Modelling the impacts of changes in economic activity on consumption measures of pollution generation

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Introduction

- As an accounting framework, input-output tables and demand-driven multipliers absolutely appropriate for pollution attribution

- Provide all the required information on pollution embodied in inter-sectoral interactions and inter-regional trade flows

- However, as a model of how economy adjusts in response to a given change (policy or other disturbance), input-output only one very special case of a wider set of economy-wide (general equilibrium approaches)

- Our ESRC CCLF; combining input-output accounting with more flexible computable general equilibrium (CGE) modelling, with focus on changes in both domestic and trade activity to permit consumption accounting of pollution generation

CGE models

- Incorporate input-output accounts as their core database

- Multi-sectoral, single or multi-region/nation

- Actively model both demand and supply behaviour, price and quantity determination

- May examine different theoretical perspectives of how key markets function, and impacts of key variables in adjustment process

- Use CGE results to generate 'post-shock' input-output accounts; revert to IO methods to examine structure of pollution problem from production and/or consumption accounting perspective

Example – export demand boost

- 'An integrated IO and CGE approach to analysing changes in environmental trade balances' by K. Turner, M. Gilmartin, P.G. McGregor and J.K. Swales, in press with *Papers in Regional Science*, doi:10.1111/j.1435-5957.2011.00365.x.

- 2 UK regions – Scotland and rest of UK (RUK); one external exogenous region, ROW (but with export and import demands responsive to changes in prices)

- Illustrative 10% increase in international demand for RUK manufacturing
  - May have more focussed (e.g. Welsh case – expansion at Port Talbot steelworks)

- Examine impacts of different assumptions regarding functioning of regional labour markets

Table 1. The CO2 Trade Balance Between Scotland and RUK (tonnes, millions) - Type I Input-Output

	Pollution supported by:								Total regional
	Scottish HH	Scottish Govt	Scottish Capital	Scot-ROW	RUK HH	RUK Govt	RUK Capital	RUK-ROW	emissions of CO2
Pollution generated in:									
Scotland	21.9	4.5	2.3	8.0	8.0	0.9	1.5	**1.8**	48.9
RUK	6.4	1.4	2.2	2.6	328.3	36.7	48.9	**89.0**	515.5
Total (UK) emissions supported by	28.3	5.9	4.5	10.7	336.3	37.6	50.4	**90.8**	564.4
Environmental trade balance:									
Scot pollution supported by RUK final demand	12.2								
RUK pollution supported by Scot final demand	12.6								
Scotland's CO2 trade surplus	-0.4								

Table 5. Long run impact of RUK export demand stimulus on the Type I CO2 Trade Balance Between Scotland and RUK (% change from base year values) - Flow Migration

	Pollution supported by:								Total regional
	Scottish HH	Scottish Govt	Scottish Capital	Scot-ROW	RUK HH	RUK Govt	RUK Capital	RUK-ROW	emissions of CO2
Pollution generated in:									
Scotland	-0.82%	-0.14%	-1.20%	-2.45%	0.33%	-0.84%	-0.26%	**4.27%**	-0.65%
RUK	-1.20%	-0.41%	-1.58%	-3.15%	0.78%	-0.34%	0.03%	**5.06%**	1.31%
Total (UK) emissions supported by	-0.91%	-0.20%	-1.38%	-2.63%	0.77%	-0.35%	0.02%	**5.04%**	1.14%
Environmental trade balance:		Tonnes, millions							
Scot pollution supported by RUK final demand	0.75%	12.30							
RUK pollution supported by Scot final demand	-1.59%	12.44							
Scotland's CO2 trade surplus/deficit	-69.1%	-0.13							

Example – labour productivity improvement

- Paper just completed – 'Productivity growth, decoupling and pollution leakage', co-authored Nick Hanley and others. Available soon at ***Stirling Economics Discussion Papers,*** http://www.management.stir.ac.uk/documents/SEDP

- Also Scotland and rest of UK – illustrative 5% increase in Scottish labour efficiency

- But key, types of disturbances can examine, types of effects can pick up and track over time etc

Price and competitiveness effects

- Demand boost – tends to have positive multiplier effects on domestic production and imports

- But, if any constraints on supply, upward pressure on prices, impacting competitiveness

- Supply-side improvement, e.g. efficiency, will also have positive multiplier effects but where lower cost of production, downward pressure on prices, increased competitiveness

- Stimulate exports, economic growth, PAP and CAP, but with reduced reliance on imports

Table 1. Impacts of a 5% increase in Scottish labour productivity in Scotland and the rest of the UK (RUK)
(% change from base year values)

	Scotland			RUK		
	Base	**SR**	**LR**	**Base**	**SR**	**LR**
GDP (£m)	88,351	2.548%	7.703%	967,744	0.014%	-0.170%
Household Consumption (£m)	54,923	2.769%	3.557%	621,187	0.012%	-0.237%
Aggregate consumption (Households and Government, £m)	79,630	1.910%	2.453%	846,395	0.009%	-0.174%
Exports to other region (£m)	34,876	1.493%	7.814%	36,480	2.106%	0.094%
Imports from other region (£m)	36,480	2.106%	0.094%	34,876	1.493%	7.814%
Exports to ROW (£m)	15,706	1.675%	7.735%	249,595	-0.013%	0.380%
Imports from ROW (£m)	18,329	2.000%	-0.373%	304,359	0.040%	-0.611%
PAP						
Total CO_2 generation (kilo-tonnes)	52,790	2.480%	6.865%	578,294	0.046%	0.000%
CO2/GDP (kilo-tonnes per £1million)	0.598	-0.066%	-0.778%	0.598	0.031%	0.170%
CAP (relaxed DTA)						
Total CO_2 generation (kilo-tonnes)	62,659	3.152%	3.061%	626,180	0.016%	-0.097%
CO2/GDP (kilo-tonnes per £1million)	0.709	0.589%	-4.309%	1	0.002%	0.073%
CO2 embodied in imports from ROW	18,236	2.489%	0.760%	172,164	-0.001%	-0.594%

Table 2. Increase (kilo-tonnes) in CO2 embodied in imports from ROW to the UK regional and national economies in response to the increase in Scottish labour productivity

	Central case			Government expenditure endogenous		
	Scotland	RUK	UK	Scotland	RUK	UK
CO2 embodied in imports from ROW (kilo-tonnes)	139	-1,024	-885	254	144	398
CO2 embodied in imports of commodities						
1. Energy	203	-494	-291	242	-154	88
2. Extraction, Quarrying, Construction and Water Suppy	11	-42	-31	14	-14	-1
3. Agriculture & Fishing	4	-31	-26	7	4	11
4. Manufacturing	-21	-248	-269	9	204	214
5. Retail, Distribution and Transport	-50	-190	-240	-13	80	68
6. Other services	-8	-20	-28	-5	23	18

Where do we go from here?

- Scottish and UK CAP measures in second example draw on ESRC CCLF collaboration between Cardiff, Stirling, Strathclyde, Surrey and West Virginia and with Norihiko Yamano, OECD

- Now plan to build towards fuller international analysis (with particular focus on issue of foreign direct investment on PAP and CAP indicators/targets), bringing in colleagues, Taoyuan Wei, international CGE modeller at CICERO, Oslo.

- But basic principles as above

- Thank you for listening

- Questions?