



# **Climate change policies and the UK business sector: overview, impacts and suggestions for reform**

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## **Appendix 1**

### **Methodology for the assessment of competitiveness and innovation impacts**

**November 2013**

**Centre for Climate Change Economics and Policy  
Grantham Research Institute on Climate Change and  
the Environment**

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This policy paper is intended to inform decision-makers in the public, private and third sectors. It has been reviewed by at least two internal referees before publication. The views expressed in this paper represent those of the author(s) and do not necessarily represent those of the host institutions or funders.

## **Appendix 1 - Methodology for the assessment of competitiveness and innovation impacts**

This Appendix accompanies Chapter 4, *'The impact of climate change policies on competitiveness and innovation'*.

This Appendix comprises two parts:

1. The impact of the Climate Change Agreements
2. The impact of the European Union Emissions Trading System

### **1. The impact of the Climate Change Agreements**

In order to investigate the impact of Climate Change Agreements (CCAs) on businesses, we gathered financial information on a large sample of 3 million UK-based businesses, for the period 1997-2010. From these, we identified 2,834 businesses operating facilities with a CCA.<sup>1</sup>

To construct a counterfactual scenario of how the businesses subject to CCAs would have behaved had they been subject to the full CCL rate, we attempted to match each business with a CCA to a similar business without a CCA (and therefore subject to the full rate of the CCL). For a successful match to be made, businesses had to share similar turnover, employee and assets characteristics, and operate in the same economic sector (defined at the 3-digit level of NACE Rev. 2 sector classification codes). The control group was constructed based on data from 1997-2000. After the matching, calipers are applied to ensure that no matched businesses are too dissimilar in their turnover, employment and asset characteristics for the period 1997–2000 (see Figure 1.1 and Table 1.1 below).

The matches are constructed using Stata's user-written command 'nnmatch', which performs nearest-neighbour matching over a multidimensional set of variables (see Abadie et al., 2004, for details). We used matching with replacement, so that each business with a CCA in place could be matched to one or more businesses without a CCA, depending on how many similar firms could be found in the control group. A maximum of four matches per business were allowed.

It was not possible to match all 2,834 businesses that are operating facilities with a CCA to one or more similar businesses without a CCA agreement. This was for two main reasons. Firstly, historical records for turnover, assets and employment are incomplete. For the period 1997-2000, records for turnover, employment and assets are only available for 435 of the 2,834 CCA firms identified. Secondly, as one might expect, similar firms are similarly likely to apply for and receive a CCA. Therefore,

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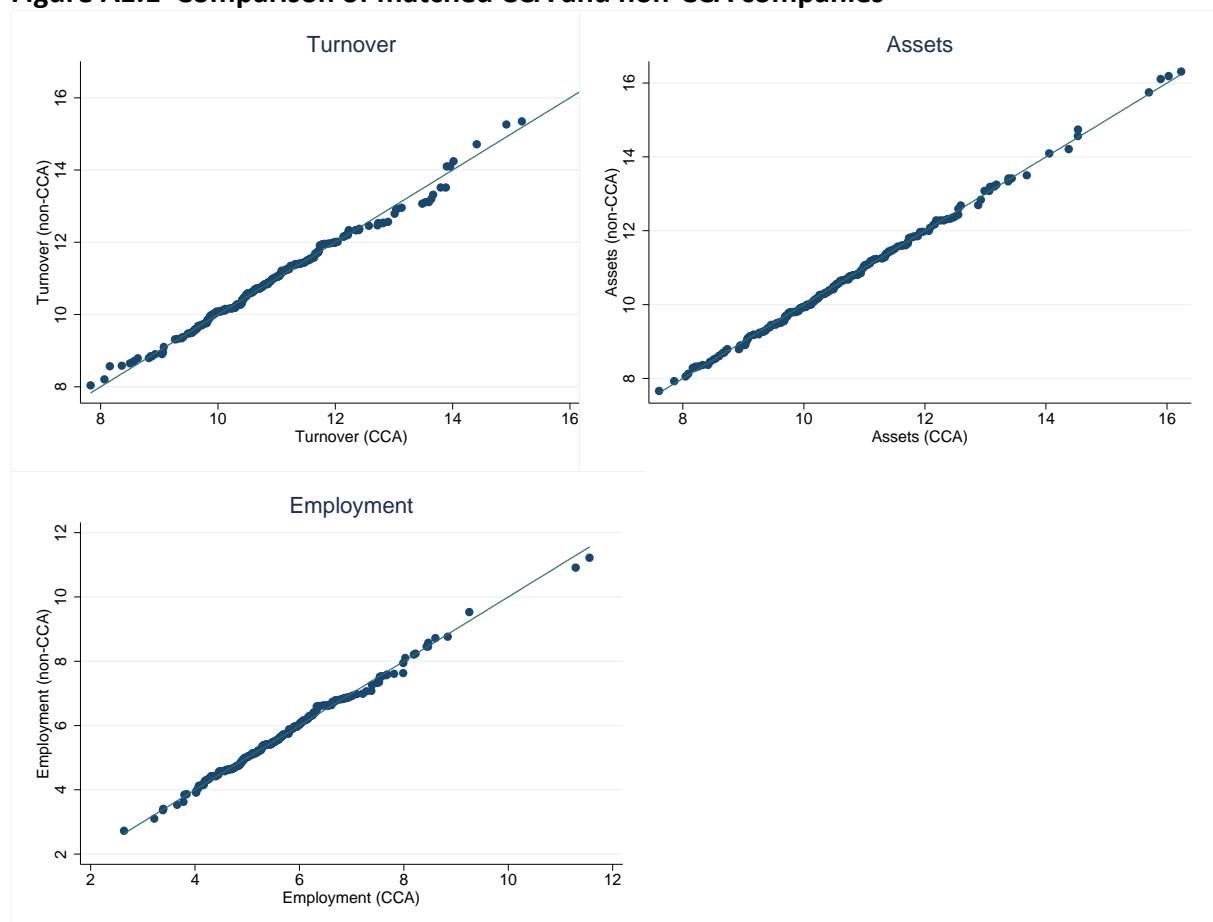
<sup>1</sup> Note that poultry meat rearing and processing facilities are not included in the analysis. This represents about 800 CCA facilities.

due to a lack of suitable comparators, the sample of businesses with a CCA that could be successfully matched to businesses without a CCA was reduced to 250.

For each of the 250 CCA firms we have found at least one non-CCA firm that shares turnover, employee and asset characteristics, and that operates in the same economic sector. This means that the firms are likely to be exposed to much the same business and regulatory environment, input prices, and sector specific shocks and trends. The resulting matched sample consists of 250 CCA firms and 251 non-CCA firms.

Figure A1.1 compares the empirical distributions of CCA and non-CCA firms in our matched sample on the variables used to construct the match (i.e. turnover, employment and assets). CCA and non-CCA firms are visually indistinguishable. Table A1.1 confirms this result statistically. We cannot reject the hypothesis that the empirical distributions are the same across the EU ETS and non-EU ETS firms at conventional levels of statistical significance.

**Figure A1.1 Comparison of matched CCA and non-CCA companies**



**Table A1.1 Comparison of matched CCA and non-CCA companies**

Matching variable	Positive differences		Negative differences		Z	p-value
	Obs.	Sum	Obs.	Sum		
Turnover	121	15589	125	15776	-0.082	0.9349
Assets	127	17438	123	13937	1.529	0.1261
Employment	120	14754	126	16610	-0.811	0.4175
Economic sector	Exactly matched					

To examine the impact of joining a CCA on businesses, we compare turnover and employment data from before (using data from 1997–2000) and after (using data from 2001–2010) CCAs were introduced, and measure the difference. This means that, even after matching, we take account of any additional time invariant firm-level heterogeneity. The outcomes of the matched control firms, all of which are subject to the full CCL rate, are then subtracted from the outcomes of the CCA firms to obtain the difference-in-differences.

The result of the difference in differences estimation is presented in Tables A1.2 and A1.3. As the data shows, the CCL has no statistically significant negative impact on the turnover and employment levels of businesses to whom the full rate applies (i.e. they do not have a CCA). On the contrary, businesses paying the full rate of the CCL seem to have marginally increased both their turnover and their employment levels compared to exempted businesses, although the increase relative to businesses with a CCA is not statistically significant.

**Table A1.2 Difference in differences – Log Turnover**

	Pre	Post	
Treatment (CCA)	10.913 (0.087)	10.961 (0.087)	
Control (CCL)	10.917 (0.084)	11.033 (0.089)	Treatment effect
T-C Difference	-0.004 (0.121)	-0.072 (0.125)	-0.068 (0.174)

**Table A1.3 Difference in differences – Log Employment**

	Pre	Post	
Treatment	5.711 (0.076)	5.581 (0.074)	
Control	5.722 (0.075)	5.630 (0.081)	Treatment effect
T-C Difference	-0.012 (0.107)	-0.049 (0.109)	-0.037 (0.153)

## 2. The impact of the European Union Emissions Trading System

In order to investigate the impact of the European Union Emissions Trading System (EU ETS) on businesses, we gathered financial information on a large sample of 3 million UK-based businesses over the period 2000-2010. From these, we identified 578 businesses operating facilities regulated under the EU ETS.

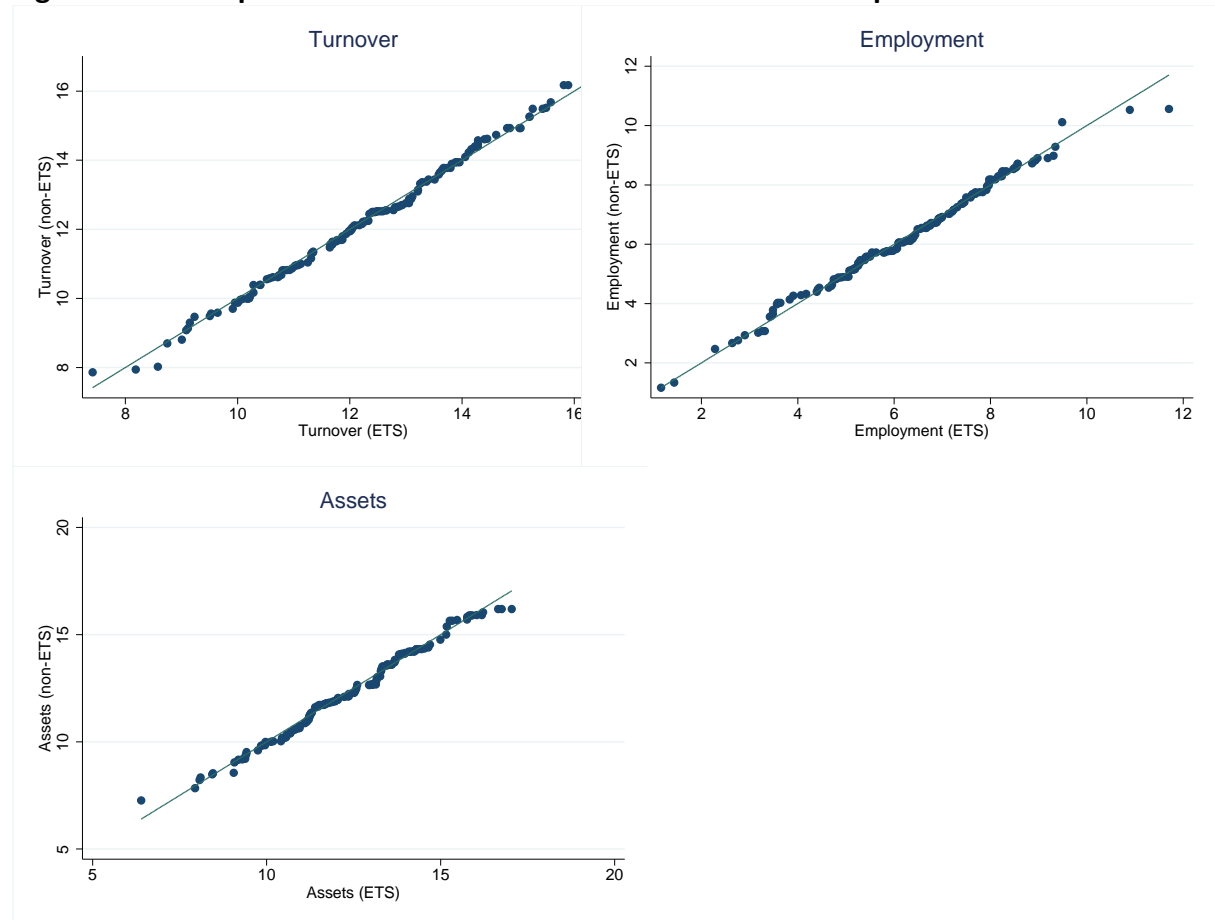
To construct a counterfactual scenario of how the businesses subject to the EU ETS would have behaved had they not been subject to the EU ETS, we attempted to match each business for who the EU ETS applies with a similar business that does not fall under the EU ETS because of inclusion criteria based on installation size. For a successful match to be made, businesses had to share similar turnover, employee and assets characteristics, and operate in the same economic sector (defined at the 3-digit level of NACE Rev. 2 sector classification codes). The matching process also considered CCA participation prior to the implementation of the EU ETS. The control group is constructed based on data from 2000-2004.

The matches are again constructed using Stata's user-written command 'nmatch'. We use matching with replacement. After the matching, calipers are applied to ensure that no matched groups are too dissimilar in terms of turnover, employment and assets in the period 2000–2004 (see Table 1 and Figure 1 below).

The UK has 578 UK businesses with facilities covered by the EU ETS. It is not possible to match all of them to a similar business not covered by the EU ETS, either because data on their turnover, employment and assets is incomplete (this data was only available for 208 out of the 578 EU ETS firms), or due to a lack of suitable comparators. Nevertheless, 146 matches can be made.

Figure A1.2 compares the empirical distributions of EU ETS and non-EU ETS businesses in our matched sample on the variables used to construct the match (i.e. turnover, assets and employment). EU ETS and non-EU ETS firms are visually indistinguishable. Table A1.4 confirms this result statistically. We cannot reject the hypothesis that the empirical distributions are the same across the EU ETS and non-EU ETS firms at conventional levels of statistical significance.

**Figure A1.2 Comparison of matched EU ETS and non-EU ETS companies**



**Table A1.4 Comparison of matched EU ETS and non-EU ETS companies**

Matching variable	Positive differences		Negative differences		Z	p-value
	Obs.	Sum	Obs.	Sum		
Turnover	71	4938	74	5792	-0.834	0.4042
Assets	73	6131	73	4600	1.495	0.1348
Employment	67	5285	77	5443	-0.154	0.8773
Economic sector	Exactly matched					
CCA participation	Exactly matched					

To examine the impact of joining the EU ETS on businesses, we compare turnover and employment data in the matched sample of firms before (using data from 2000-2004) and after (using data from 2005-2010) the EU ETS was introduced, and measure the difference. This means that, even after matching, we take account of any additional time invariant firm-level heterogeneity. The outcomes of the matched control firms are then subtracted from the outcomes of the EU ETS firms to obtain the difference-in-differences.

The result of the difference in differences estimation is presented in Tables A1.5 and A1.6. As the data shows, the EU ETS has had no statistically significant negative impact on businesses. On the contrary, businesses regulated under the EU ETS appear to have marginally increased both their turnover and their employment levels compared to similar unregulated business, but this increase is not statistically significant.

**Table A1.5 Difference in differences – Log Turnover**

	Pre	Post	
<b>Treatment (EU ETS)</b>	12.239 (0.151)	12.356 (0.160)	
<b>Control (CCL)</b>	12.206 (0.154)	12.257 (0.174)	<b>Treatment effect</b>
<b>T-C Difference</b>	0.033 (0.216)	0.099 (0.236)	0.065 (0.320)

**Table A1.6 Difference in differences – Log Employment**

	Pre	Post	
<b>Treatment</b>	6.283 (0.152)	6.262 (0.147)	
<b>Control</b>	6.277 (0.148)	6.163 (0.155)	<b>Treatment effect</b>
<b>T-C Difference</b>	0.006 (0.212)	0.099 (0.213)	0.093 (0.301)