the so-called Old Industrial Regions (OIR). This paper seeks to analyze the impact that different levels of relocation of the iron and steel industry have in the OIRs.

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1. Introduction

CO_2 emissions are being increasingly scrutinized, regulated and priced. There is an extensive body of literature focusing on the economics of CO2 control at global level (Nordhaus 2009), at country level (Strachan and Kannan 2009) and also at regional level (Gonzalez-Eguino and Dellink 2007). However, given the stringency of the policies required and the differences between countries, a growing literature is now examining how these asymmetries can affect competitiveness (IEA 2005).

One of the main concerns in the EU in regard to establishing more stringent cuts in emissions within the European Trading System (ETS), or auctioning more permits, has been precisely the fear of losing competitiveness in some industries. The iron and steel industry, which is included in the ETS, is one of the most exposed industries in Europe to carbon leakage; since it is both highly CO_2-intensive and relatively open to international trade (Hourcade et al 2008).

Some studies have focused specifically on the impact of the CO2 price on the iron and steel sector (e.g. Gielen and Moriguchi 2002, OECD 2002, Hidalgo et al. 2002, Demailly and Quirion 2008).There is, however, an important gap in the literature. So far, all the studies have looked into a large geographical scale, either at country level (Japan, US, China) or at supra-national level (UE-27, Asia). This means that an important feature of this sector is omitted: the fact that from its origin this industry has been highly concentrated in specific regions (the so-called Old Industrial Regions, OIR). For instance, in Spain it is mainly concentrated in the Basque Country, and in the UK in Wales and North-West England. This adds extra importance to comprehending the impacts and learning who the losers will be.

This *policy brief* analyses the impact of the carbon leakage and relocation phenomenon on a geographical scale better suited to the intrinsic characteristics of the iron and steel industry. The analysis centres on the Basque Country; an OIR that produces 10% of EU's total output from Electric Arc Furnace (EAF) mills.

2. Case study: the Basque Country

Old Industrial Regions OIRs (Birch et al 2009) are regions (see Figure 1) that were at the forefront of early industrialisation in the European economy, geared to the exploitation of coal and other raw materials, and more importantly a high proportion of their activity remains focused on heavy industry and energy intensive sectors. The key drivers of these economies are the production of capital goods and infrastructure industries such as iron and steel, shipbuilding, heavy engineering and railway engineering. Despite progress and efforts to diversify, these regions continue to rely upon these traditional sectors.

The Basque Country has one of the highest concentrations of iron and steel producers in Europe (see Table 1) and a large processing industry which produces a wide range of steel products, especially long products, stainless steel and specialty steels. This sector accounts for nearly 50% of steel production in Spain and 10% of all the steel produced in Europe with EAF technology. Total production of raw steel in 2005 in Spain was 17.8 million tonnes, of which the Basque Country produced 6.9 million tonnes. The production of steel in the Basque Country can even be compared directly with some countries as a whole; its output is similar to that of Australia (7.6 million tonnes), the Netherlands (6.9), the Czech Republic (6.4) and Greater Indonesia (3.6). In fact, there are only 24 countries in the world that produce more steel than the

Basque Country. The steel industry provides 23,188 direct jobs in the Basque Country (2.5% of total employment) and accounts for 5.9% of Basque gross domestic product (GDP).

Figure 1**:** Old Industrial Regions in the Largest European States

Source: Birch, Mackinnon and Cumbers (2009)

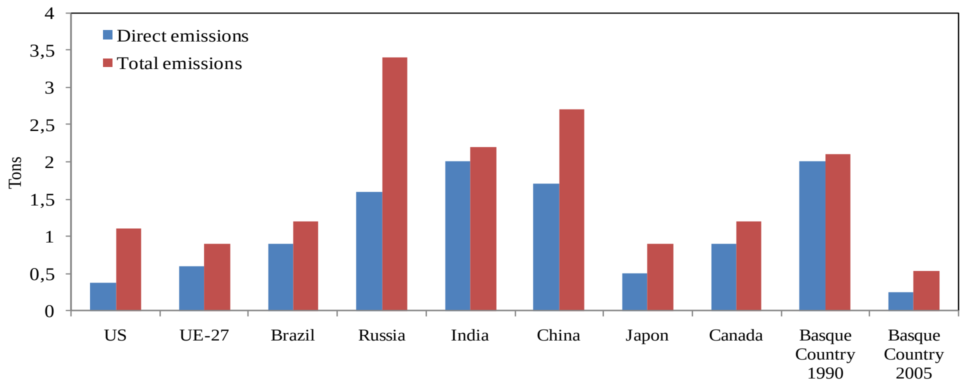
From 1990 to 2005 steel production grew by 10% while direct emissions of CO_2 resulting from the production process decreased from 3760 tCO2 to 1235 tCO2. This change is attributable to industrial restructuring and technological change (Ansuategi and Arto, 2004). After the industrial restructuring of the nineteen eighties, integrated steelmaking plants were closed and replaced entirely by several new EAF facilities. Currently all the steel produced in the region is made in mini-mills with EAF technology. On average, these are the least CO2 intensive plants in the world (see Figure 2). Thus, energy efficiency in the iron and steel industry in the Basque Country is very close to the current limits of technology and could only be substantially improved by new processes or innovations.

Table 1: % of output by region and sector, 2005

	Basque Country	Spain	EU-27
Agriculture, Fishing and Mining	1.2%	3.5%	2.7%
Industry	26.6%	15.8%	17.3%
Iron and Steel Industry	*8.9%*	*2.6%*	*2.4%*
Energy	3.0%	2.0%	2.1%
Construction	8.9%	11.5%	6.0%
Transport and communications	7.0%	6.9%	7.0%
Services	53.3%	60.2%	64.9%
Total	100%	100%	100%

Source: Eurostat, Regions- Economic Accounts

Figure 2: Carbon intensity of steel, 2005 (tonnes of CO2 per tonne of steel)



Source: ISSI and UNESID

3. The model

To analyze the economy-wide impacts of iron and steel sector relocation we use an applied general equilibrium (AGE) model. AGE models can capture the interdependencies between different economic agents. The iron and steel industry is implemented with a Leontief function which implies little capacity for technological changes aimed to reduce CO2 emissions. In order to include the relocation of iron and steel production in our model we assume that: (1) relocation is determined exogenously; (2) the reduction in production due to relocation is perfectly substituted with imports and (3) the proportion of capital related to the loss in production is also lost. Finally, we calibrated the model using a Social Accounting Matrix (SAM) for the Basque Country.

4. Results

Figure 3 shows the link between steel output reduction and GDP. The figure shows that a relocation of this activity of between 0 and 50% means a drop in GDP that may come close to 4%. This result reflects not only the direct impact of relocation but also its indirect effects.

Figure 3: Economic impact of the relocation of the iron and steel industry

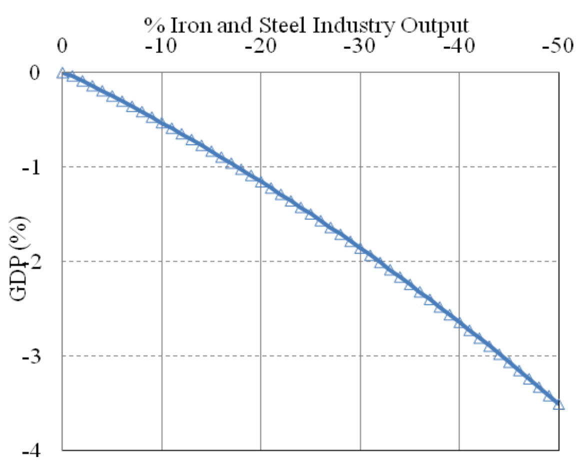


Table 3 shows the results broken down according to general variables, sector-related variables and energy-related variables for three exogenous relocation levels of reduction: 1.5%, 15% and 35%. The results show a high impact on Industry (-2.62% for a 15% relocation) due to the strong linkages of iron and steel with other industries. For high levels of relocation of the iron and steel industry, indirect effects also extend into Agriculture and Services. Another significant effect that can be measured is the impact on energy consumption. On the one hand, the relocation of the iron and steel industry induces a change that is proportional to the energy mix of the industry. Given that in the Basque Country iron and steel production is based entirely on EAF technology that consumes coal, gas and electricity, these are the energy inputs that show the highest reduction rates. On the other hand, the energy mix is also altered by the fact that most indirect effects affect heavy industry, which consumes more coal.

The model estimates that a relocation of iron and steel production of between 1.5 and 35% would entail reductions in CO2 emissions of between 0.23% and 4.42% (100 to 705 KtCO2). This effect captures both the direct reduction of CO2 emissions in the iron and steel industry and their indirect reduction in other sectors. Figure 7 shows a disaggregation of the two effects and highlights the importance of taking into account the indirect effects. The indirect reduction of CO2 accounts for almost half of the total effect. Finally, the reduction of CO2 emissions could be considered a positive outcome of the relocation of the iron and steel industry, since it results in less need for emissions allowances. For a price of 20€/TCO2 this would mean a saving of 2M€ to 14.1M€. However, if the real cost of this reduction in terms of GDP loss is examined the picture changes dramatically. To reduce emissions by 0.23-4.42% via relocation of the iron and steel industry, GDP would have to fall by between 0.09% and 2.26%. The real cost paid per unit of CO2 reduction is therefore between 187 €/Tco2 and 202 €/Tco2.

Table 3: General Results (%) for different levels of relocation of iron and steel production

Scenarios	-1,5%	-15%	-35%
General			
Utility	-0,05	-0,59	-1,62
GDP	-0,09	-0,92	-2,26
Consumption	-0,05	-0,59	-1,62
Investment	-0,19	-1,82	-4,25
Sectors			
Agriculture	-0,04	-0,40	-0,93
Industry	-0,27	-2,62	-5,66
Services	-0,15	-0,31	-1,02
Energy Consumption			
Coal	-0,36	-3,43	-7,36
Oil	-0,10	-1,01	-1,40
Gas	-0,29	-2,82	-6,34
Electricity	-0,27	-2,70	-6,06
Others			
Iron and Steel Output	1,50	15,00	35,00
CO2 emissions reduction	-0,23	-2,23	-4,42
Implicit cost of CO2 (€/Tco2)	187,8	191,9	202,1

Finally, the reduction of CO_2 emissions could be considered a positive outcome of the relocation of the iron and steel industry, since it results in less need for emissions allowances. For a price of 20€/TCO2 this would mean a saving of 2M€ to 14.1M€. However, if the real cost of this reduction in terms of GDP loss is examined the picture changes dramatically. To reduce emissions by 0.23-4.42% via relocation of the iron and steel industry, GDP would have to fall by between 0.09% and 2.26%. This means a total loss in Basque GDP of between 470 M € and 1686 M €. The real cost paid per unit of CO2 reduction is therefore between 187 €/Tco2 and 202 €/Tco2.

5. Conclusions

CO2 prices may decrease the competitiveness of some industries. This paper argues that analyses at a national scale might fail to reveal the importance of the impacts of relocation of some sectors such as the case of iron and steel industry in OIRs. The results of the AGE model developed to estimate these impacts in the Basque economy show that for a rate of relocation reported from the literature ranging from 1.5% to 35% the total loss in terms of GDP for that region may be as much as 2.26 %. This is clearly a very serious economic impact that cannot be fully appreciated in studies conducted at a national or supra-national geographical scale.

The paper shows that if the reduction in emissions is achieved through some degree of relocation of the iron and steel industry, then the cost of mitigation may rise to 200 €/tonne, whereas the same reduction can be achieved with other options at a lower cost. In fact, the range of cost per tonne of CO2 obtained from relocation would be by far the highest of any technological measure available to mitigate emissions. IEA (2005), for example, predicts that capture and storage (CCS) technology would cost in the range of 35 to 60$ per tonne of CO2. Even the most expensive measures for mitigating CO2 emissions, which are related to transformation of the transport sector and development of alternative fuels and vehicles, would not, according to IEA estimates, exceed 150 € per tonne of CO2.

Many different policy recommendations could be drawn from this analysis. In our view, the most important conclusion is that when designing climate policy special attention should be paid to the burden imposed on sectors prone to relocation. More specifically, we believe that environmental policy applied to industrial sectors should be the subject of careful design. These are usually sectors in which there is little room for further improvements in energy efficiency. Additional measures should be incorporated when needed to avoid or offset the undesired impacts of asymmetric global climate policy in OIRs.

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