Carbon emissions and the economic impact of healthy eating in Scotland

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Abstract

This article uses on-going research at the Fraser of Allander Institute that explores the possibility of a policy "triple win" in the area of healthy eating. It shows that were food consumption in Scotland to follow healthy eating guidelines, it would not only improve the health of the population, but also have positive environmental impacts and may even be associated with positive economic impacts as well. We demonstrate that were healthy eating in Scotland to become more prevalent it would impact positively on several stated Scottish Government policy objectives in health, environment and the economy.

Introduction and background

It is well known that red meat is a particularly inefficient and carbon intensive way of generating calories for human consumption. For each calorie of meat produced, many calories of grain and other vegetable crops have to be grown to feed livestock. To the extent that arable farming has a certain emissions consequence per human calorie supplied, livestock production clearly multiplies these emissions per calorie produced. And, this is before we take into consideration the methane produced by livestock, which further adds to climate change emissions.

So, red meat consumption matters for climate change. It also matters for health, with high red meat diets associated with increased incidence of type II diabetes, heart disease and certain kinds of cancer. This immediately suggests the prospect of a policy win-win: if, somehow, we can eat in accordance with healthy eating guidelines (reducing calorie intake generally, but especially from red meat consumption) then not only will it help meet health policy outcomes, it may also reduce climate change emissions with consequential environmental benefit.

In a study conducted by researchers at the Oxford Martin School, Springmann et al (2016) found that "*transitioning toward more plant-based diets that are in line with standard dietary guidelines could reduce global mortality by 6–10% and food-related greenhouse gas emissions by 29–70% compared with a reference scenario in 2050*". So such a dietary shift would have positive health and environmental benefits, but what might be the economic impacts?

Springmann et al (2016) do not consider the economic impact of such a dietary shift. If demand for food, and especially red meat, falls then, in the absence of any increases in demand for other goods, GDP and employment are likely to fall too. As part of a project now underway at the Fraser of Allander Institute, we consider the climate change and macroeconomic impacts of such

a change in consumer demands toward a more healthy diet in Scotland on the Scottish environment and economy.

The Scottish Government aims (see Scottish Government, 2015) to create "*a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth*". This is underpinned by the recently released Climate Change Plan (currently under consultation, see Scottish Government, 2017), which recognises the role of agriculture in emissions and noted the possible economic benefits of a reduction in emissions from agriculture. To what extent can a shift in consumer demand for food and red meat contribute to achieving these policy objectives?

1. Red meat and the food industry in the Scottish economy

Table 1: SIC industries that constitute the Food & Drink sector in Scotland

	GVA (£m)	%Scot	Employment (no. of employees)	%Scot	Exports (£m)	%Scot	Other Final Demand (£m)	%Scot
Agriculture	1,142	0.9%	39,778	1.8%	889	1.4%	931	0.9%
Fishing	74	0.1%	3,410	0.2%	157	0.2%	6	0.0%
Aquaculture	120	0.1%	4,049	0.2%	337	0.5%	4	0.0%
Meat processing	201	0.2%	5,743	0.3%	864	1.3%	230	0.2%
Fish & fruit processing	305	0.2%	7,361	0.3%	938	1.4%	241	0.2%
Dairy products, oils & fats processing	130	0.1%	2,670	0.1%	346	0.5%	237	0.2%
Grain milling & starch	19	0.0%	251	0.0%	63	0.1%	8	0.0%
Bakery & farinaceous	408	0.3%	10,928	0.5%	704	1.1%	290	0.3%
Other food	214	0.2%	4,829	0.2%	397	0.6%	124	0.1%
Animal feeds	55	0.0%	975	0.0%	134	0.2%	26	0.0%
Spirits & wines	2,205	1.8%	9,335	0.4%	3,628	5.6%	179	0.2%
Beer & malt	107	0.1%	1,178	0.1%	141	0.2%	41	0.0%
Soft Drinks	170	0.1%	2,038	0.1%	321	0.5%	77	0.1%
Total	**5,149**	**4.2%**	**92,544**	**4.2%**	**8,919**	**13.8%**	**2,393**	**2.3%**

Source: *Scottish Government (2016)*

Scotland's Economic Strategy (see Scottish Government, 2015) identifies 'key sectors' where Scotland has a distinct comparative advantage, `Food & Drink' is one of them. In terms of standard industrial classifications (SIC), the Food and Drink sector includes : Agriculture; Fishing; Aquaculture; Meat Processing; Fish & fruit Processing; Dairy Products, Oils & Fats Processing;

Grain Milling & Starch; Bakery & Farinaceous; Other Food; Animal Feeds; Spirits & Wines; Beer & Malt; and, Soft Drinks (refer Table 1). Using 2013 data (see Scottish Government, 2016), the Food and Drink sector generates 4.2% of Scottish Gross Value Added (GVA) and employment, 13.8% of exports (defined as exports both to the rest of the UK and international destinations), and supplies 2.3% of Scottish final demand.

The Scottish Government produces economic accounts, known as Input-Output (IO) tables, that describe the structure of production and the components of final demand in the Scottish economy, at a highly disaggregated level. The Scottish economy is disaggregated into 98 different industrial sectors, including the 13 industrial sectors that comprise Food & Drink. The full IO tables show, in columns, what firms in each sector buy from all other sectors and what they import for use in production, plus the wages, profits and taxes that these firms pay. Across rows, the IO tables show what firms in each of sector sell to all other sectors for use in production, and also what they sell to households, governments, and what they export. The interconnectedness of the Scottish economy, and the input/output relationships between different industrial sectors and their contribution to final demand within the Scottish economy is thus shown in these Input / Output (IO) economic accounts.

The Scottish IO tables shows that there are strong links between the industries which make up the Scottish Food & Drink sector. For example, Meat Processing purchases inputs from Agriculture (e.g. meat), which in turn purchases inputs from Animal Feeds, which in turn purchases inputs from Agriculture (plant foods). But there are also links between the industries that constitute the Food & Drink sector and the wider economy. For example, Food and Drink industries use the haulage industry to transport their output to final markets and destinations. Hence, this means that any reduction in consumer expenditure on the output of one industry – such as Meat Processing - will have spillover effects on the levels of activity in other industries, especially (but not limited to) the other industries of the Food & Drink sector (e.g. in transport).

Given the differential carbon intensity of red meat consumption as compared to the consumption of other foods, it would be useful to be able to disaggregate the agriculture sector in the IO table into “red meat” and “other agriculture” sub-sectors. Fortunately, Moxey (2016) has done much of the work to do this in a report for Quality Meat Scotland. This research uses Moxey’s disaggregation of the Agriculture sector, to help allocate food and drink carbon emissions to red meat consumption and to other food and drink consumption.

2. Carbon emissions

Carbon emissions at a national level can be considered using two alternative perspectives: production-oriented territorial emissions and the consumption-oriented carbon footprint. Territorial emissions are those actually produced within a territory and therefore include the emissions generated from the production of goods which will be exported and consumed outside

a territory. The carbon footprint conversely seeks to measure the emissions associated with the production of all goods consumed by the residents of a territory, wherever in the world they are actually emitted. All goods and services imported into Scotland for consumption by Scottish residents will have emissions associated with their production which appear in the territorial emissions of another country – the carbon footprint metric allocates these emissions to Scotland; while all goods and services produced in Scotland but exported for consumption by the residents other countries will have emissions associated with their production which appear in Scottish territorial emissions – the carbon footprint metric does not allocate these emissions to Scotland. Scotland's estimated carbon footprint, at 95MtCO_2e (Scottish Government, 2017b), is much higher (almost twice as high) than its territorial emissions of 51MtCO_2e (National Atmospheric Emissions Inventory, 2016). This reflects the facts both that Scotland imports more than it exports (where exports and imports are both to/from the rest of the UK and to/from international destinations), and that its imports are much more carbon intensive than its exports, as is normally the case for an advanced, service sector dominated economy, like Scotland.

Table 2: Scotland's Territorial Carbon Emissions and Carbon Footprint

	Values (£m)	**Emissions (MtCO_2e)**	
Production	232,964	47.1	
International Transport		2.3	
Land Use Changes		1.7	
Gross Output	**232,964**	**51.1**	**Territorial Emissions**
rUK Intermediate Imports	28,476	8.6	
International Intermediate Imports	16,588	28.9	
Less Total Intermediates	(105,987)		
Total Final Goods	**172,042**	**88.6**	
Exports	(67,931)	(20.8)	
rUK Final Good Imports	19,707	5.3	
International Final Good Imports	13,172	22.3	
National Income	**136,991**	**95.4**	**Carbon Footprint**

Table 2 shows how we can reconcile Scotland's territorial emissions with its carbon footprint, under the assumption that Scotland's exports are as carbon intensive as its consumption from domestic production, and assuming that economic activity in the rest of the UK is as carbon intensive as it is in Scotland. Productive economic activity in Scotland takes place and (in

combination with international aviation and shipping emissions and emissions from land use changes) is associated with Scotland's territorial emissions of 51MtCO_2e. This activity relies on imported intermediate goods which also have caused emissions in their production outwith Scotland, and these emissions must be added as being associated with Scottish production. However, not all Scottish production is consumed by Scottish consumers, and so we can subtract the emissions associated with Scotland's exports. Conversely, we must add the emissions associated with final goods imports into Scotland in order to reach the Carbon Footprint total of 95MtCO_2e.

The territorial emissions, and the emissions associated with imported intermediate goods and services, can then be allocated to economic activity in specific sectors, while emissions associated with final goods imports can be associated with consumer demand for specific goods.

3. Scenarios and results: environmental and economic impacts of healthy food consumption

In this section we are interested in the impact of a change in consumer expenditures on Food & Drink, in line with healthy eating guidelines, on economic activity and carbon emissions in Scotland. We model this using the Input-Output framework, and as described below, we create two scenarios that represent the extremes of what households can do with the money that they now do not spend on food and drink: that is they either entirely save this money or they entirely spend it on other goods and services. Both scenarios, however, feature the same reduced expenditure on the output of the Food & Drink sector.

We use the healthy eating guidelines described in Springmann et al (2016) which approximate to a 39% reduction in calories from red meat, and a 3% reduction in calories from other foods and drinks. Assuming that there is a one to one correspondence between expenditure and calories, the healthy eating scenario is assumed to be a 39% reduction in household expenditure on the output from the Red Meat and Meat Processing industries, and a 3% reduction in household expenditure upon the output of all the other Food & Drink sector industries.

The two scenarios differ in terms of what these consumers are assumed do with the money they have saved from their reduction in food and drink expenditures. In the first scenario, household expenditure on food and drink is reduced as described and nothing else changes (i.e. the money is saved). The second scenario assumes that household expenditure in total is unaltered, and the reduction in food expenditure is compensated by an increase in expenditure across all other discretionary goods (in proportion to current households' expenditure on these items – this turns out to require a 0.5% increase in such expenditure). Discretionary goods are identified as all those goods in the economy other than public services, accommodation costs and legal and financial services (i.e. the assumption is that, just because food expenditure has gone down, this does not mean that, for example, rent or insurance costs have gone up, or that the government

starts taxing households more in order to fund and spend more on public services). Both of these scenarios are modelled using an Input-Output framework as previously described.

Table 3: Scenario results

Households	GVA		Employment		Incomes					
	(£m)	%	(no e'ees)	%	(£m)	%	Emissions Territorial		(ktcO2e/%)	Footprint
Save the money	-103	-0.1%	-3076	-0.1%	-51	-0.1%		-1.0%	-338	-0.9%
Spend it on other goods	-7	0.0%	-899	0.0%	+5	0.0%	-479	-0.9%	-218	-0.7%

In the first scenario, households save all the money that they no longer spend on food and drink, and this leads to a reduction in GDP and employment associated with the food sectors, and in the sectors which supply inputs to the food sectors. Looking at the whole economy, GDP falls by 0.1%, employment falls by 0.1% (around 3,000 FTE jobs), and carbon emissions generated within the Scottish economy fall by 1.0% (around 0.5MtCO_2e). Exports are assumed to be unchanged, but various sectors of the Scottish economy now have reduced import demand (because of the reduced economic activity) and consumers have reduced their expenditure on food imports. The combination of these two effects improves Scotland's trade balance by £145m, and reduces the emissions generated outwith Scotland, but on behalf of Scottish residents, by 0.3MtCO_2e. The combination of reduced emissions within and outwith Scotland is to reduce Scotland's carbon footprint by 0.9%.

Figure 1: Changes in GVA & Employment in Scenario 1 for 13 sectors with biggest absolute GVA changes

In the second scenario, the unchanged total household expenditure is reallocated away from food and drink, and results in approximately unchanged GDP, employment and trade balance (all changes are ±0.0% to this level of accuracy). Carbon emissions generated within the Scottish economy fall by 0.9% (around 0.5MtCO2e), and emissions generated outwith Scotland but on behalf of Scottish consumers are reduced by 0.2MtCO2e. Scotland's carbon footprint falls by 0.7%.

Figure 2: Changes in GVA & Employment in Scenario 2 for 13 sectors with biggest absolute GVA changes

As can be seen in Figure 2, households substitute their spending away from food and drink towards other sectors, and as a result we see large gains in activity and employment in Retail especially. This additional economic activity is associated with increased carbon emissions from these sectors. But the result of this shift in aggregate demand is that value added (wages and profits) and employment are largely unchanged – they just move sectors; but total carbon emissions fall, because activity has moved from high emission sectors (red meat production etc.) to lower emission sectors (e.g. retail).

4. Conclusions

The results of the second scenario shows that the potential exists in Scotland to shift consumer spending away from food and drink, and especially away from red meat, in line with healthy eating guidelines, and to reduce carbon emissions without harming Scotland's overall economic performance. This result is before taking into account the economic benefits arising from the health impacts that we would expect to see from such a change, such as reduced healthcare costs and improved workforce productivity. Such a conclusion is clearly of interest to

policymakers as it aligns well with the Scottish Government's aims to create "a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth".

Across the two extreme scenarios considered, the carbon emission benefits are clear. The difference between the economic impacts across the two scenarios highlights that the final economic impact of spending decisions depends not only upon the level of spending, but also upon to where this spending is directed. When we consider that the (unanalysed) health impact is also likely to be positive, this analysis suggests that a policy "triple win" to improve economic, health and environmental outcomes is possible.

However, it should be noted that in our analysis we have assumed and imposed a simple change in household spending patterns; however, as big a policy question is why would households make such a change? Government could, in principle, persuade households via healthy eating advertising, but the success of such a policy is highly uncertain. In future developments to this work we will look at other policy options, such as taxing red meat. This would cause price changes that mean that consumers may respond by reducing their consumption in line with healthy eating guidelines. Such an analysis not only describes a policy which may well have more certain effects, but it also provides for another margin for this policy impact positively: the tax revenues could perhaps be recycled into increased public spending, or used to reduce other taxes, both of which may provide economic stimulus.

Acknowledgements

This report was funded by the Rural & Environment Science & Analytical Services (RESAS) Division of the Scottish Government. This funding is part of the RESAS Strategic Research Programme 2016-2021 under Theme 1: Natural Assets.

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