The economic impact of healthy eating as part of climate change policy

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Research Question

- Red meat $\Rightarrow$ carbon emissions
- Red meat $\Rightarrow$ poor health outcomes
- Possibility of win-win if reduce red meat consumption?
- Springmann et al (2016) "*adhering to health guidelines on meat consumption could cut global food-related emissions by nearly a third by 2050*"
- But what are the economic consequences of this?
  - Is there a possibility for a "triple win"?
- Ask question in a Scottish context as part of wider project to develop environmentally augmented whole economy model of Scotland at Strathclyde
  - Funded by Scottish Government under *RESAS Strategic Research Programme 2016-2021, Theme 1: Natural Assets*

Policy Context

- Scottish Government aims (Scottish Government, 2015) to create "*a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth*"
- This encompasses policy that
  - enhances economic output, while
  - enhancing health of the population and
  - reducing carbon emissions
- underpinned by Climate Change Plan (Scottish Government, 2017), which recognises the role of agriculture in emissions and mentions the possible economic benefits of reduced emissions from agriculture

The Food & Drink sector in Scotland

- Scottish Government has identified 6 *Key Sectors* in which Scotland has comparative advantage, and in which intervention & policy is targeted
- One of these sectors is Food and Drink
  - Others are: Financial and Business Services; Life Sciences; Energy; Tourism; and Creative Industries.
- Policy context: economic growth, health, climate change? Yes, clearly.
  - Other policy implications: rural growth, spatial economic inequality, food security, ...

The Food & Drink sector in Scotland

	GVA (£m)	%Scot	Employment (no. e'ees)	%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)

NB Exports are both to rUK and to RoW

Healthy eating

- The Global dietary guidelines cited in Springmann et al (2016) limit red meat consumption to 300g per week, and energy to $\sim 2250 kcal$ per day
- Scottish Government (2010) says that, on average, Scots consume ~ 120 excess calories per day
- National Diet and Nutrition Survey (data from 2000 to 2001) suggests that in UK, people eat an average of 70g per day of red meat ($\sim 160 kcal$)
- i.e Translate healthy eating guidelines into 5% reduction in calories consumed; 39% reduction in red meat consumption; implies that non-red meat consumption falls by 3%

Disaggregating the Agriculture sector in the IO

- Given research question, and carbon intensity of red meat production, want to disaggregate Scottish Government IO table to split Agriculture into Red Meat and Other Agriculture
- Moxey (2016) does most of the work $\Rightarrow$ Gross Output, GVA, intermediate inputs, employment levels for Red Meat
- Make assumptions on exports and intermediate sales $\Rightarrow$ disaggregated IO table
- Results so far are with single set of assumptions, still to reconsider these and examine sensitivity of results

Disaggregating the Agriculture sector in the IO

- Inter-agriculture sales allocated using GVA
- Other intermediate sales are allocated to Red Meat/Other Agriculture on basis of minimising changes in mutipliers seen on non-agriculture
- Red Meat is assumed to be exported like Meat processing output
- Other components of final demand are assumed to be split by total non-exported final demand
- Income is split assuming same wage and profit shares in both Red Meat and Other Agriculture
- International imports of Red Meat estimated by noting that 45% of meat consumed in the UK is imported
- rUK imports are derived by then noting that Scotland is broadly self-sufficient in red meat on a net basis and has $\sim$ 20% of UK herd
- Assume Scotland imports contain a share of other food and drink goods in same proportion as in domestically produced consumption

Scottish Carbon Emissions

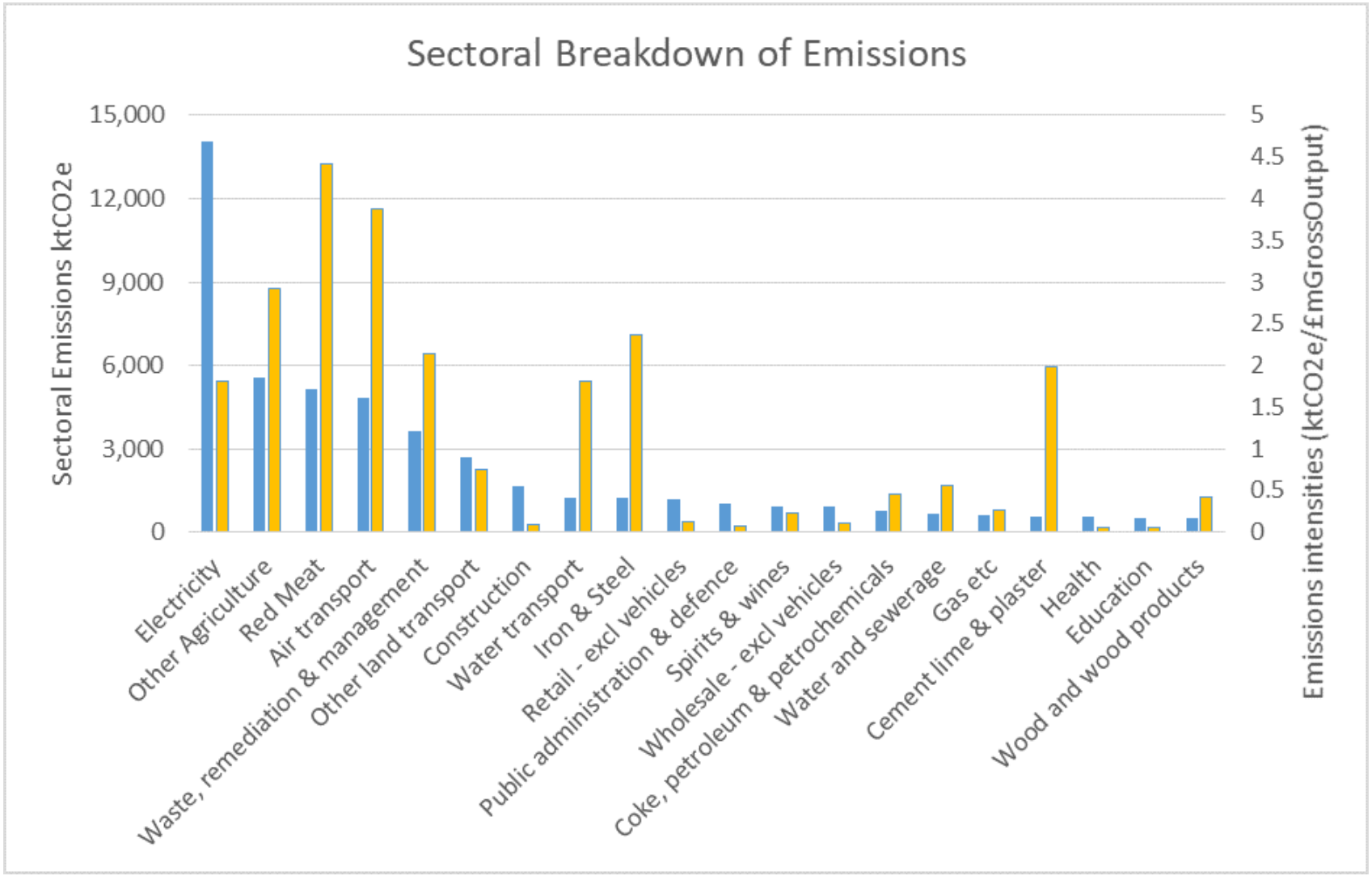
- Carbon footprint (with imported emissions separately identified) from Scottish Government (2017b)
- Territorial emissions (by broad sectoral category) from National Atmospheric Emissions Inventory (see Salisbury et al, 2016)
- Apportion into IO table using both broad sectoral categories, and coefficients used by Scottish Government in their preparation of carbon impact of their own budget decisions (Scottish Government, 2016b)
- Assuming rUK carbon intensity = Scottish, and Scottish and rUK exports have same carbon intensity as supply for domestic consumption, can produce a reconciliation between territorial emissions and the carbon footprint

Scottish Carbon Emissions

	Values (£m)	Associated CO2e Emissions (MtCO2e)	
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**

- NB Carbon footprint $>>$ Territorial emissions
- Consequence of (a) trade deficit, (b) services dominated economy

Scottish Carbon Emissions



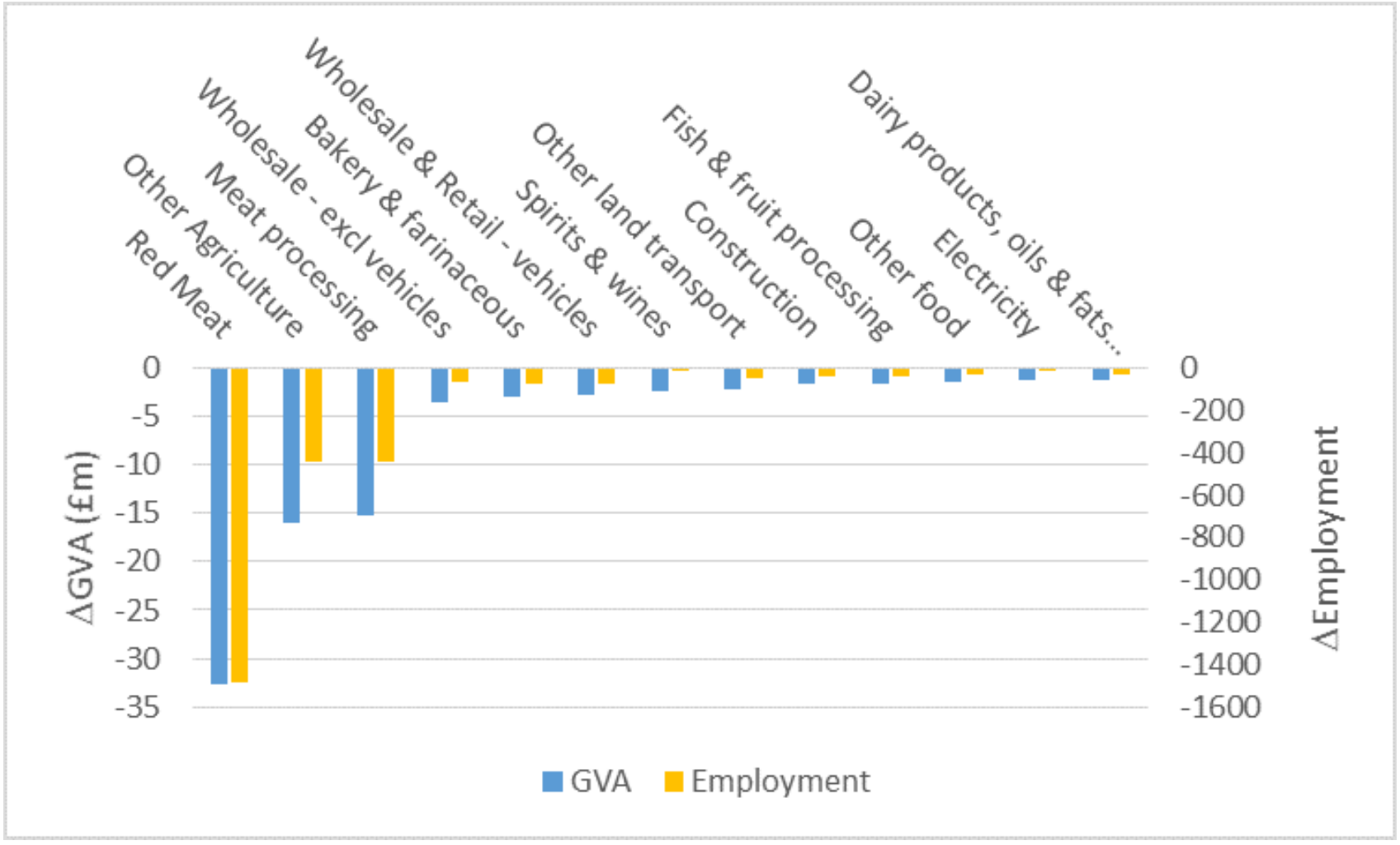
Exercise

- Assume that the 39% reduction in red meat consumption and 3% reduction in other food and drink consumption translates into reductions in expenditures
- Then considering a pure, exogenous, change in consumer expenditures, ΔY, so looking at a Type I Leontief IO modelling exercise
- Carbon impact of this change is $C'\Delta X = C'(I - A)^{-1}\Delta Y$
  - where C is vector of sectoral carbon intensity (per unit gross output) coefficients, X is the vector of sectoral gross outputs, and A is the Type I Leontief coefficient matrix
- Then consider 2 extreme secenarios:
  - $\Delta Y = 39\%$ reduction in red meat & 3% reduction in other food and drink expeditures, and 0 for everything else i.e. all savings saved
  - $\Delta Y = 39\%$ reduction in red meat & 3% reduction in other food and drink expeditures, and $x\%$ increase in discretionary spending so that all savings are spent
    - Discretionary $\equiv$ not public services, rents, or financial services
    - x is solved for so that overall household spending is unchanged

Scenario 1

- This scenario involves only reductions in expenditure, so not surprising that see falls in both emissions and economic activity
  - GDP falls by £$103m$ (-0.1%)
  - Employment falls by 3076 employees (-0.1%)
  - Trade balance improves by £$145m$ (-1.4%)
  - Territorial emissions fall by $0.5 MtCO_2e$ (-1.0%)
  - Carbon Footprint falls by $0.9 MtCO_2e$ (-0.9%)

Scenario 1


Red Meat
Other Agriculture
Meat processing
Wholesale - excl vehicles
Bakery & farinaceous
Wholesale & Retail - vehicles
Spirits & wines
Other land transport
Construction
Fish & fruit processing
Other food
Electricity
Dairy products, oils & fats...
ΔGVA (£m)
0
-5
-10
-15
-20
-25
-30
-35
ΔEmployment
0
-200
-400
-600
-800
-1000
-1200
-1400
-1600
GVA
Employment

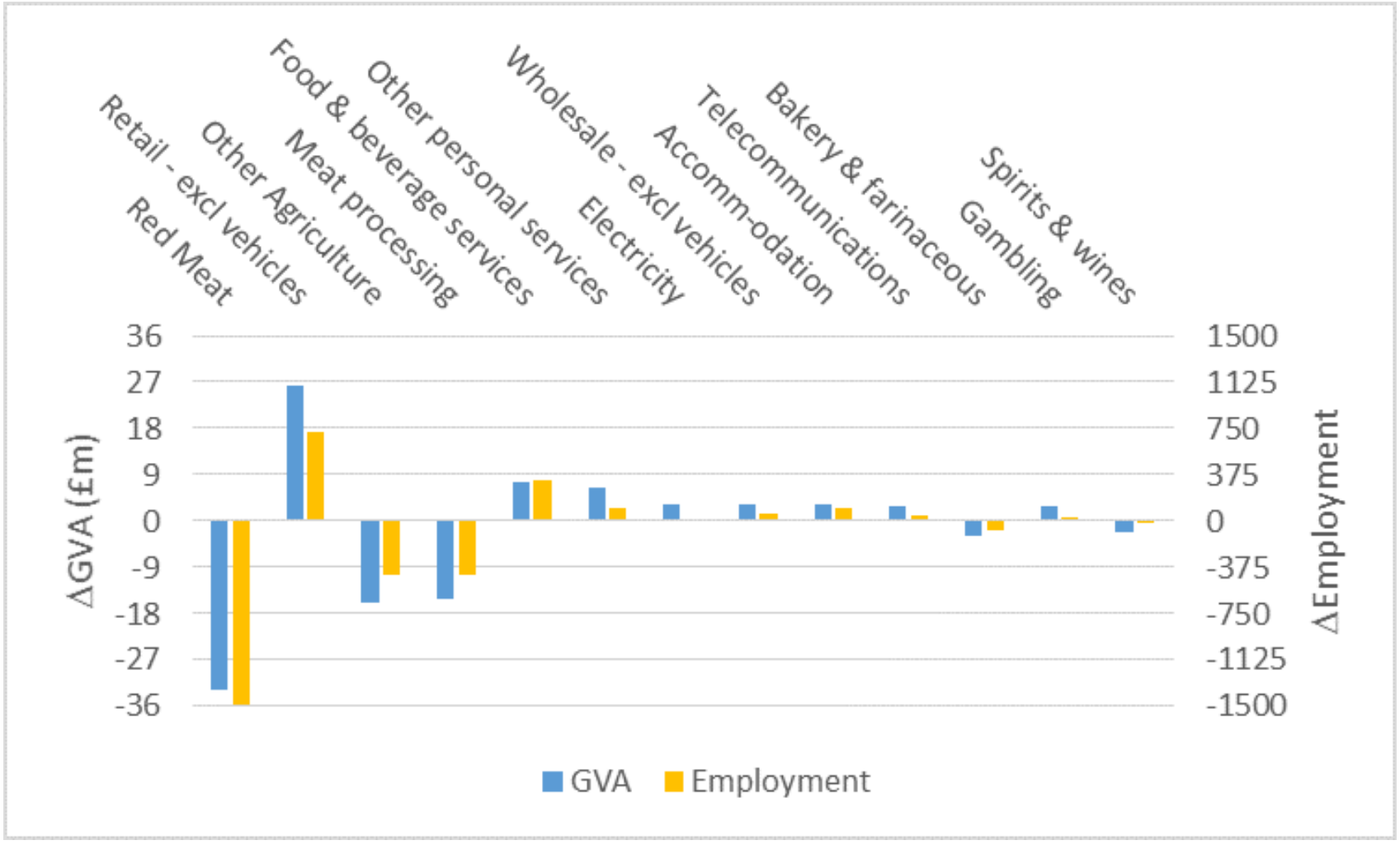
Scenario 2

- Now spending patterns are shifted without the level of spending being reduced, not necessarily see falls in either emissions or economic activity
  - GDP rises by £5m (0.0%)
  - Employment falls by 916 employees (-0.0%)
  - Trade balance deteriorates by £7m (0.1%)
  - Territorial emissions fall by $0.5 MtCO_2e$ (-0.9%)
  - Carbon Footprint falls by $0.7 MtCO_2e$ (-0.7%)

Scenario 2

	Values (£m)		Associated CO2e Emissions (MtCO2e)		
Production	232,834	(130)	46.6	(0.5)	
International Transport			2.3	-	
Land Use Changes			1.7	-	
Gross Output	**232,834**	**(130)**	**50.6**	**(0.5)**	**Territorial Emissions**
rUK Intermediate Imports	28,436	(40)	8.5	(0.1)	
International Intermediate Imports	16,564	(24)	28.8	(0.1)	
Less Total Intermediates	(105,864)	122			
Total Final Goods	**171,971**	**(71)**	**87.9**	**(0.6)**	
Exports	(67,931)	-	(20.8)	-	
rUK Final Good Imports	19,754	47	5.3	(0.1)	
International Final Good Imports	13,196	24	22.3	(0.0)	
National Income	**136,991**	-	**94.7**	**(0.7)**	**Carbon Footprint**

Scenario 2


Red Meat
Retail - excl vehicles
Other Agriculture
Meat processing
Food & beverage services
Other personal services
Electricity
Wholesale - excl vehicles
Accomm-odation
Telecommunications
Bakery & farinaceous
Gambling
Spirits & wines
ΔGVA (£m)
36
27
18
9
0
-9
-18
-27
-36
1500
1125
750
375
0
-375
-750
-1125
-1500
ΔEmployment
GVA
Employment

Conclusions

- Scenario 2 shows very small economic impacts, with a positive carbon impacts (i.e. reduction in emissions)
- This analysis ignores health impacts (reduced healthcare costs and improved workforce productivity) but these will be positive
- Potentially "triple win"? - makes policy to achieve this outcome attractive
- Aligns well with the the Scottish Government's aims to create "a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth"
- Modelled as exogenous change in expenditures (in a Leontief model with no prices): policies that could achieve this e.g. advertising to change preferences? Very uncertain

Next Steps

- As well as analysing all data used and assumptions made and conducting sensitivity analysis to these
- Implement in CGE model in which policy can be implemented through e.g. tax on red meat
- Part of a wider project to enhance our CGE models with ecosystem services (ESS) and natural capital
  - As well as carbon emissions (and sequestration), other ESS flows include natural imputs to agriculture, fishing, and timber: add to production functions for these sectors
  - How do these additions affect CGE scenario results?
  - Conduct other exercises e.g. reducing these natural inputs (consequence of climate change?) $\Rightarrow$ impacts on economic output from these sectors and spillovers into wider economy
  - Aim of the overall project is to *link ecosystems and economy-wide models to allow us to identify and quantify multiple benefits and the impacts upon, and trade-offs between, national economic indicators and the management of natural assets.*

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Plus ...
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