Modelling European Agriculture with Climate Change for Food Security

What drives meat consumption? Combining cross-country analysis with the MAGNET model

Anna Birgitte Milford, NILF (Norway)
Martin Banse, Thünen Institute (Germany)

MACSUR Conference 2015
Integrated Climate Risk Assessment in Agriculture & Food
Wednesday 8th – Thursday 9th April 2015, University of Reading, UK

NILF
Norsk institutt for landbruksøkonomisk forskning

THÜNEN

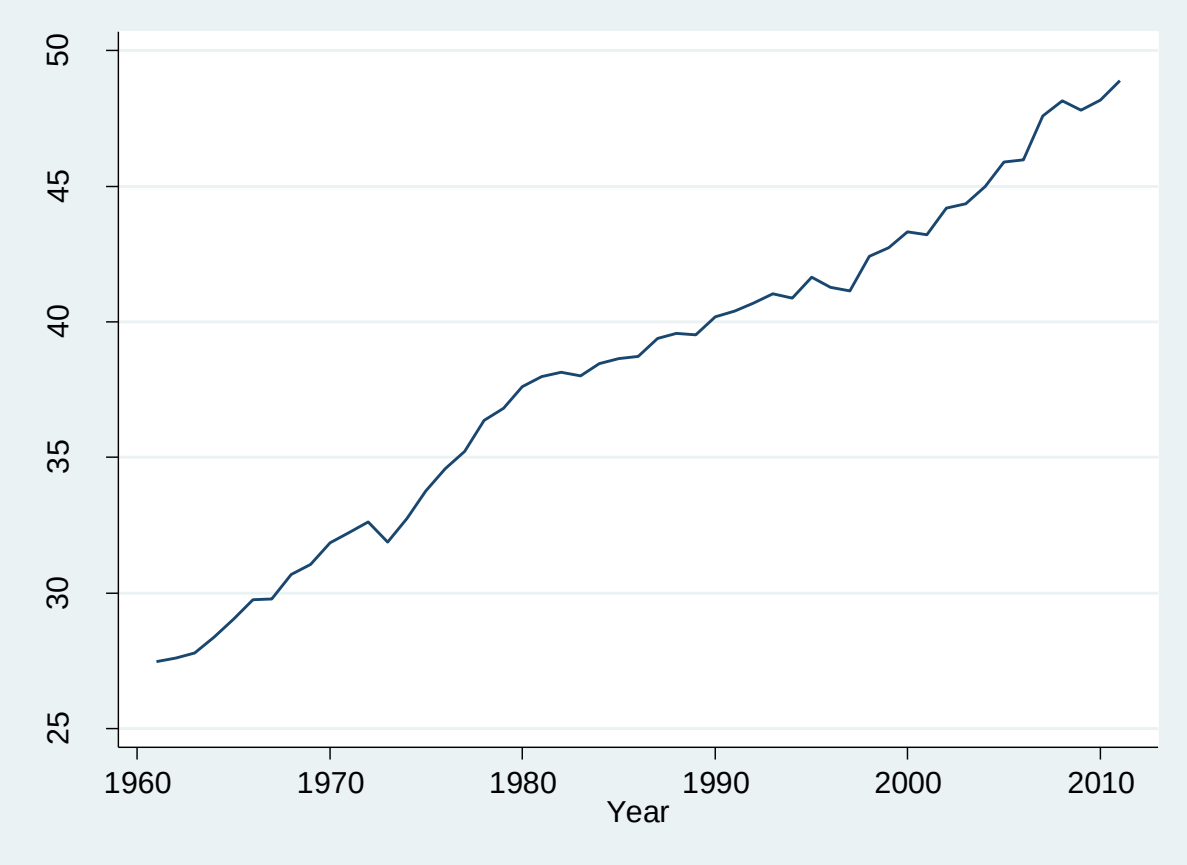
Introduction

- Motivation
  - MACSUR strongly focuses on supply side of agriculture and food sector
  - Contribution of demand to CC and impact of (changing) consumption pattern is not reflected in current work
  - Regression analysis about ling-term drivers of meat demand
  - Integrating this work in (better) calibrated demand functions in market models applied in MACSUR

Food choices matter…

- Producing 1 kg of animal protein requires about 100 times more water than producing 1 kg of grain protein (Pimentel and Pimentel 2003)
- The potential to reduce GHG emissions through changes in consumption is substantially higher than that offered by supply-side, technical GHG mitigation measures (Popp 2010)
- Demand-side measures offer a greater potential in meeting the challenges of both GHG mitigation and food security than do supply-side measures (Smith et al 2013)

World average meat consumption per capita, 1960-2011



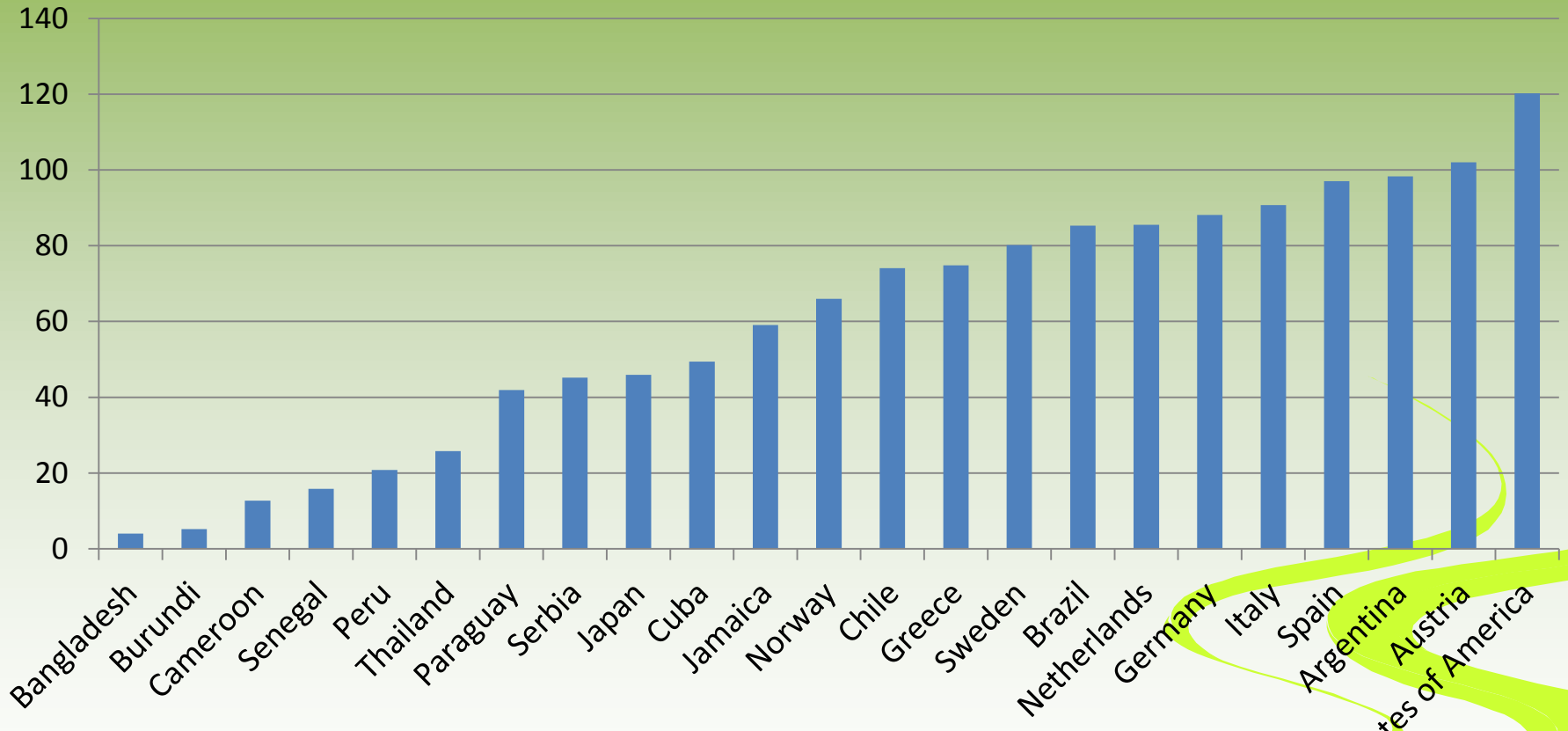
Source: FAO food balance sheet

Drivers of meat consumption

- There are large differences between countries when it comes to meat consumption
- What are the drivers?

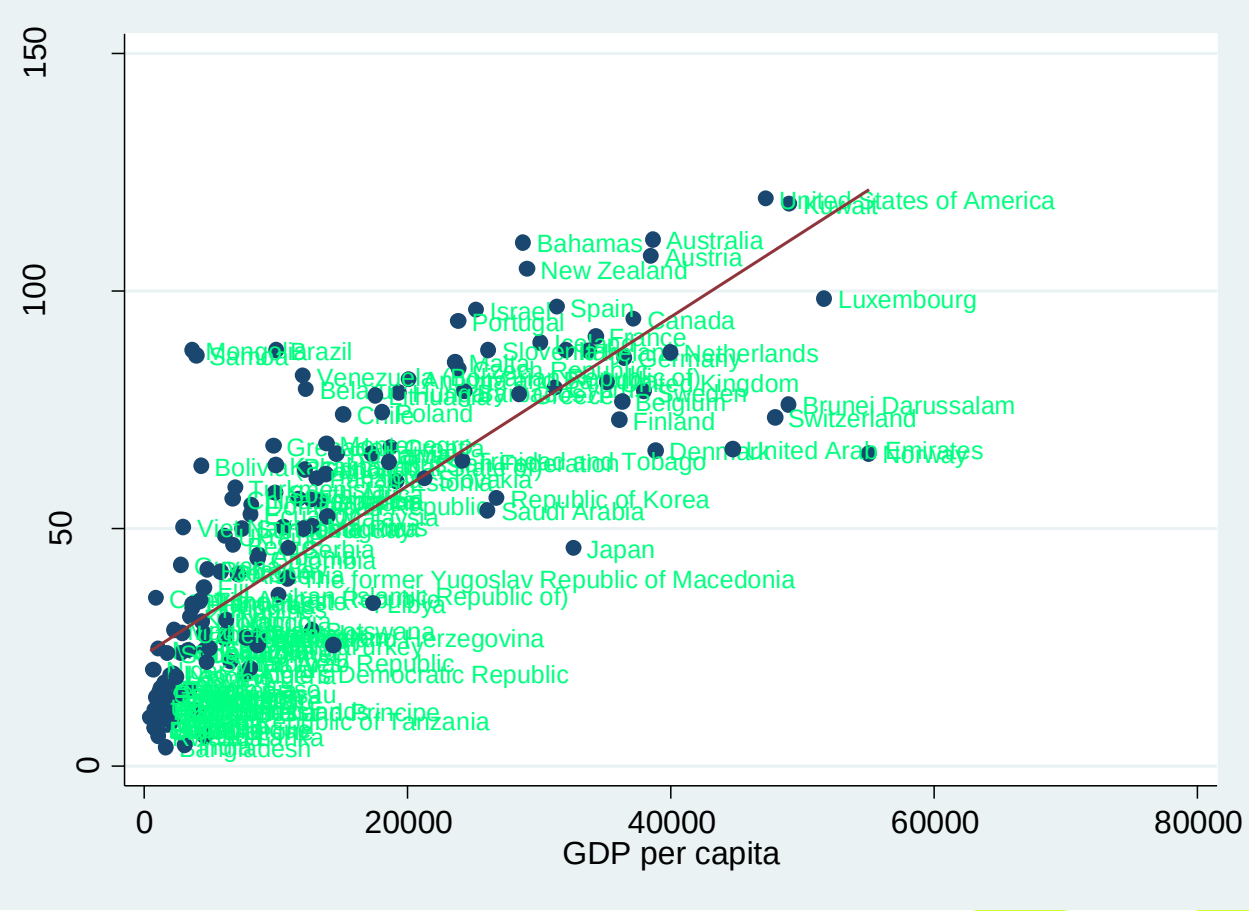
- Income, prices, urban population, religion, and agricultural landscape

Meat consumption in a selection of countries, kg/pc, 2010



Source: FAO food balance sheet

Meat consumption relative to income

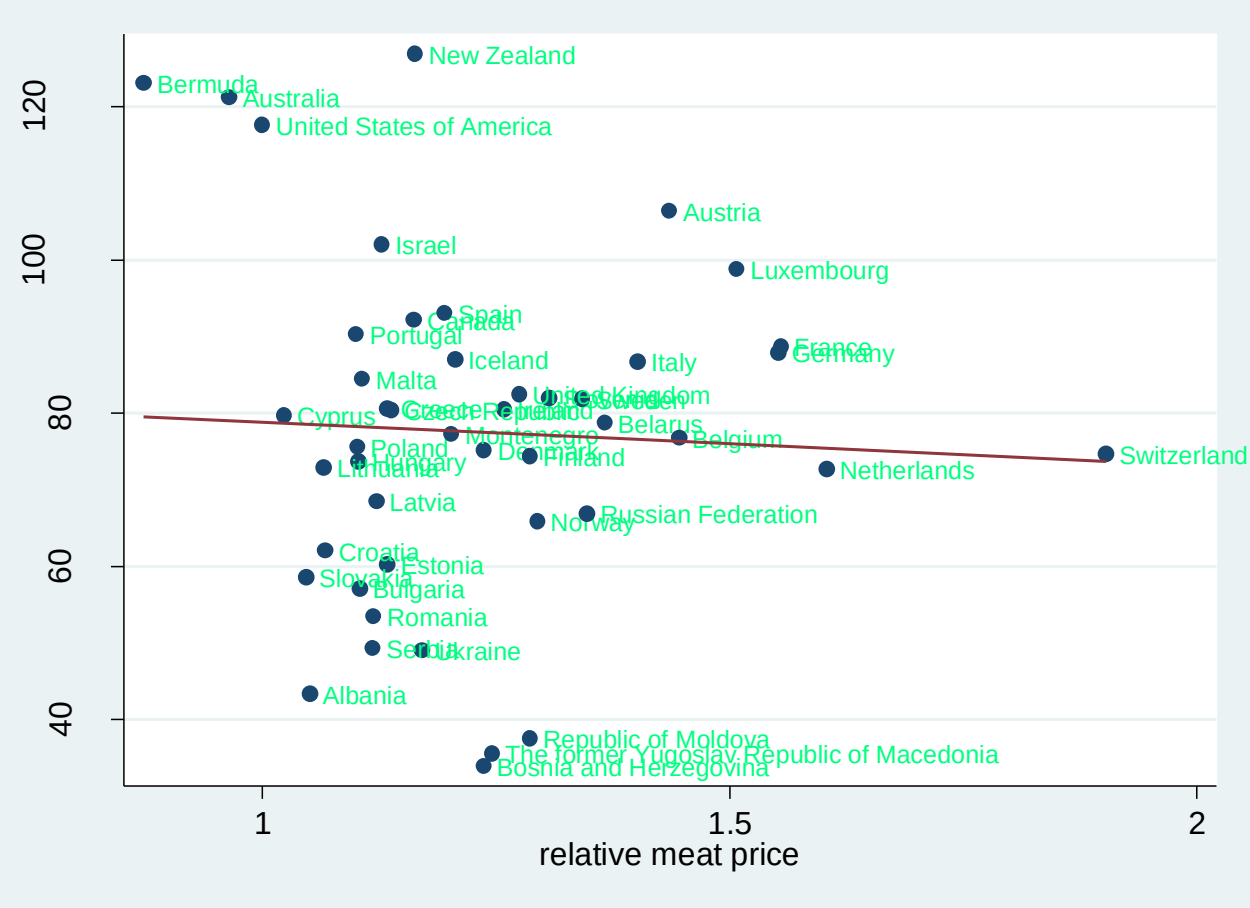


Source: FAO food balance sheet

Meat consumption and price, all countries

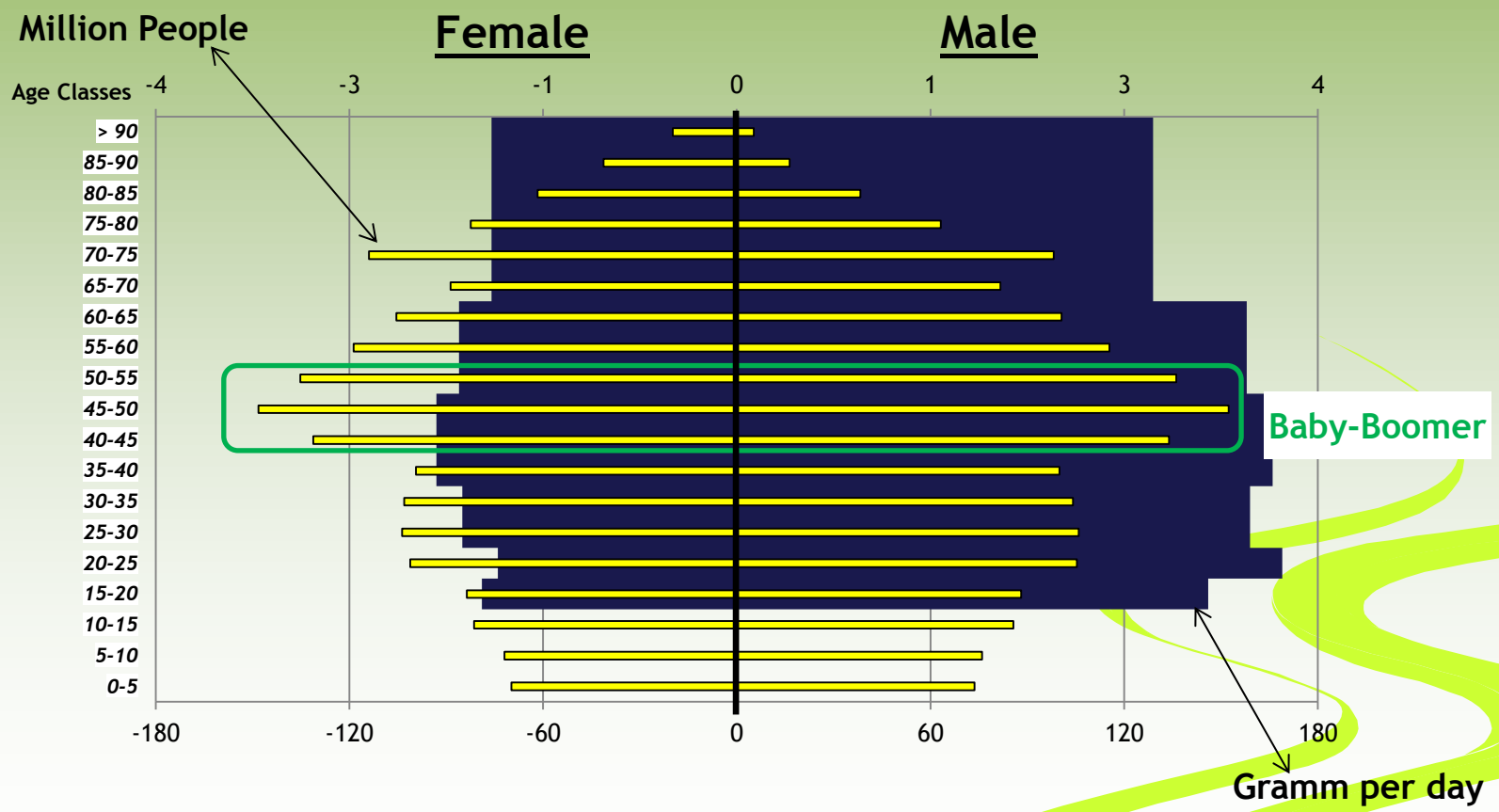
Source: FAO food balance sheet

Meat consumption and price, western countries



Source: FAO food balance sheet

Meat Demand, Germany 2013



Source: Efken (2014).

Regression analysis

- Estimate the effect on meat consumption (FAO data) of:
  - Meat prices (controlling for general food price level) (World Bank International Comparison Program (ICP) data) from 2011
  - Share of population living in urban areas (FAO data)
  - Income (PPP adjusted GNI per capita) (World Bank data) from
  - Religion dummies (ARDA data)

The regression analysis is an OLS with data from 2011, from 136 countries

Results: The drivers of meat consumption

pricemeat	-16.793**	(6.293)
pricefood	28.115**	(10.290)
meatprod_cap	0.060**	(0.028)
meadowagric	7.842*	(4.541)
agricpop	0.487	(0.298)
hdi	63.878***	(17.873)
GNIPPP	0.001***	(0.000)
urbanshare	15.477*	(8.506)
Muslim	-3.382	(3.435)
Catholic	0.967	(2.862)
western	8.869*	(4.627)
africa	-1.279	(4.858)
latinamer	5.229	(5.125)
middleast	-6.276	(5.956)
_cons	-30.525	(11.743)
R^2	0.829	
Observations	136	

The models: CGE-model - MAGNET

- GTAP: applied general equilibrium model based on neo-classical microeconomic theory
  - multi-regional
  - multi-sector
  - static

MAGNET

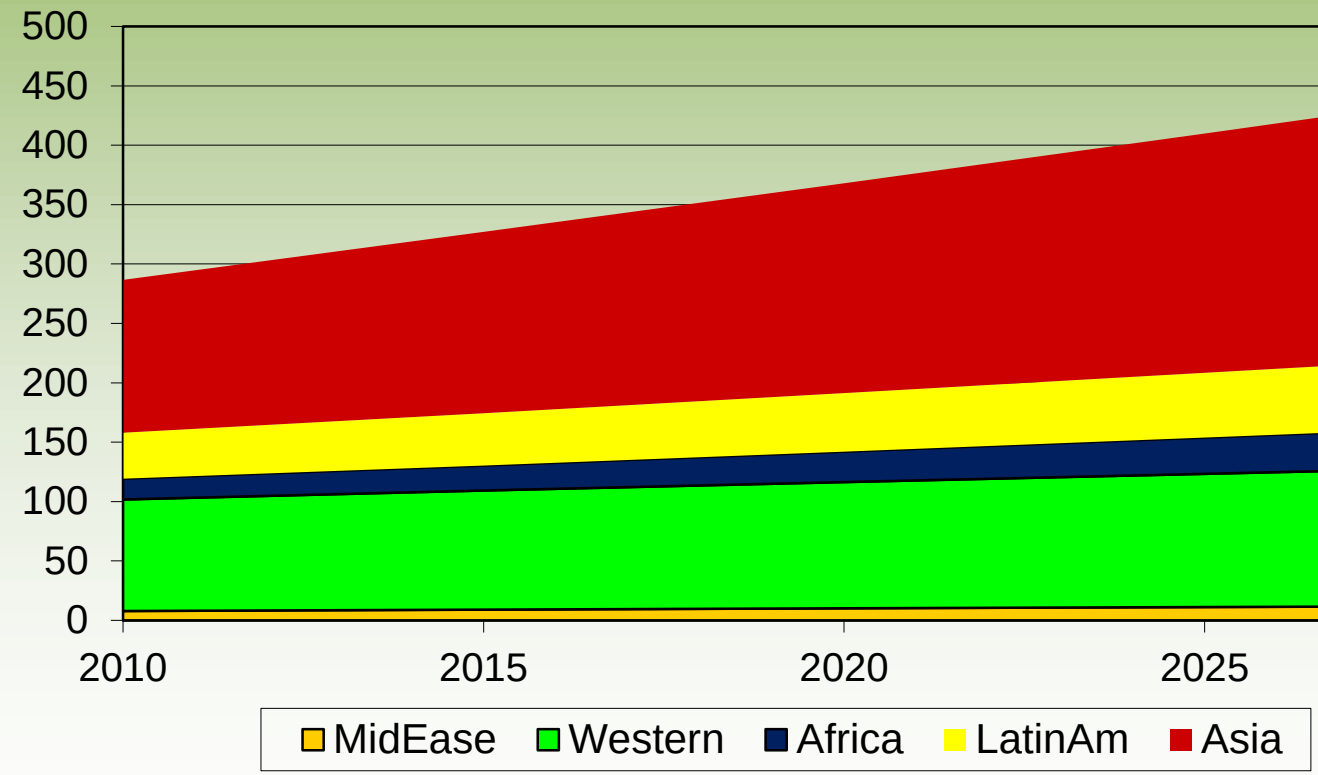
Outcomes of MAGNET

- Complete picture of the economy, including changes in:
  - consumption and production of commodities, incl. important crops and food
  - prices
  - trade (exports and imports)
  - employment, land supply and use across agricultural sectors
  - developments in wages and rental rates for land and capital
  - GDP
- Makes visible impacts: all sectors & all activities
  - across countries and/or regions in the world
  - within countries: consumers vs. producers, etc.
- Time horizon: 2007-2020
  - Comparison of (policy) scenarios with the BAU reference scenario

Consumption Structure of MAGNET

- Consumption of private households in GTAP is a Constant Difference of Elasticity (CDE) Function:
  - is calibrated using data on income and price elasticities of demand
  - and will be further re-calibrated in this analysis
- No constant income elasticities over time
  - leading to unrealistically high consumption of food items in fast growing economies
  - in MAGNET: income elasticities are dynamically adjusted using real GDP per capita (in the form of a decreasing function)

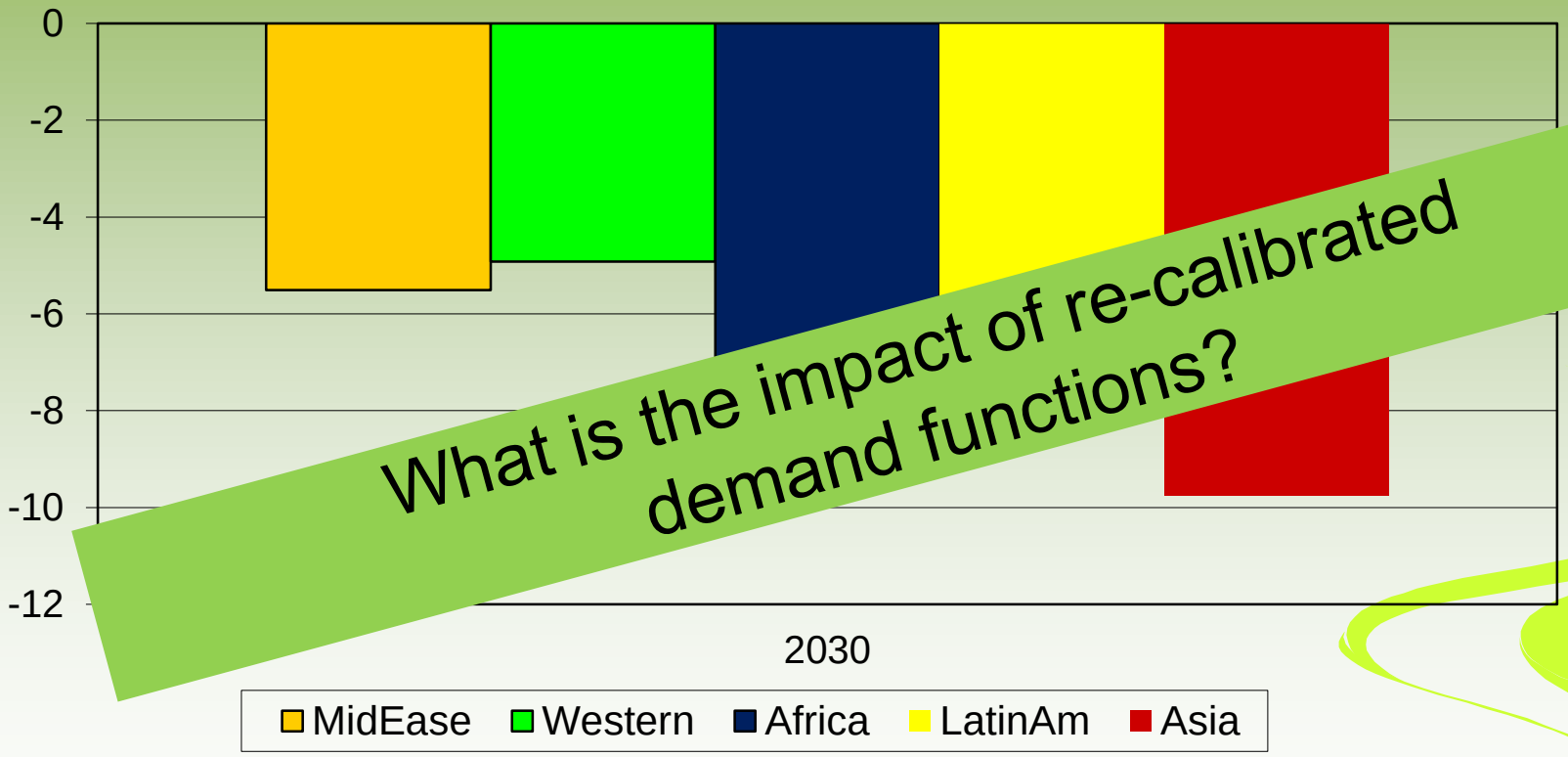
Development of Meat Consumption
Baseline in million tons, 2010-2030



	2010-2030
MidEase	55.2%
Western	25.8%
Africa	102.4%
LatinAm	54.0%
Asia	76.5%
WORLD	42.6%

Meat consumption grows by more than 40% until 2030 at global level

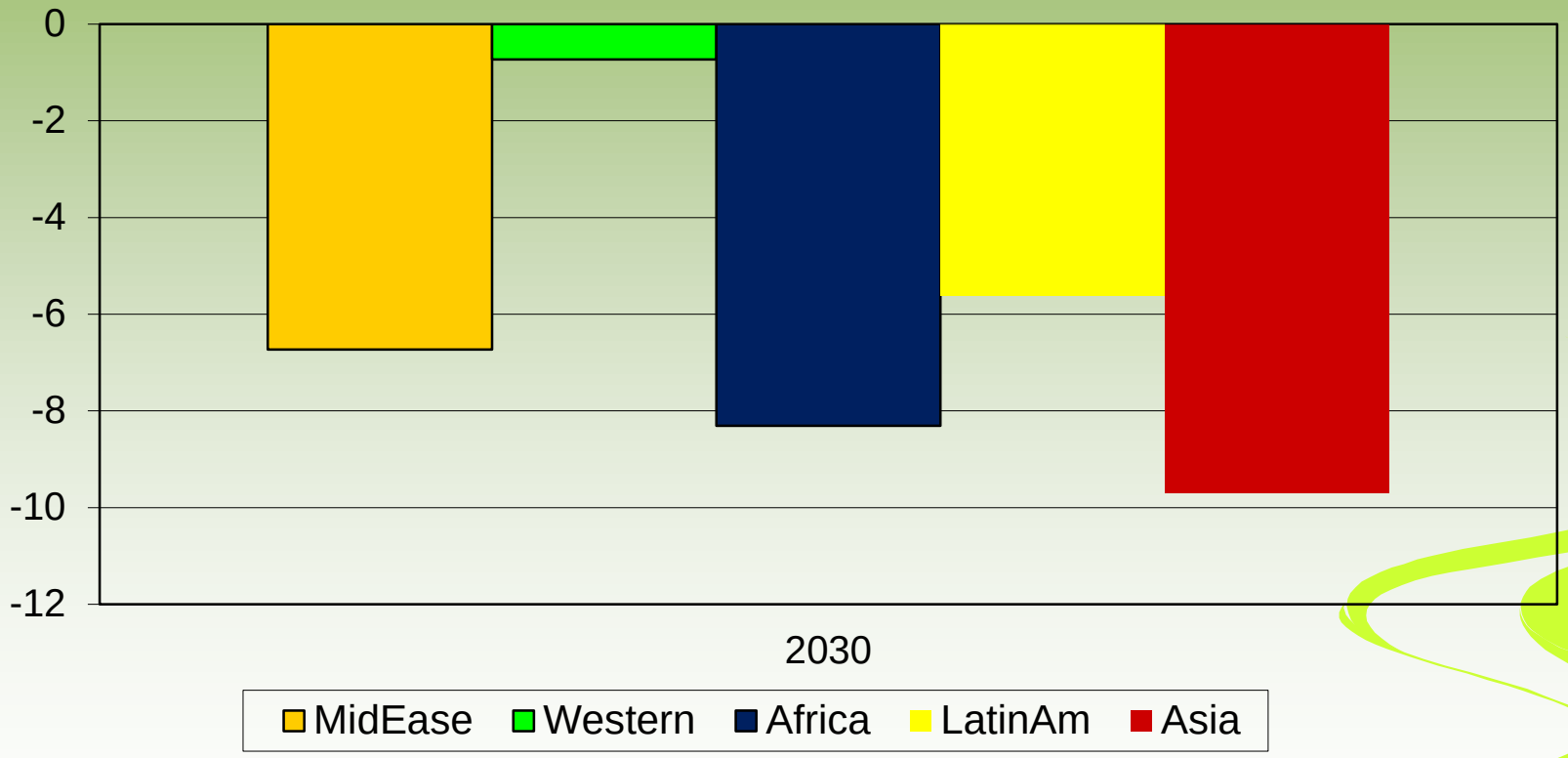
Meat Consumption: Baseline rel. to LowInc in %, 2030



What is the impact of re-calibrated demand functions?

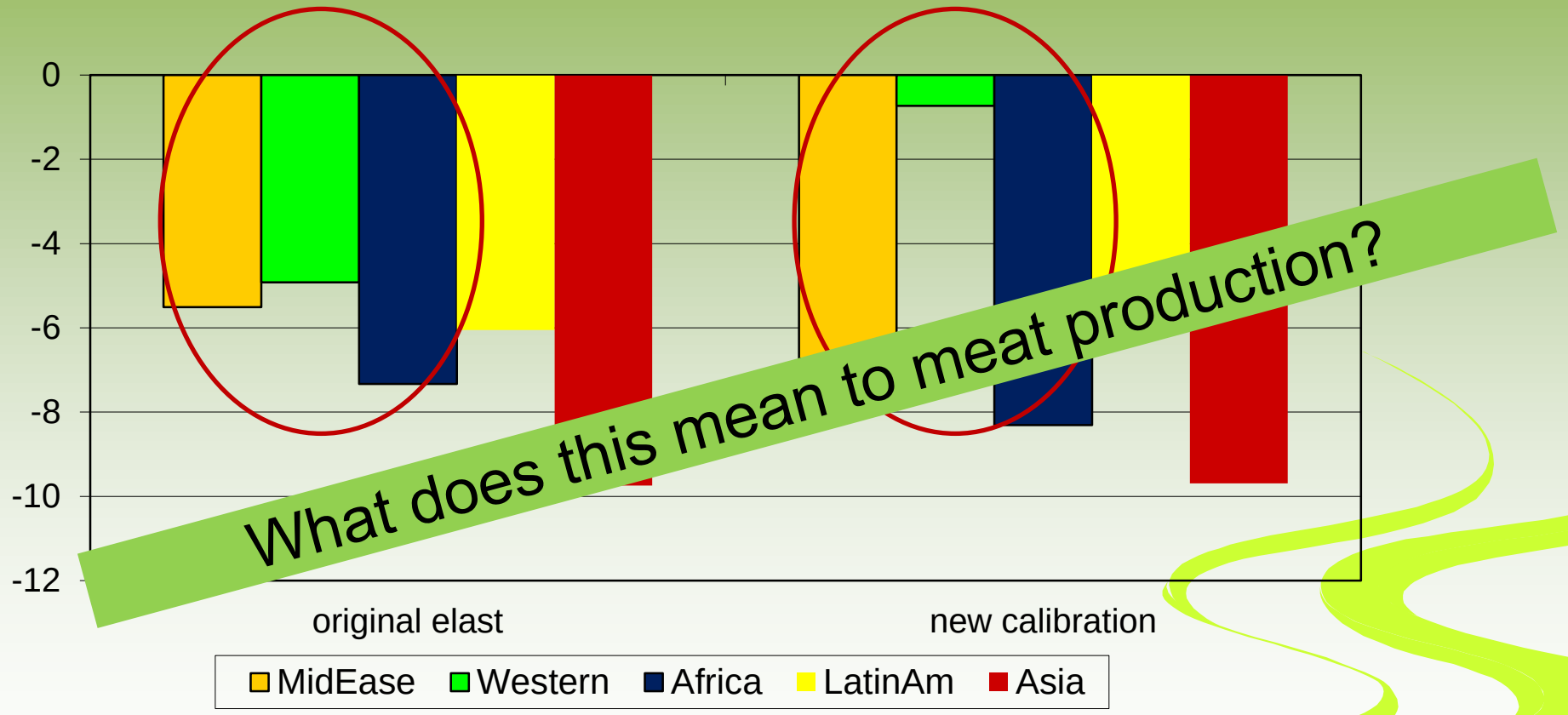
Regions matter: Differences in response to lower income

Meat Consumption: Basleine rel to LowInc in %, 2030



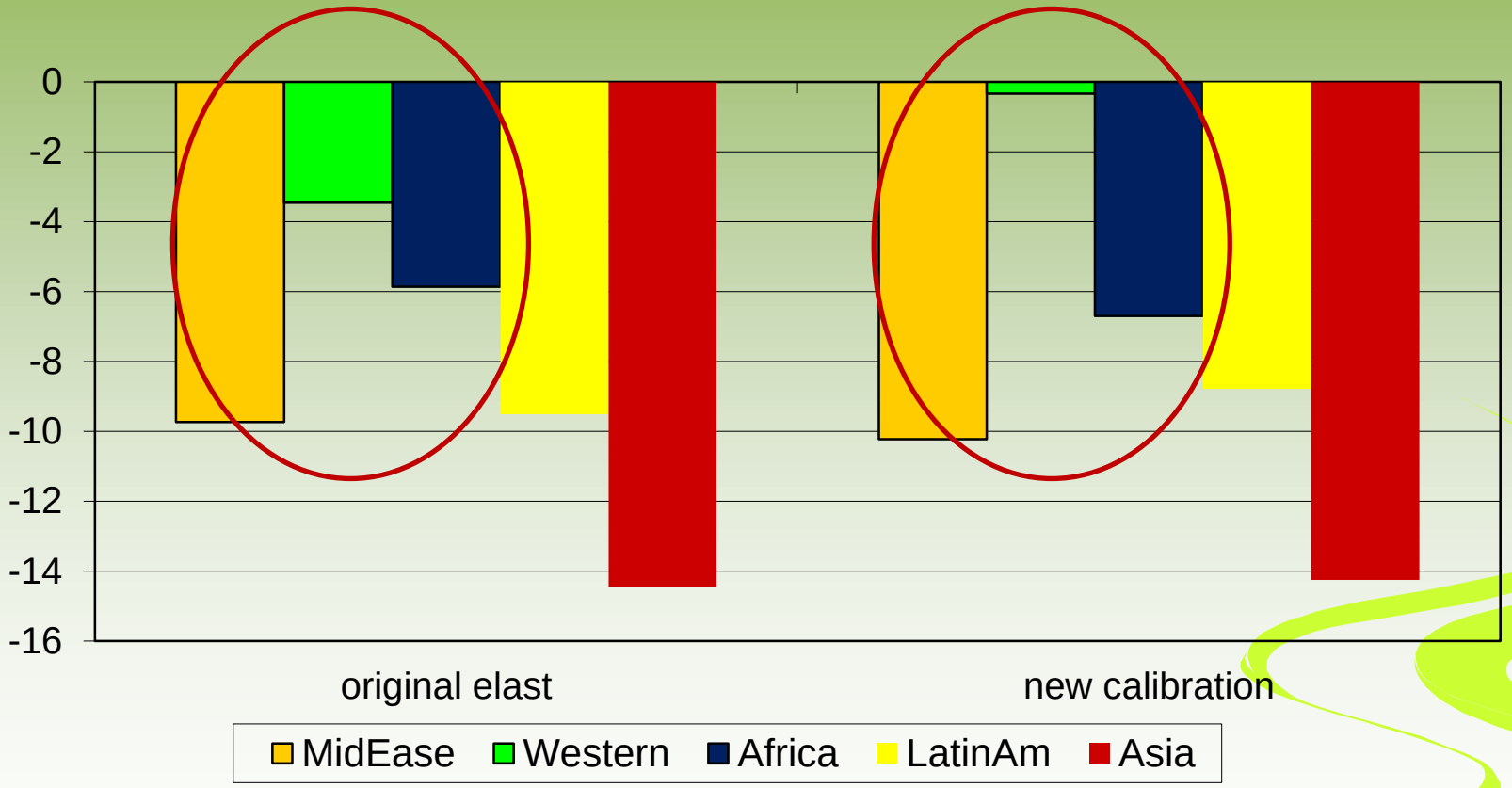
Regions matter: Differences in response to lower income

Impact of re-calibrated Demand Functions: Change in Meat Consumption, in %, 2030



Calibration matter too:
Regional differences in response to lower income change substantially

Impact of re-calibrated Demand Functions: Change in Meat Production, in %, 2030



Calibration matter too on Production side:
Regional differences in response to lower income change substantially

Conclusions

- Empirically estimated price- and income elasticities
  - Strong differences in responsiveness among different regions
  - First attempt to use this information in MAGNET
- Price- and income elasticities for meat re-calibrated in MAGNET
  - First results show strong effects especially for Western, industrialized countries on consumption and on production
  - Main focus of MACSUR analyses

Conclusions

- Measures/development that affect meat consumption
  - Tax instruments
  - Changing preferences (vegans, vegetarians)
- MACSUR-2 will include consumption behavior in integrate risk assessment of climate change in Europe
  - Task T3.6: Impact of consumer behavior

MACSUR

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