Emissions pricing of food commodities: climate change mitigation potential and global health impacts

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FUTURE OF Food — The Oxford Martin Programme on the Future of Food

UNIVERSITY OF OXFORD — OXFORD MARTIN SCHOOL

Meat taxes

Rationale for taxing meat:

- Environmental impacts
- Health impacts

Impacts:

- Health and environmental co-benefits
- Benefits the greater the more diets change towards healthy and sustainable diets

Background

Rise in food-related GHG emissions could seriously impede efforts to limit global warming:

- Food system responsible for $> 25\%$ of all GHG emissions, most of which related to livestock (Vermeulen et al, 2012; Steinfeld et al, 2006; Tubiello et al, 2014).
- Food-related emissions projected to increase by up to 80% by mid-century due to population growth and dietary changes (Popp et al, 2010; Hedenus et al, 2014; Tilman and Clark, 2014; Bajzelj et al, 2014; Springmann et al, 2014).
- In 2050, food-related GHG emissions could take up half of emissions budget allowed to keep global warming below 2°C, and exceed it by 2070 (Hedenus et al, 2014; Springmann et al, 2016).

$\Rightarrow$ Reducing food-related GHG emissions will be critical for climate change mitigation.

Background

Difficulties of regulating emissions from food and agriculture:

- Ag emissions are variable (non-point) and hard (and costly) to monitor at source (Lassey, 2007; Bouwman et al, 2002; Snyder et al, 2009).
- Most Ag emissions are intrinsic to the system (methane from ruminants, nitrous oxide from fertilizers) $\rightarrow$ difficult to address without affecting output and food availability (Smith et al, 2007, 2008).
- Potential impacts on food security (Golub et al, 2013; Havlik et al, 2014).

$\rightarrow$ Food and agriculture largely spared from climate policies.

Background

This study:

- *Global analysis of emissions and health impacts of levying GHG taxes on food commodities (at point of purchase).*

Addresses difficulties:

- Demand-side policies (in theory) preferable when monitoring costs high, high substitutability, and limited mitigation options apart from output reduction (Schmutzler and Goulder, 1997; Wirsenius et al, 2010).
- Health impacts depend on both food availability and food composition, e.g., dietary changes away from emissions-intensive animal-based foods associated with better health (Tilman and Clark, 2014; Springmann et al, 2016).

Research approach

Methods: coupled modelling framework

- Agricultural analysis:
  - Use of IMPACT model to project future food consumption
- Environmental analysis:
  - Commodity and region-specific GHG emissions factors from FAO and Tilman and Clark (2014)
- Economic analysis:
  - Social cost of carbon estimates from model comparison of integrated assessment models (for US Gov)
  - Consumer responses to price changes with international data on prices and elasticities (IMPACT),
- Health analysis:
  - Use of global comparative risk assessment framework developed at Oxford

Research approach

Scenario assumptions:

- GHG taxes on food commodities at point of purchase;
- Taxes are implemented independently in each country as coordinated implementation unlikely (focus on demand response, no international feedbacks);
- Emissions and health impacts for the year 2020 (when new global climate agreement is to be implemented);
- Health impacts for adults (aged 20 or older), but sensitivity analysis of health impacts on children.
- GHG price of 52 USD/tCO_2-eq associated with discounting future climate damages with a discount rate of 3%.

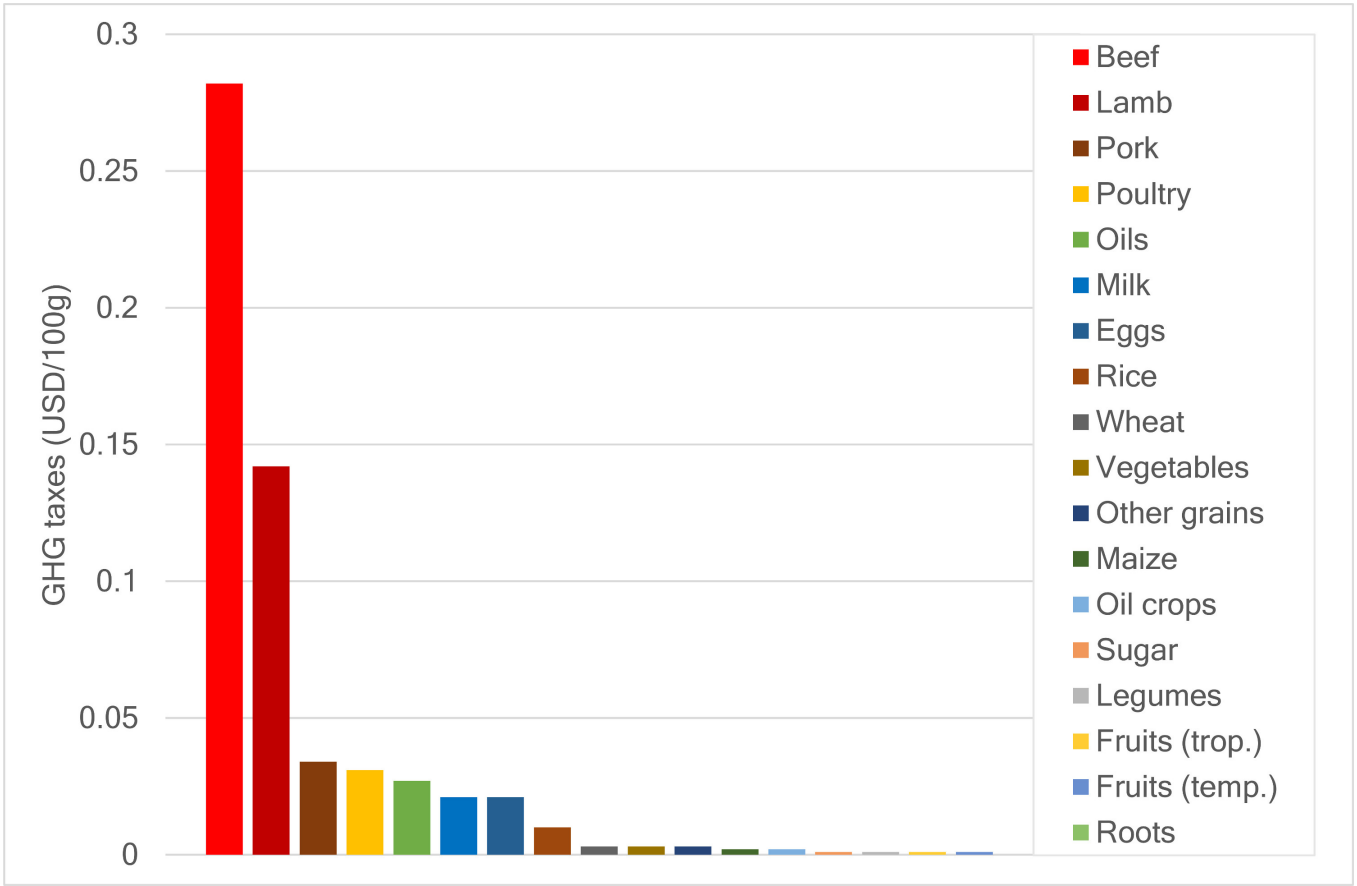
Research approach

Model scenarios:

- *TAX*: GHG taxes on all food commodities
- *TAXadj*: Tax exemptions for health-critical food groups in dev countries (fruits&veg and staples)
- *TAXani*: GHG taxes only on animal products (meat, dairy, eggs)
- *TAXrem*: GHG taxes only on red meat (beef, lamb, pork)
- *TAXbef*: GHG taxes only on beef
- Income-compensated variants ($_r$)
- Variants in which half of tax revenues are used to subsidize fruits&veg ($_s$)

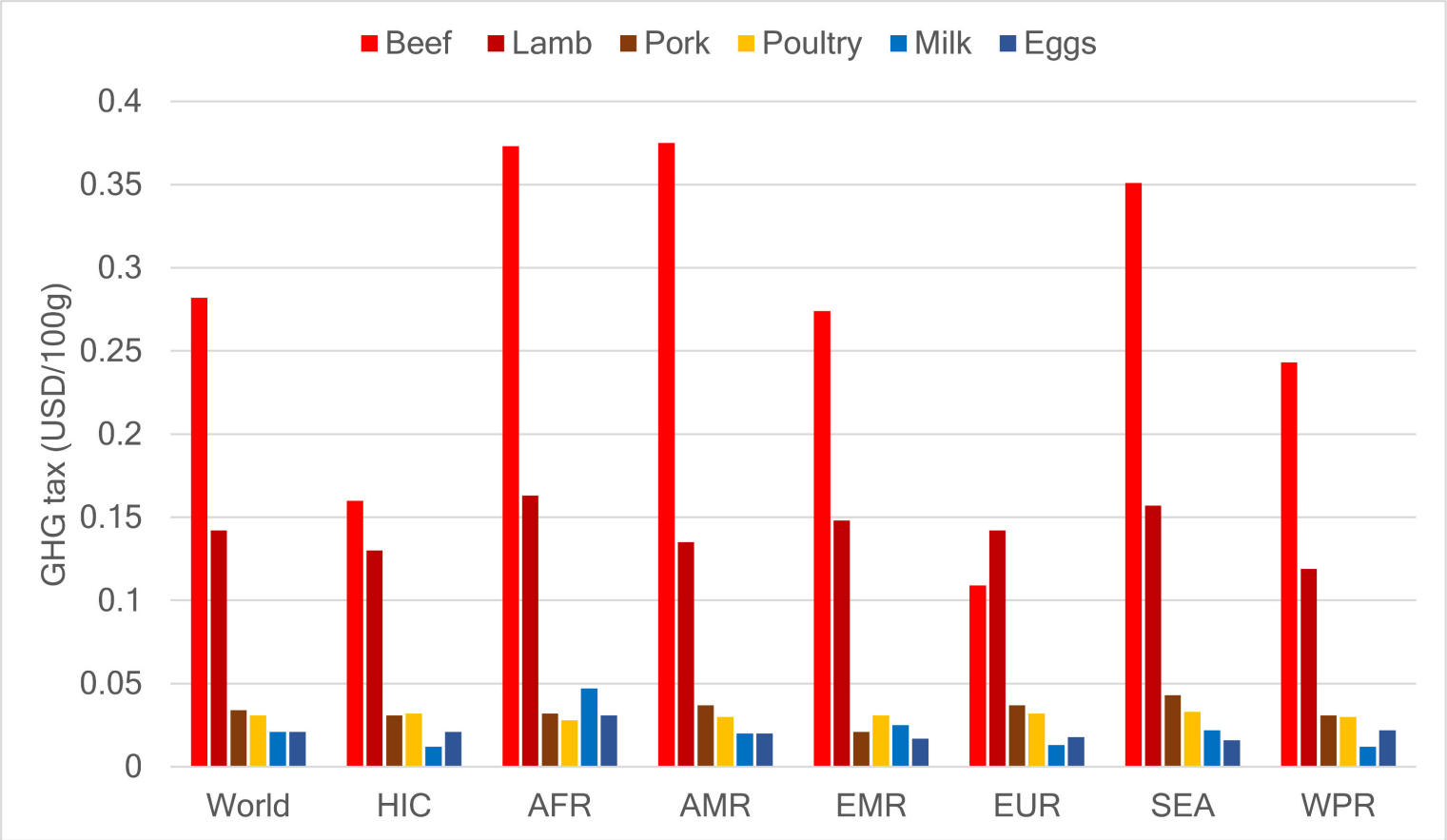
$\Rightarrow$ **15** different tax scenarios

Results: GHG taxes on all food commodities



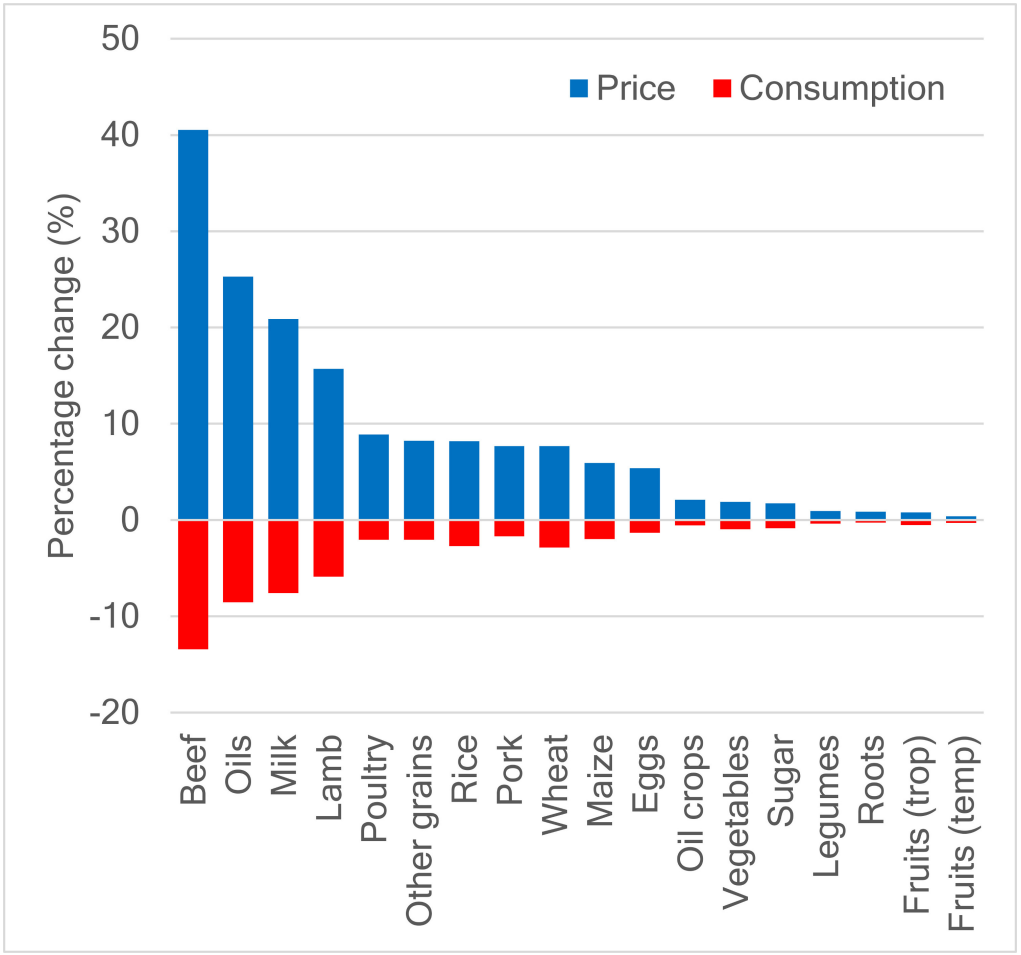
- GHG taxes highest for animal-sourced foods.

Results: GHG taxes on all food commodities



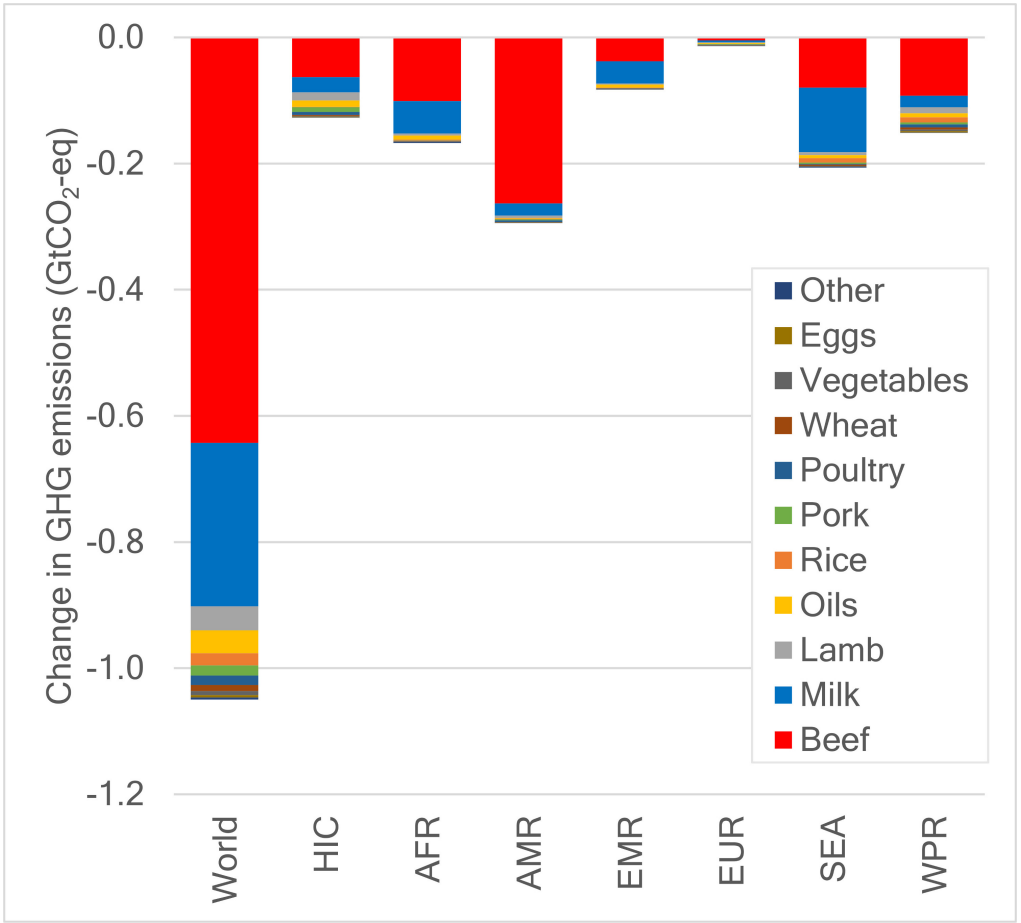
- Regional differences due to different production systems (e.g. grass-fed beef in AMR vs intensive grain-fed beef in USA vs mixed beef and dairy systems in EUR).

Results: GHG taxes on all food commodities



- High price and consumption changes for ruminant meat and dairy (det by GHG taxes and baseline prices).

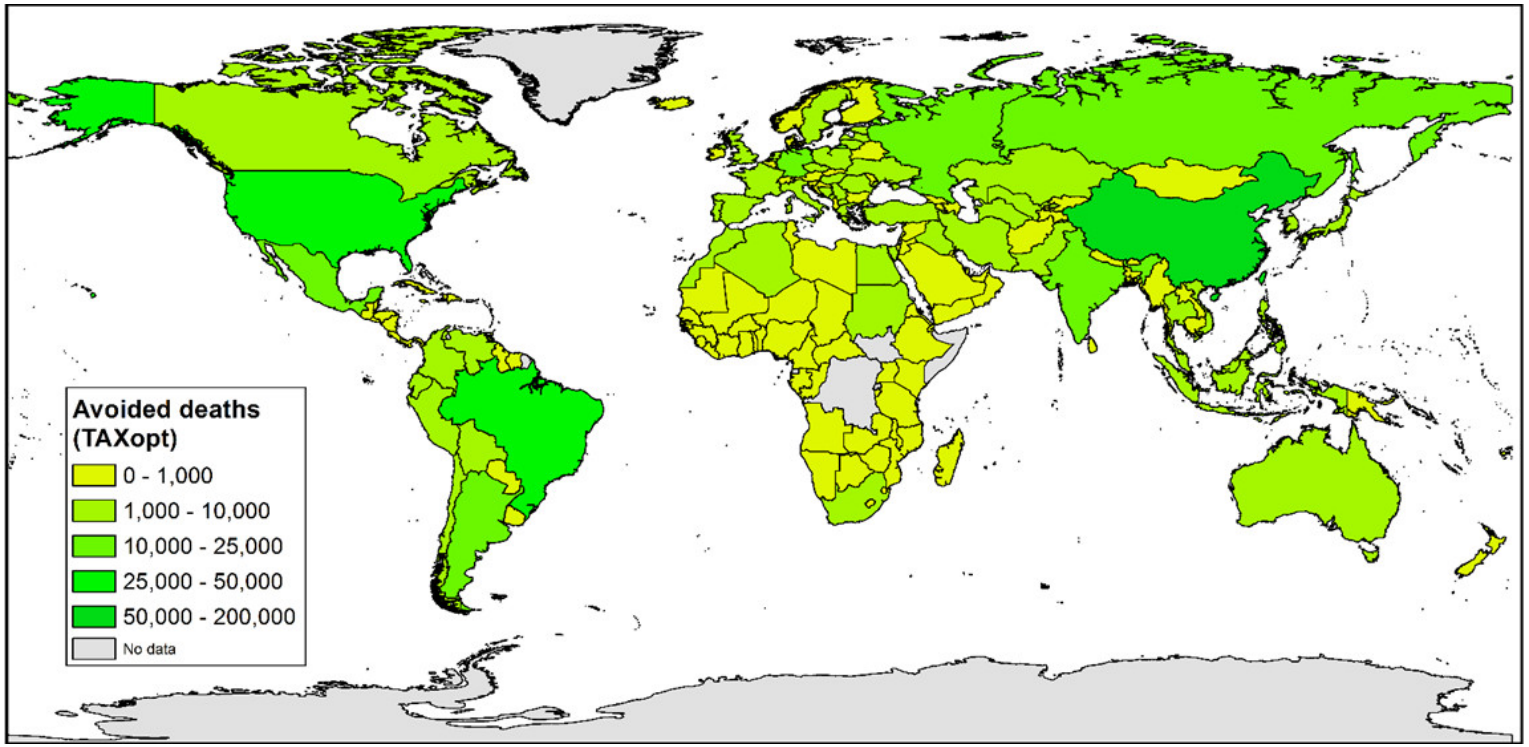
Results: GHG taxes on all food commodities



- High emissions reductions ($\approx$ 1 $GtCO_2$); two thirds from less red meat, a quarter from less milk; three quarters from MICs.

Results: optimal tax scenario

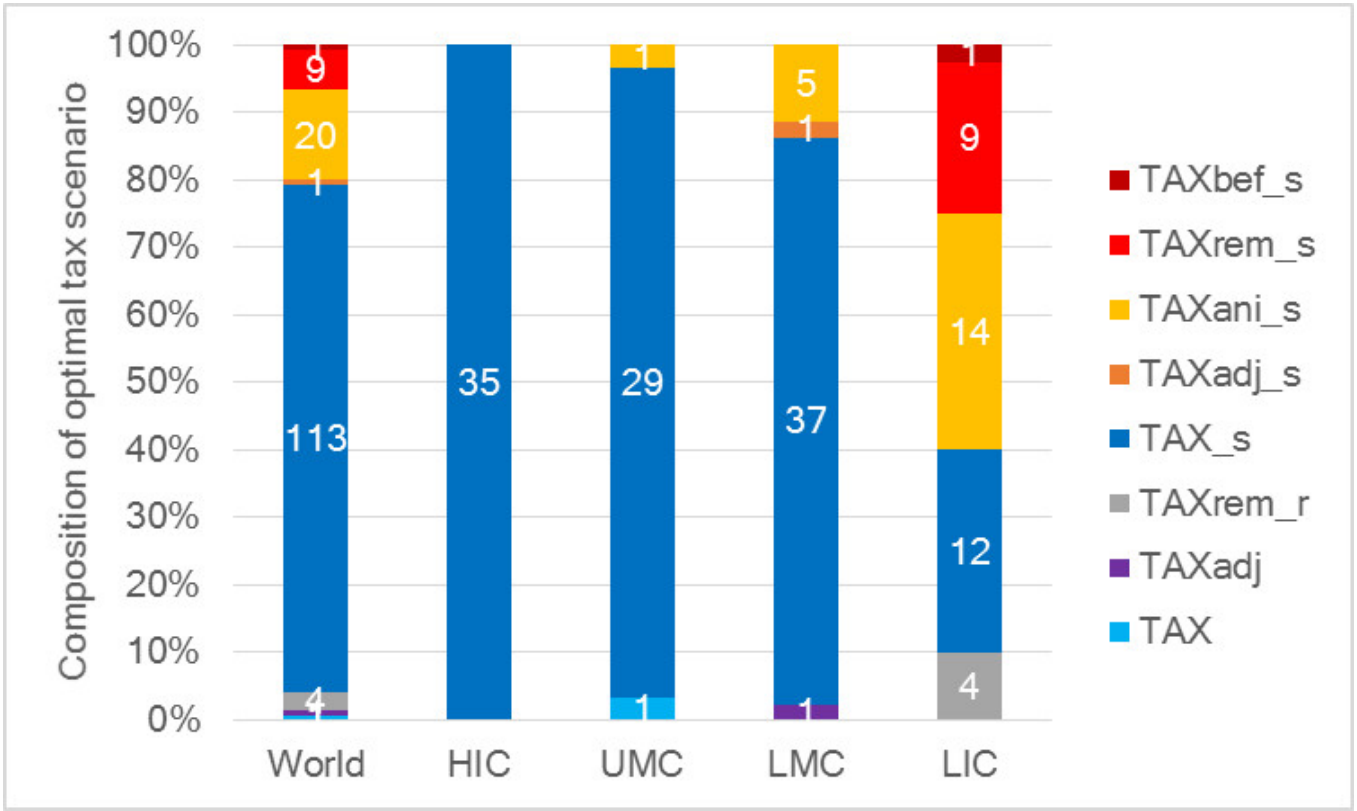
Health-sensitive taxing schemes:



Results: optimal tax scenario

Health-maximising tax scenario for each region:

- Optimization across all 15 tax scenarios:



Discussion

Results in context:

- GHG mitigation potential ($\approx$ 1 $GtCO_2$):
  - More than current GHG emissions of global aviation;
  - 10% of emissions gap for 2020;
  - $>$ supply-side measures, such as rice, livestock, and manure management (each below 250 $MtCO_2$-eq; Smith et al, 2014);
  - Similar to global mitigation target for agriculture in 2030 (Wollenberg et al, 2016).
- Health benefits ($\approx$ 100,000-500,000 avoided deaths)
  - Comparable to health benefits of reduced air pollution from coal-fired power plants (West et al, 2013);
  - Small when compared to potential health benefits of global dietary change towards more plant-based diets ($\approx$ 5-8 million avoided deaths in 2050; Springmann et al, 2016)

  $\rightarrow$ Additional policy measures needed for more health benefits from dietary change.

What about direct health impacts?

International Agency for Research on Cancer

World Health Organization

PRESS RELEASE
N° 240

26 October 2015

IARC Monographs evaluate consumption of red meat and processed meat

Lyon, France, 26 October 2015 – The International Agency for Research on Cancer (IARC), the cancer agency of the World Health Organization, has evaluated the carcinogenicity of the consumption of red meat and processed meat.

Red meat

After thoroughly reviewing the accumulated scientific literature, a Working Group of 22 experts from 10 countries convened by the IARC Monographs Programme classified the consumption of red meat as *probably carcinogenic to humans* (Group 2A), based on *limited evidence* that the consumption of red meat causes cancer in humans and *strong* mechanistic evidence supporting a carcinogenic effect.

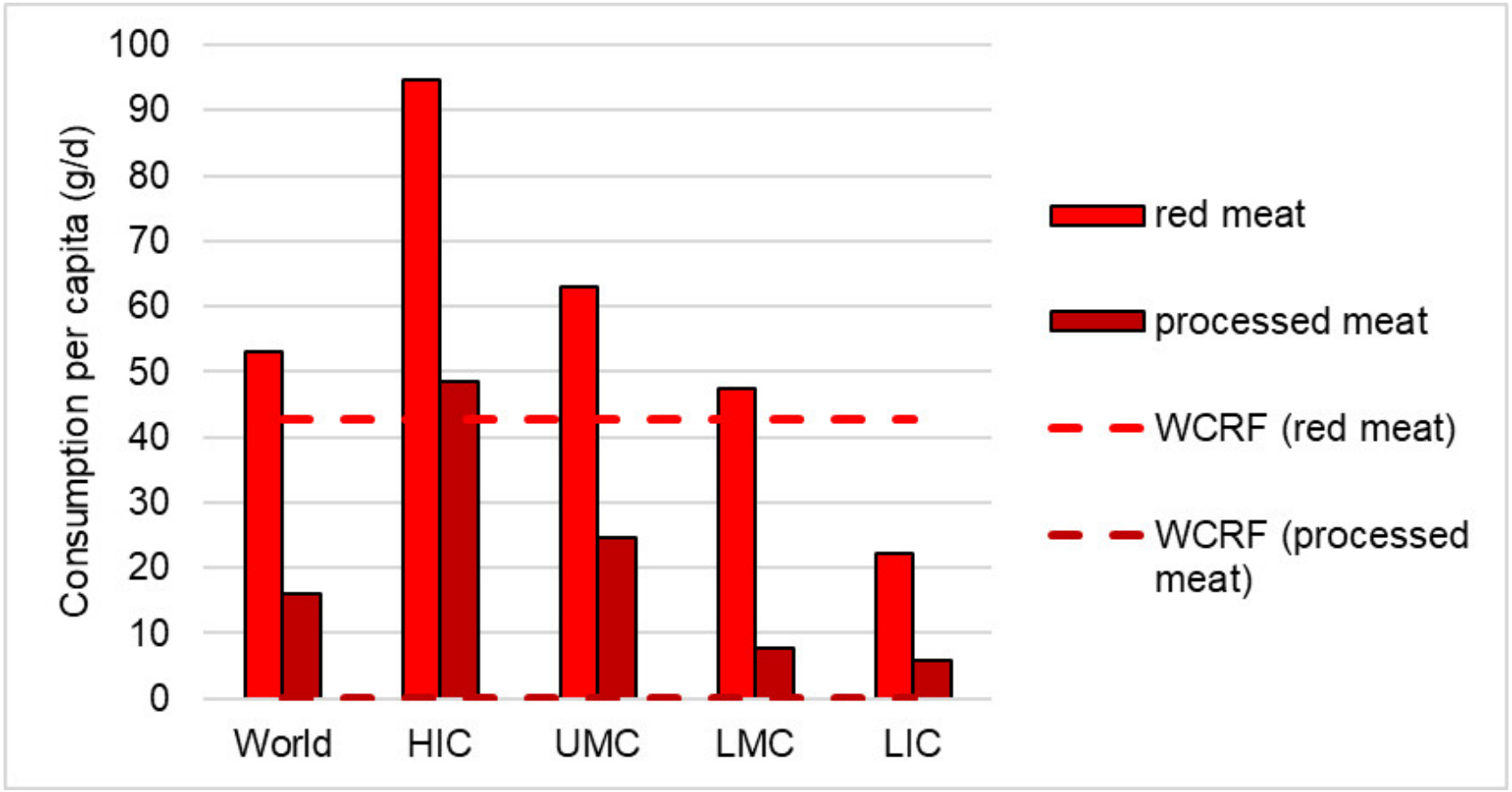
This association was observed mainly for colorectal cancer, but associations were also seen for pancreatic cancer and prostate cancer.

Processed meat

Processed meat was classified as *carcinogenic to humans* (Group 1), based on *sufficient evidence* in humans that the consumption of processed meat causes colorectal cancer.

Background

Current consumption exceeds recommended levels in most high and middle-income countries (Micha et al, 2015; Springmann et al, 2016):



Background

Research questions:

- Should red and processed meat be regulated similar to other carcinogens, such as tobacco smoking and asbestos, or to other food of public health concern, such as sugary drinks?
- How high should health-motivated taxes be?
- What would be the health impacts of tax-based regulation?
- Would there be any environmental co-benefits?
  - The livestock sector is responsible for the majority of food-related GHG emissions, and for about 14.5% of GHG emissions overall, a similar proportion as from transport.

Methods

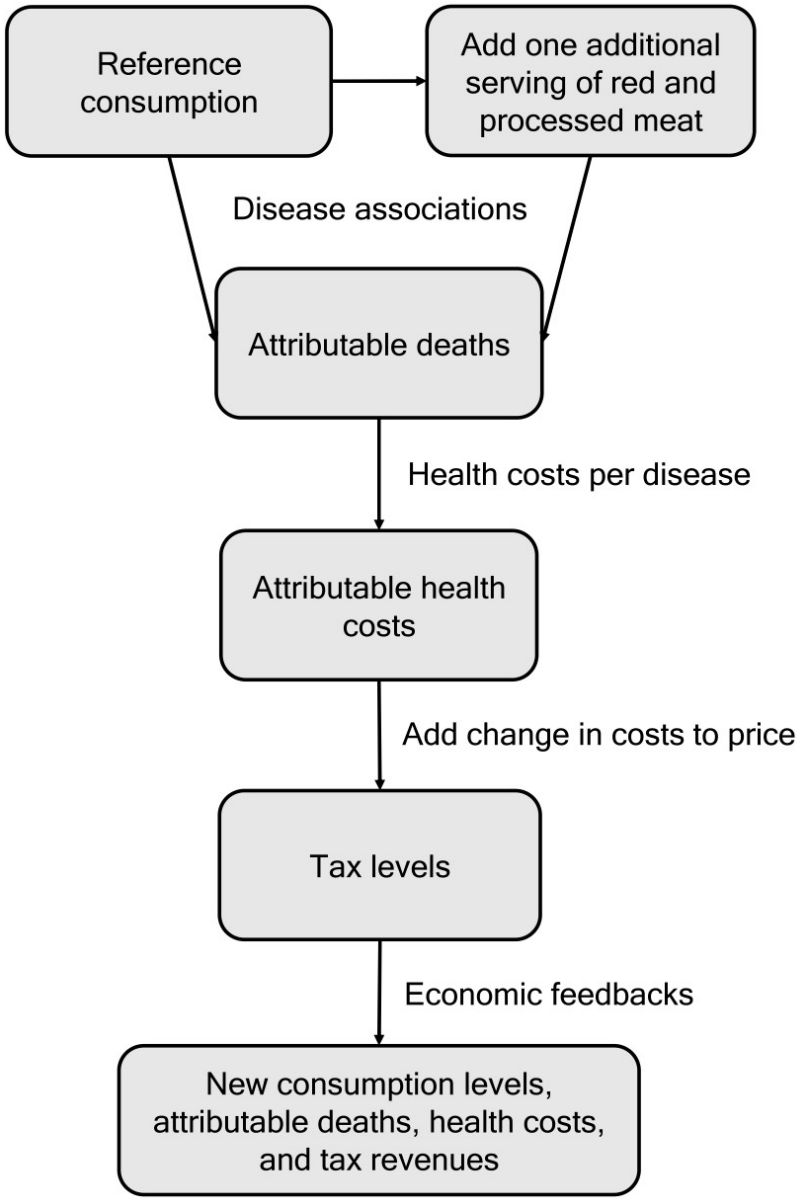
This study:

- Estimate health costs to society and optimal tax levels for red and processed meat for all major world regions;
- Estimate tax-related impacts on food consumption, mortality from diet-related diseases, and food-related GHG emissions.

Optimal taxes:

- Taxes that incorporate marginal health costs of consuming one additional serving of red and processed meat consumption.

Methods

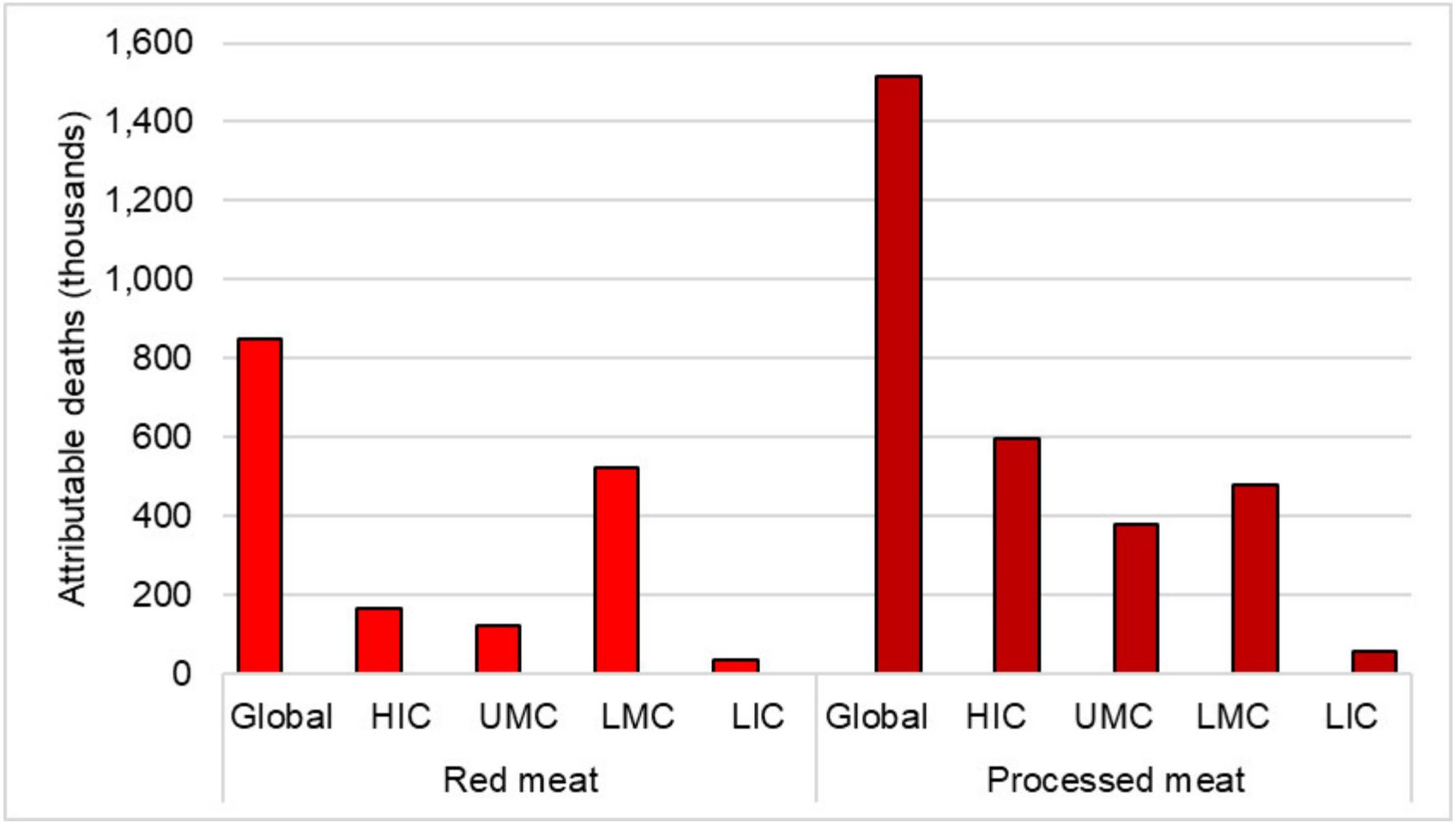

Reference consumption
Add one additional serving of red and processed meat
Disease associations
Attributable deaths
Health costs per disease
Attributable health costs
Add change in costs to price
Tax levels
Economic feedbacks
New consumption levels, attributable deaths, health costs, and tax revenues

Methods

Methods:

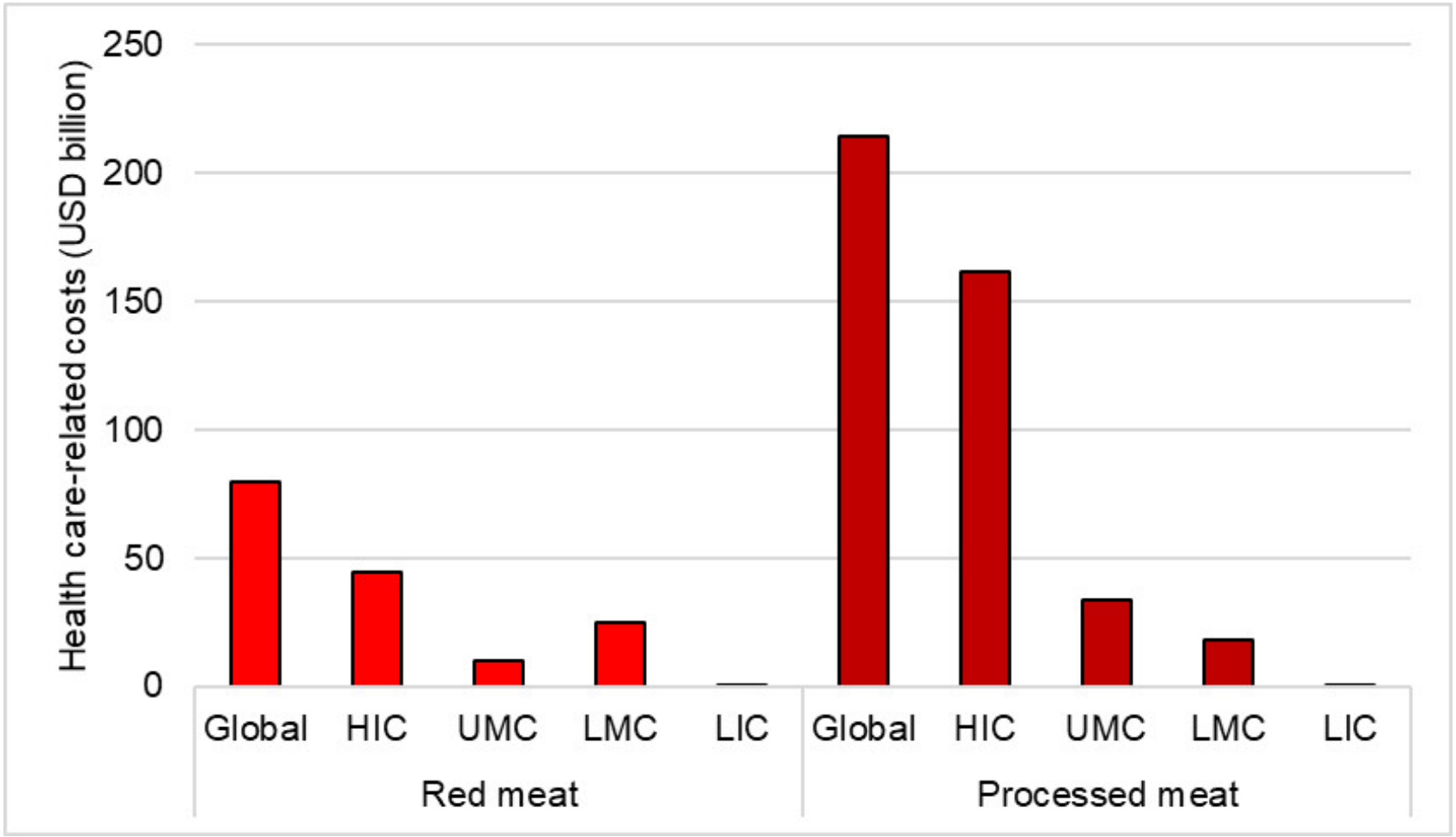
- Use of coupled modelling framework
- Data on food consumption, own and cross-price elasticities, and commodity prices adopted from IFPRI's IMPACT model (Robinson et al, 2015)
- Disease associations of food consumption adopted from meta-analyses of prospective cohort studies (Micha et al, 2010; Chan et al, 2011; Chen et al, 2013; Feskens et al, 2013)
- Health costs per disease adopted from COI estimates (Springmann et al, 2016)
- GHG emissions intensities from meta-analysis of LCAs (Gerber et al, 2013; Tilman and Clark, 2014)

Attributable deaths in 2020



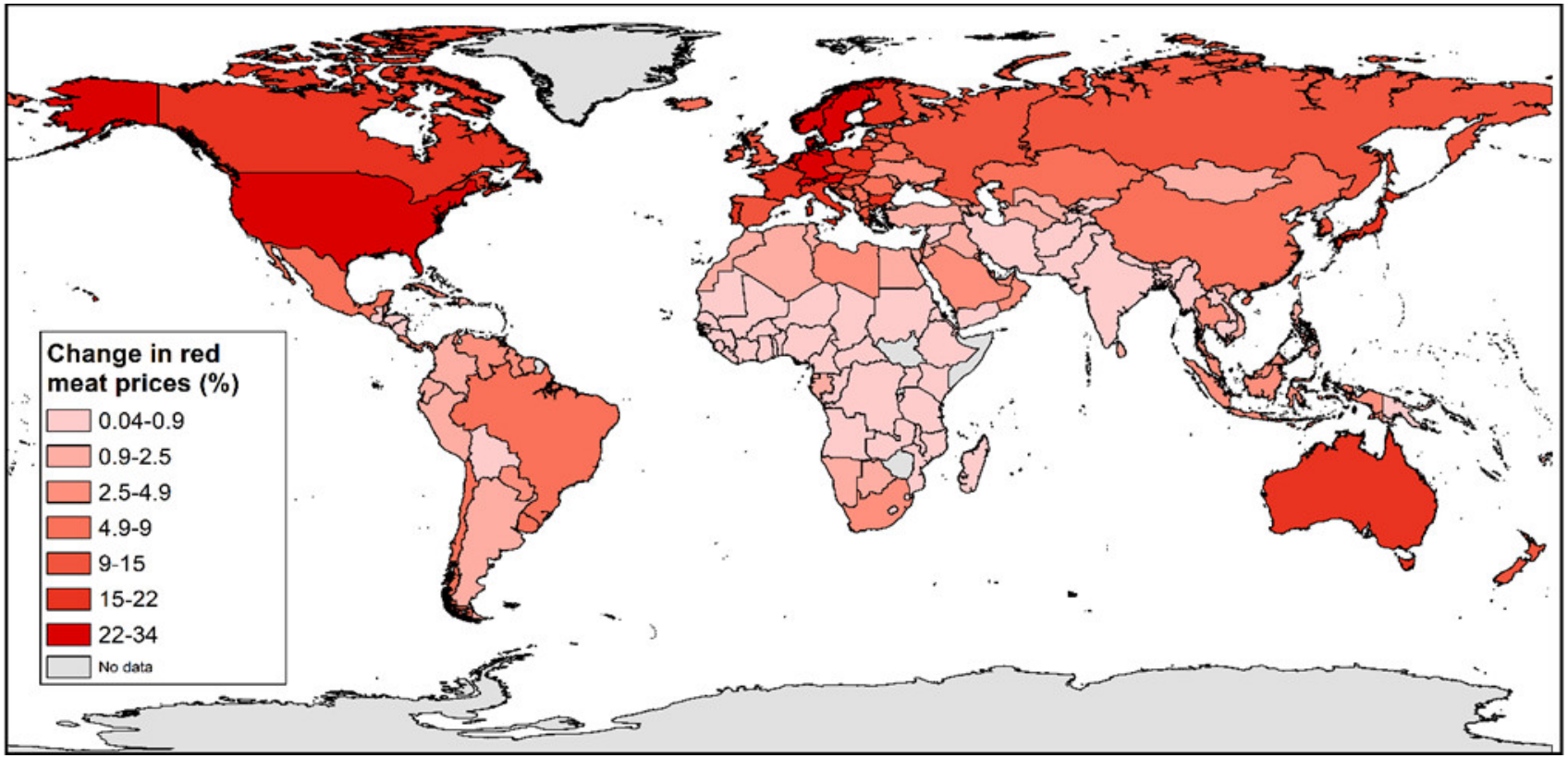
- together $\approx$ 4.4% of all deaths in 2020
- deaths(PM) = 2 x deaths(RM); cons(PM) = 1/3 x cons(RM)

Attributable health care-related costs in 2020



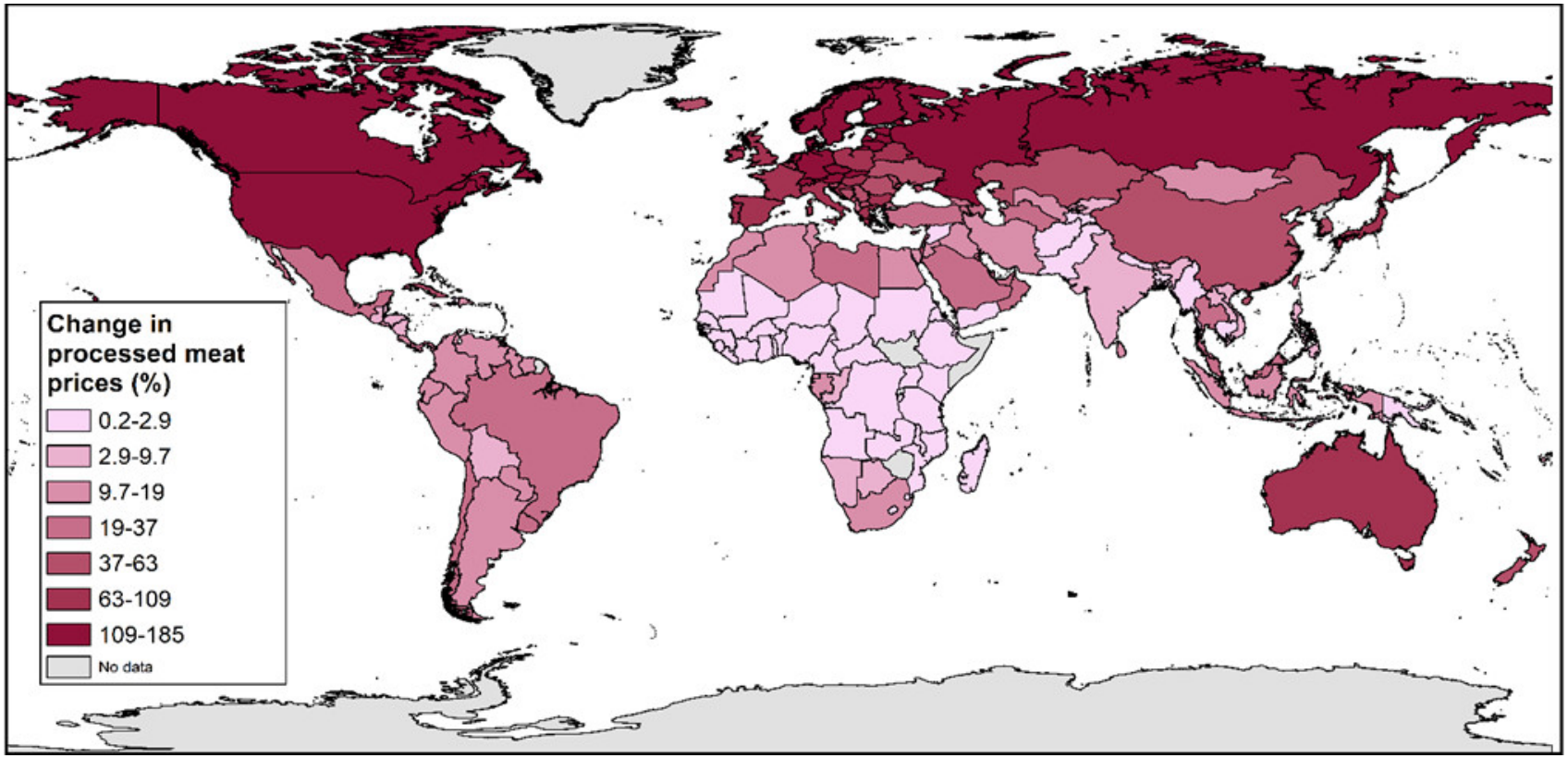
- $\approx$ 2.2% of health expenditure in 2020
- 2/3 in HIC due to high costs; 1/3 in MIC; very little in LIC

Optimal tax levels for red meat



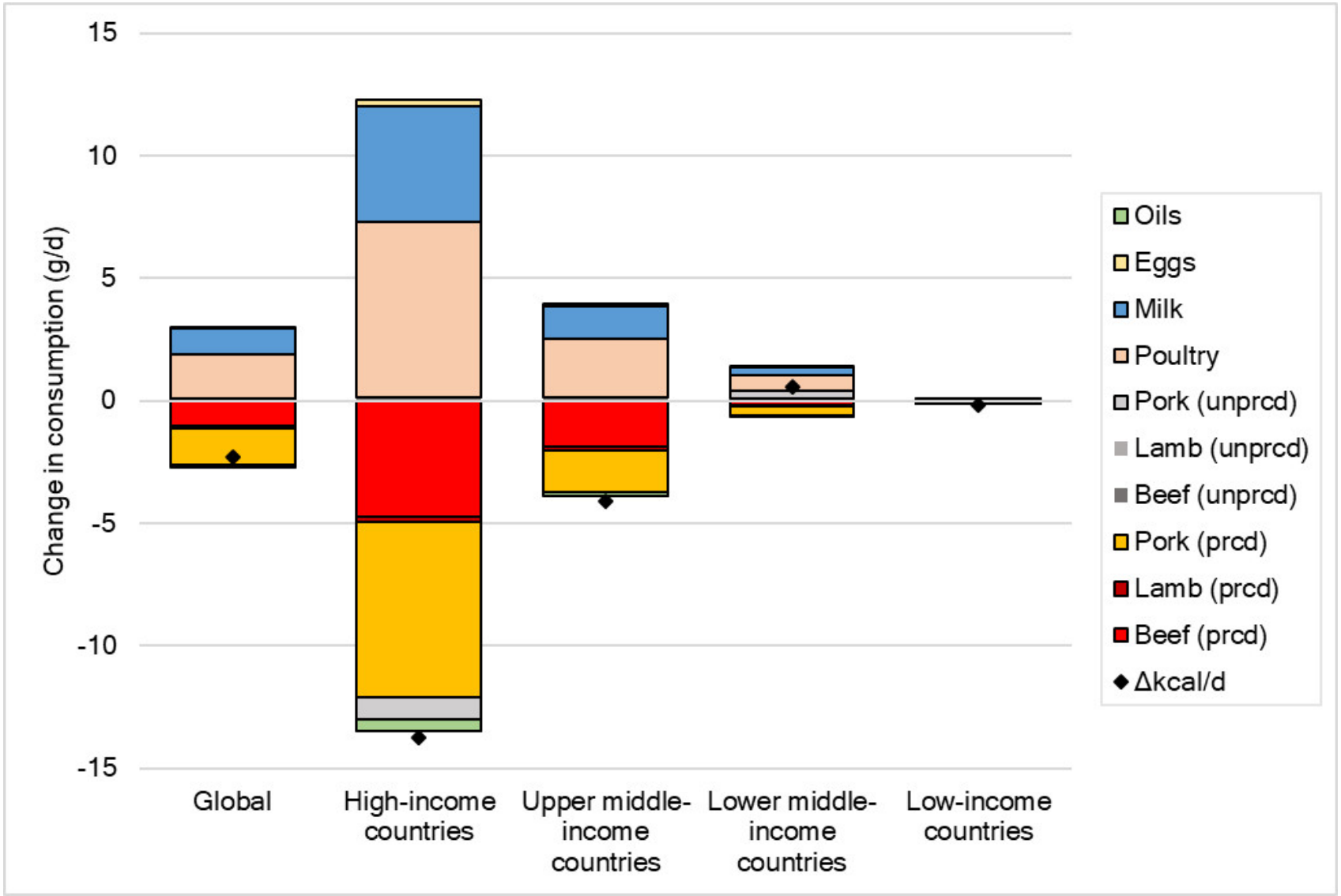
- 4% on average, 1% in LIC to 21% in HIC

Optimal tax levels for processed meat

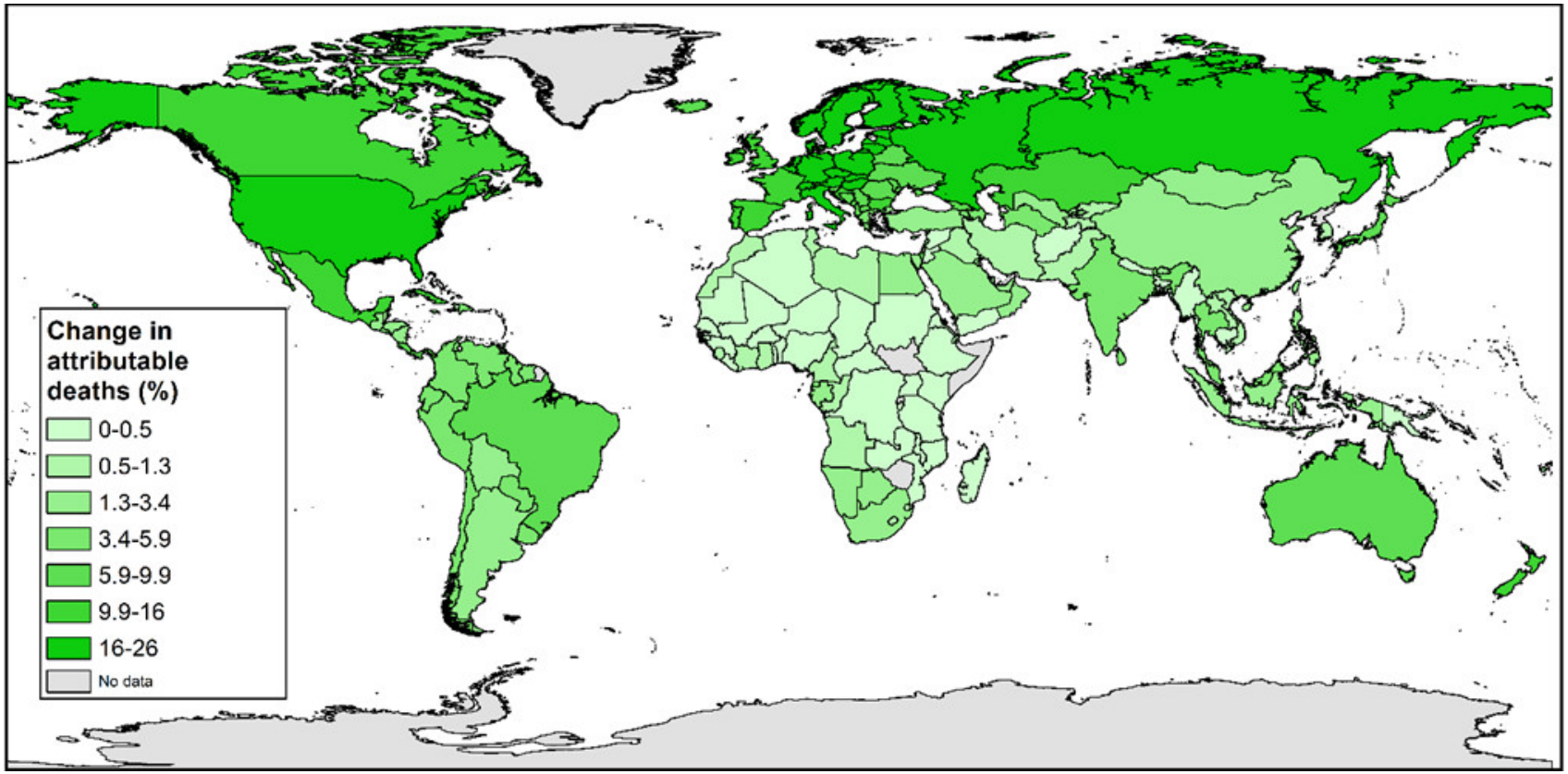


- 25% on average, 1% in LIC to 111% in HIC

Consumption changes

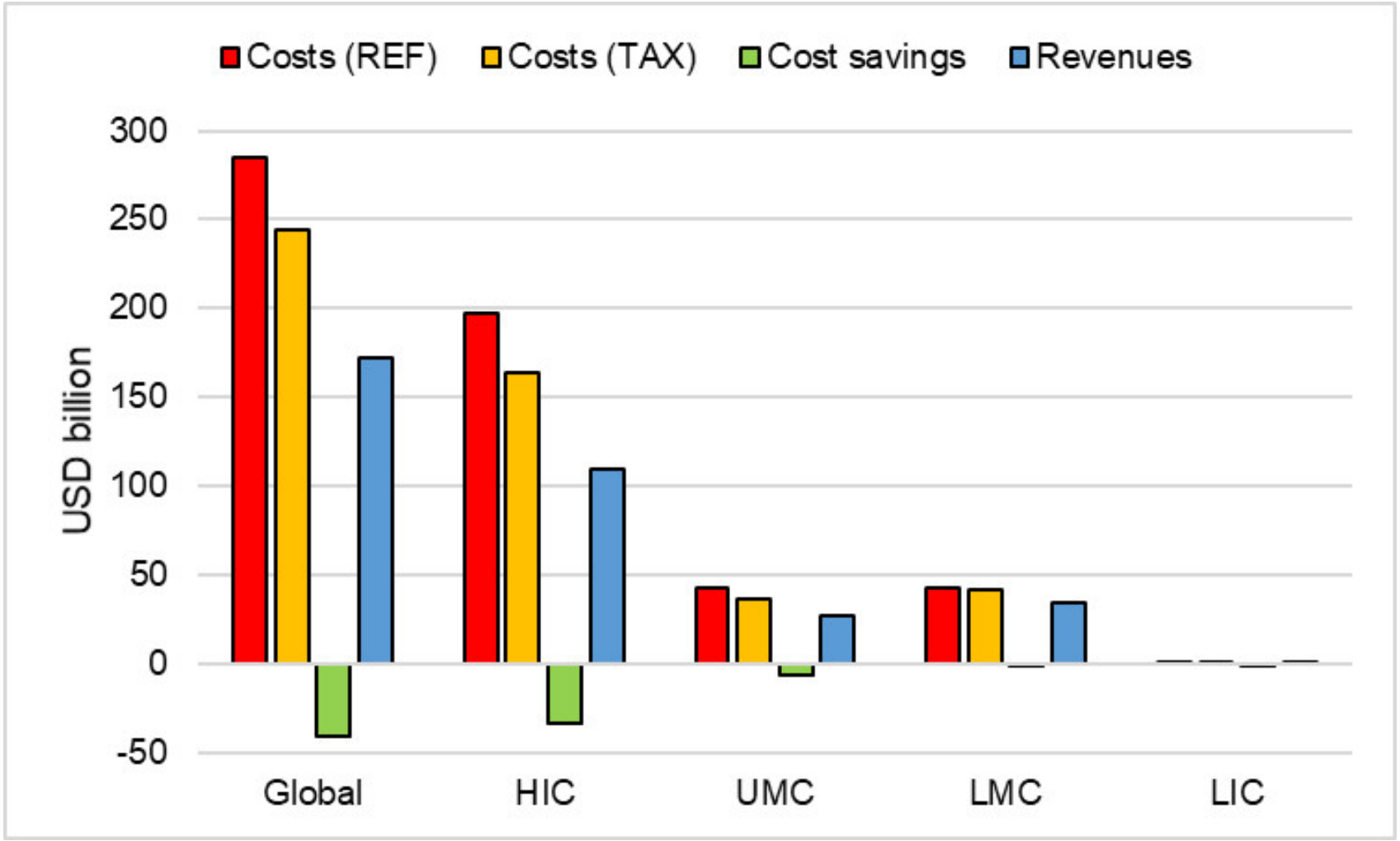


Reductions in attributable deaths



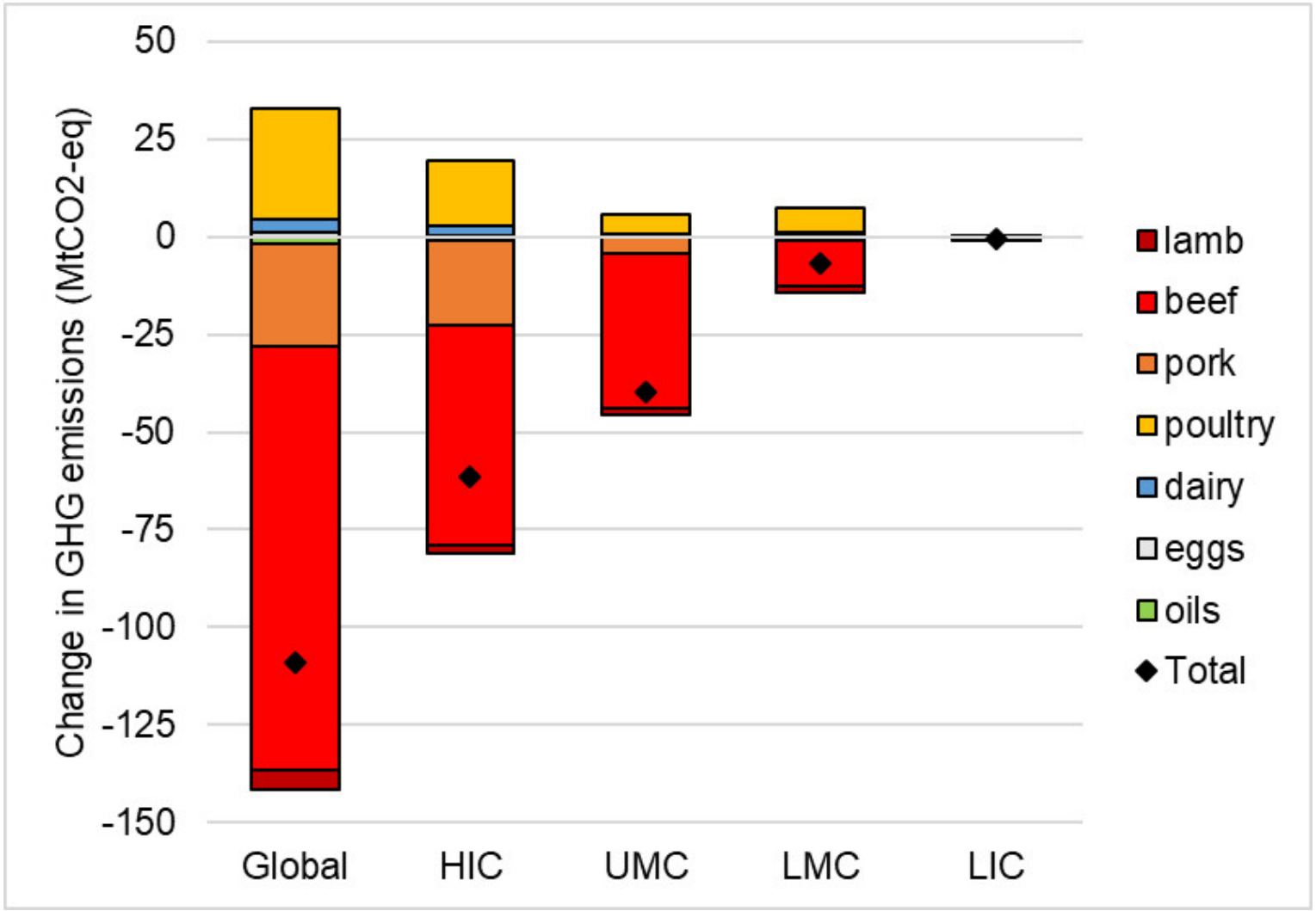
- 222,000 less deaths from red and processed meat intake
- 9% reduction, 1% in LIC, 17% in HIC

Economic impacts



- USD 41 billion (14%) less health costs
- USD 172 billion in tax revenues

Climate impacts



- 1.2% less emissions (0.1-3.3%)

General take-aways

Taxation of red and processed meat could:

- Improve diets;
- Lower diet-related mortality from chronic diseases;
- Lead to savings in health-care costs;
- Raise tax revenues;
- Reduce GHG emissions.
- Optimal tax levels estimated here are context specific and depend on health costs and mortality in a given location.
  - Optimal tax levels would be low in LIC, but high in MIC and HIC.
  - Future changes in income and consumption are likely to increase optimal taxes in LIC.

Conclusion

Rationale for taxing meat:

- Health impacts
- Environmental impacts

Impacts:

- Health and environmental co-benefits
- Benefits the greater the more diets change towards healthy and sustainable diets

Contact

Thank you for your attention.

Comments and suggestions:

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