Global food production and markets: Long term challenges and short term fluctuations

Perspectives on Productivity and Policy Responses

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Outline

- ✓ A simple approach: The food equation
- ✓ Productivity is key
- ✓ Reason for hope? – Depends on R&D policy response

The food equation

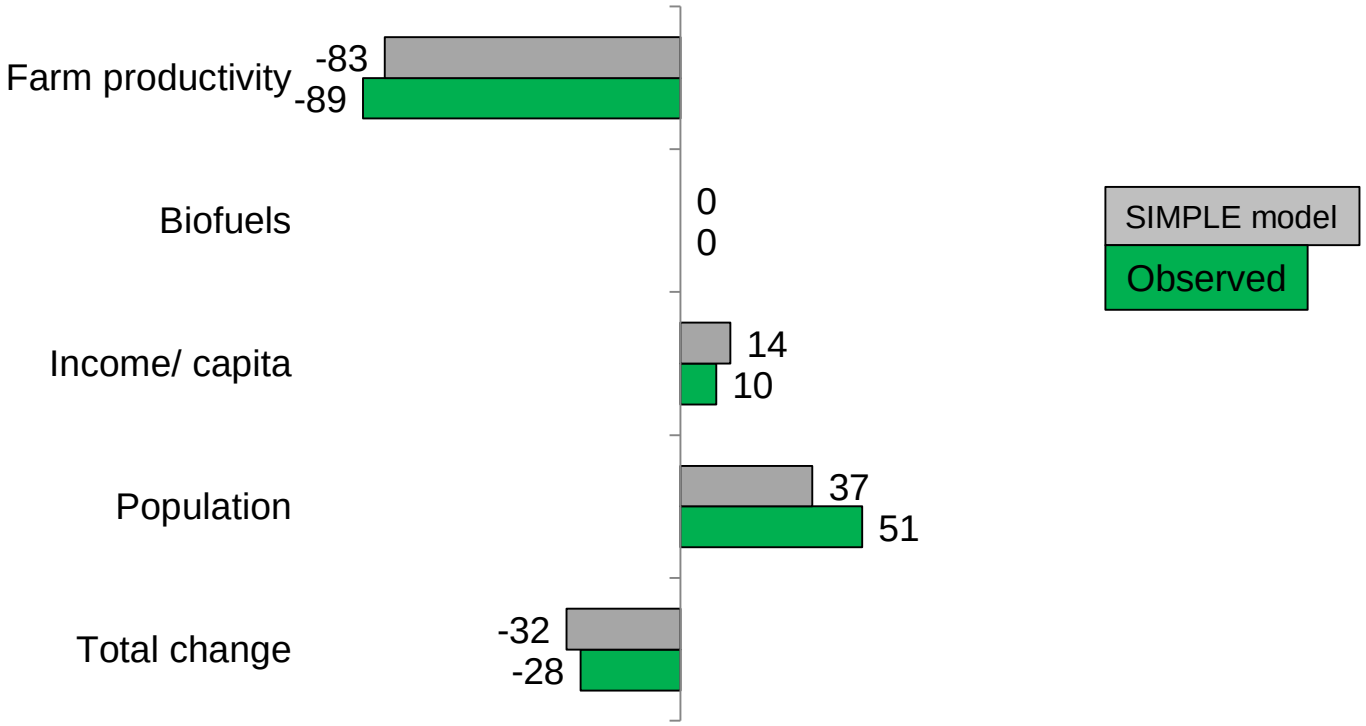
1. Malthus: Is there a likely chance of a global food deficit?

$$\underbrace{Q * d}_{\text{Demand}} - \underbrace{A * f(L,K)}_{\text{Supply}} > 0$$

2. Neo-classical: What is the price that balances food markets?

$$\underbrace{Q * d}_{\text{Demand}} - \underbrace{A * f(L,K)}_{\text{Supply}} = 0$$

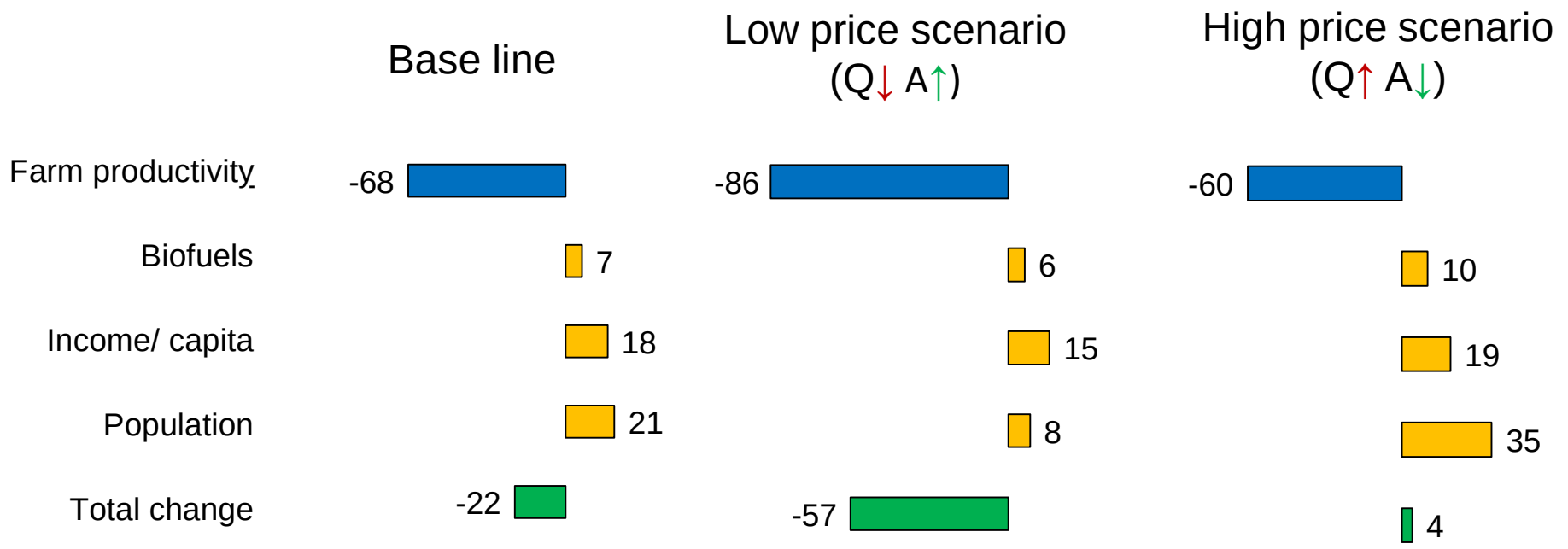
Decomposition of *historical* crop price development (1960-2009)



Source: Baldos and Hertel (2014): *Bursting the Bubble: A Long Run Perspective on Crop Commodity Prices*. GTAP Working Paper No. 80.

Decomposition of *prospective* crop price development (2006-2051)

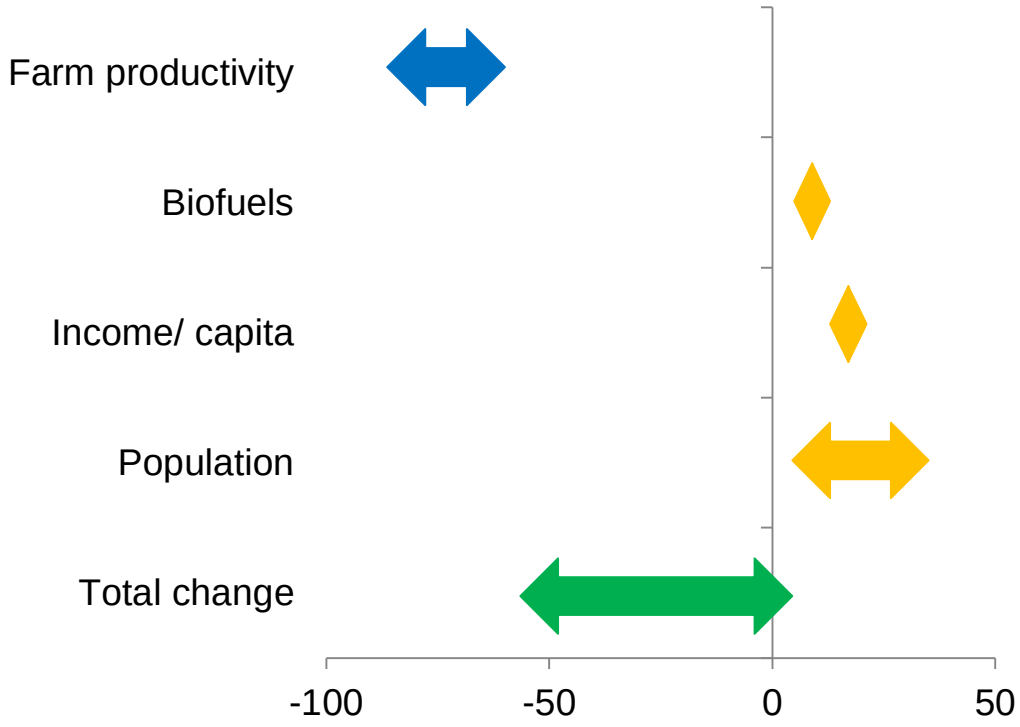
Percentage points by factor



Source: Baldos and Hertel (2014): *Bursting the Bubble: A Long Run Perspective on Crop Commodity Prices*. GTAP Working Paper No. 80.

Uncertainy about key drivers of food demand and supply: Variation in estimates

Max and minimum levels of impact on future price changes for individual driving factors.
Percentage points impact on price change per explanatory factor



Productivity isn't everything, but in the long run it is almost everything.
Paul Krugman

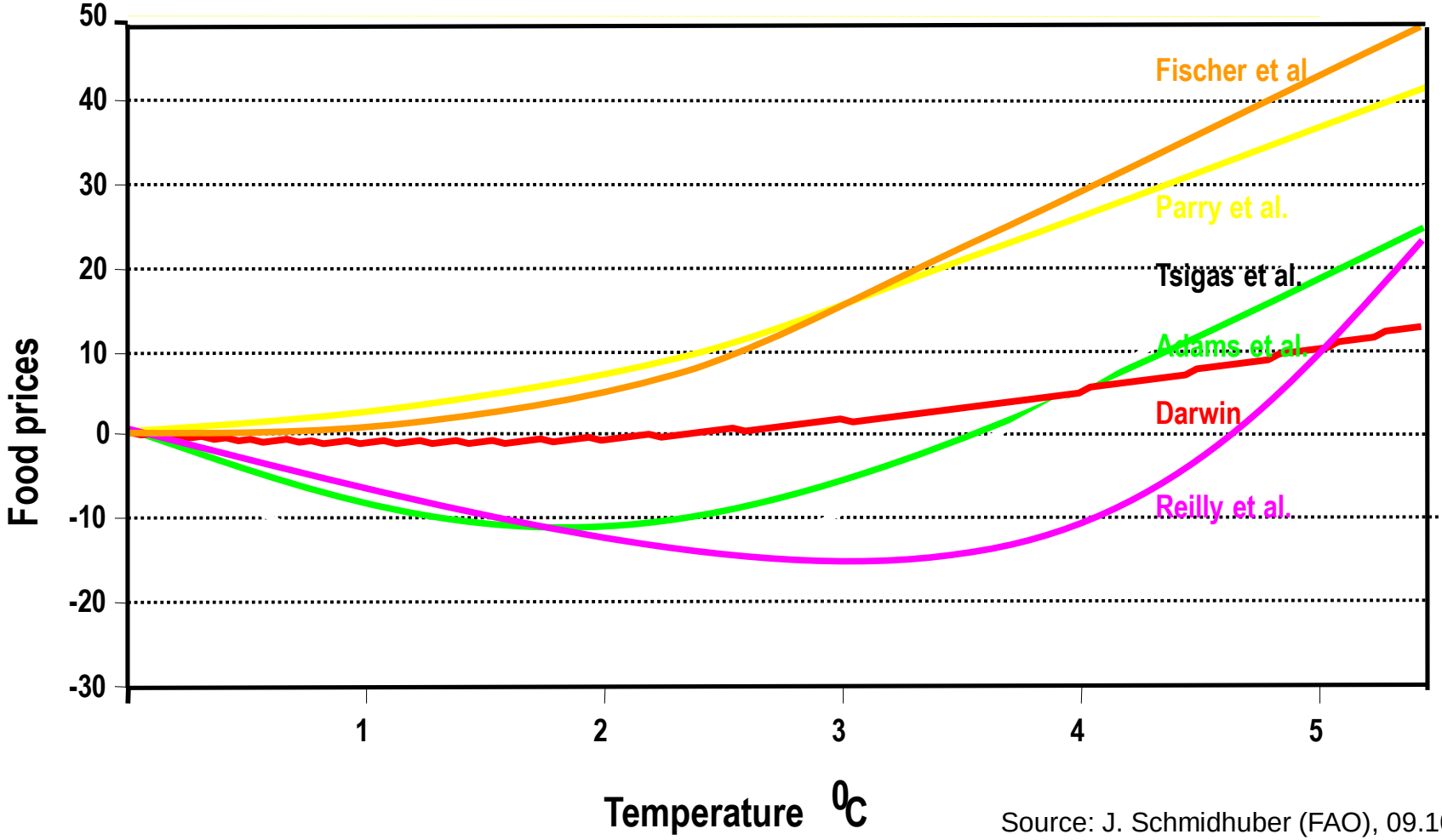
Source: Baldos and Hertel (2014): *Bursting the Bubble: A Long Run Perspective on Crop Commodity Prices*. GTAP Working Paper No. 80.

Model assumptions

- Global warming: Not if, but when
  - Climate impact – in the long run – post 2050
  - How to make priorities for the post 2050-era?
- Population growth: Demography adds substantal uncertainty
- Productivity: The complex factor

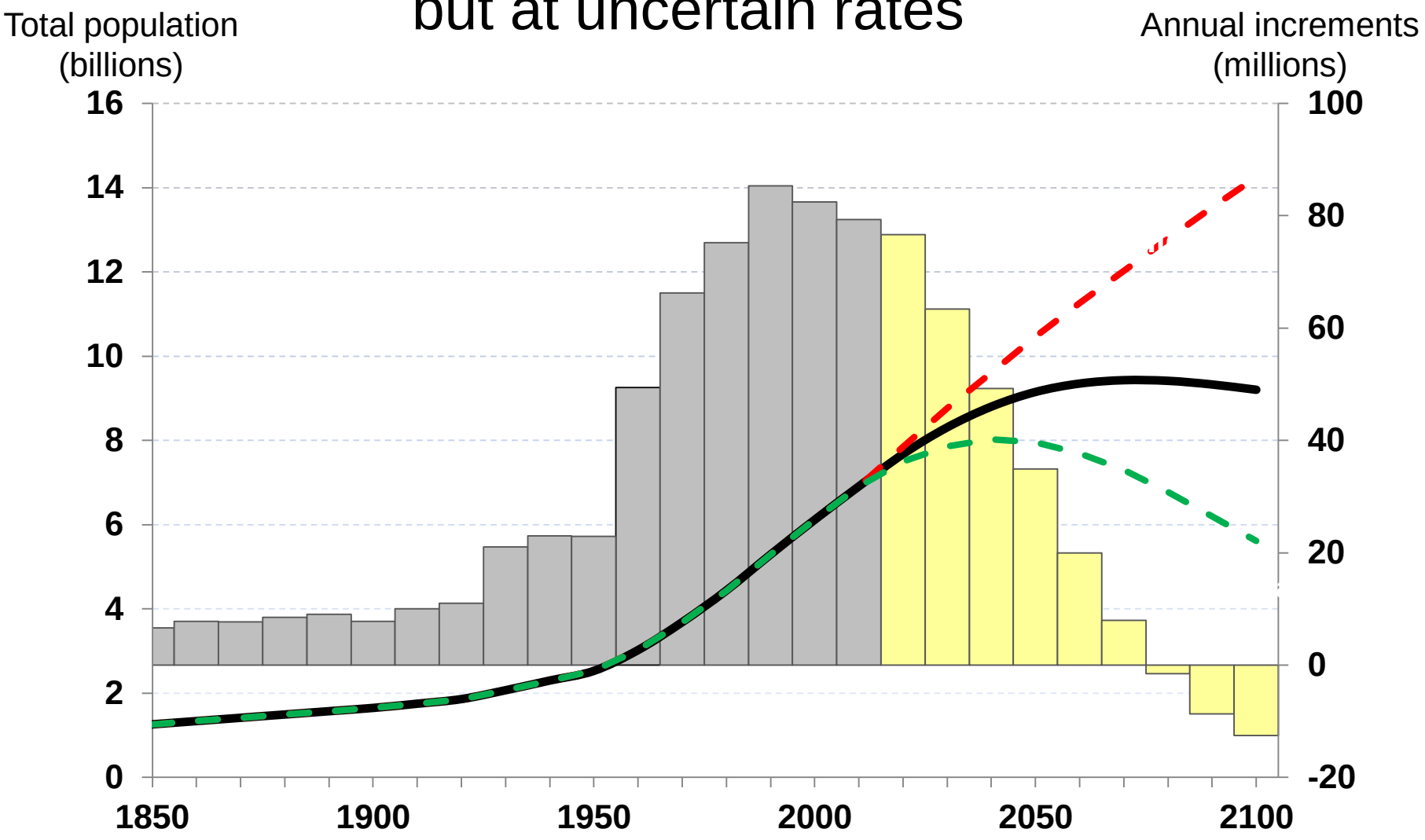
Global warming will impact markets and productivity, but only after some degrees and decades have passed

Percentage change in world food (cereal) prices in relation to changes in temperatures



Source: J. Schmidhuber (FAO), 09.10.2014

Population growth to continue, but at uncertain rates



Source: J. Schmidhuber (FAO), Berlin, 09.10.2014

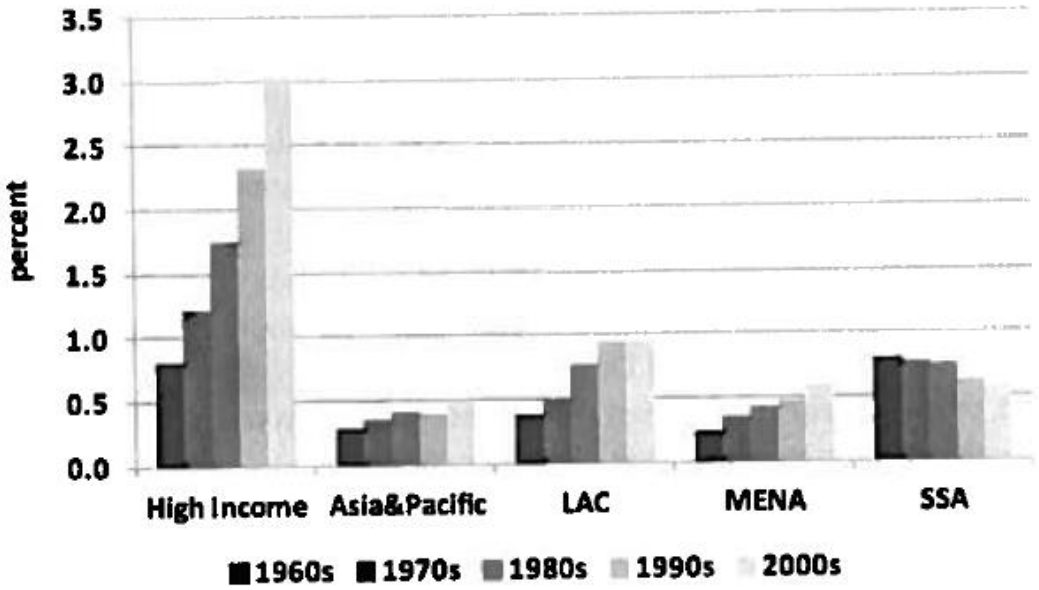
Link between productivity and R&D policy

- Agricultural R&D significantly increases productivity (Alston 2010)
  - Marginal cost-benefit ratio > 1
  - Systematic global underinvestment in agricultural R&D

- R&D policy plays a key role
  - But: Local or global research priorities?
  - But: Public or private R&D?
  - But: Short-term research investment versus long-term returns?
  - But: National or global ag policy priorities?

Agricultural production becomes steadily more research-intensive

Agricultural R&D relative to agricultural GDP by region (1960-2009)

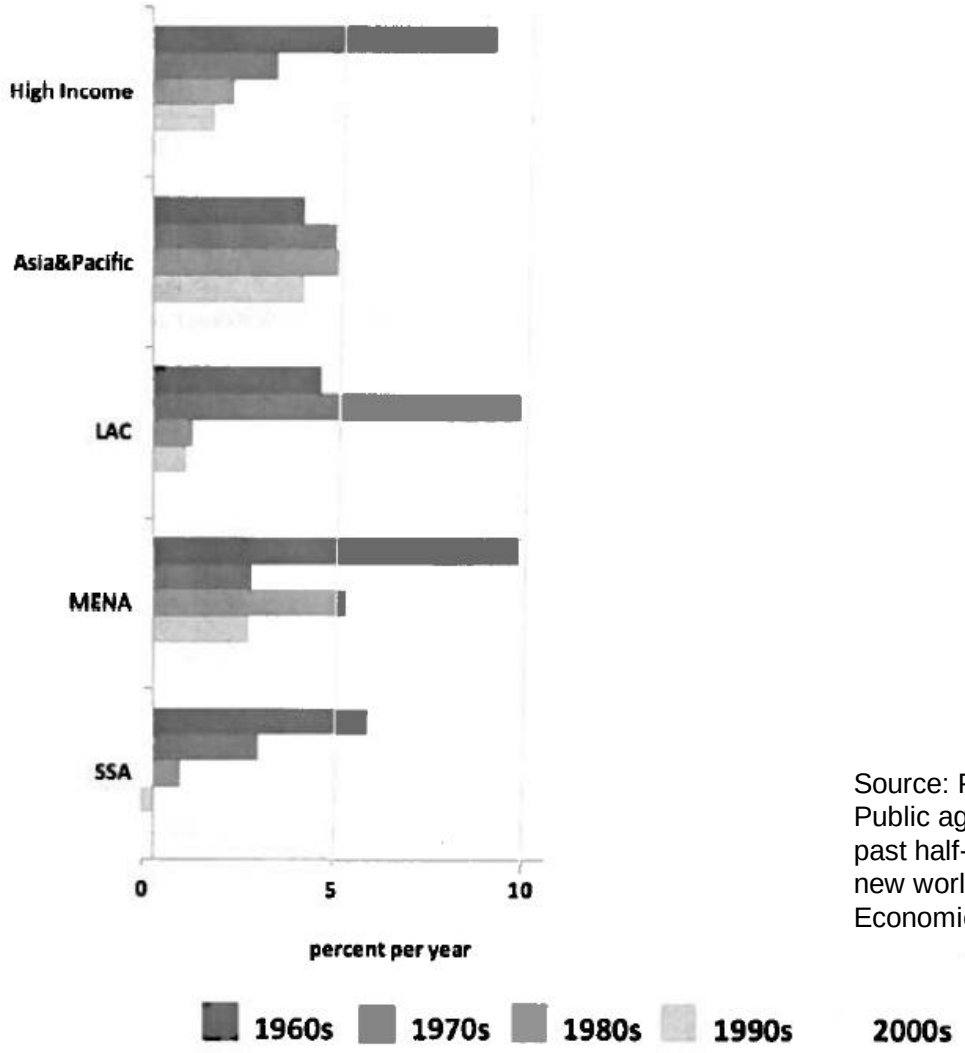


High Income	Asia&Pacific	LAC	MENA	SSA
North-America, Europe, Japan, Singapore, Qatar, United Arab Emirates	including China and India	Latin America & Carribean	Middle East & North Africa	Sub-Saharan Africa

Source: Pardey et al. (2013): Public agricultural R&D over the past half-century: an emerging new world order. Agricultural Economics 44: 105-113

Reduced growth rates in agricultural R&D in all world regions

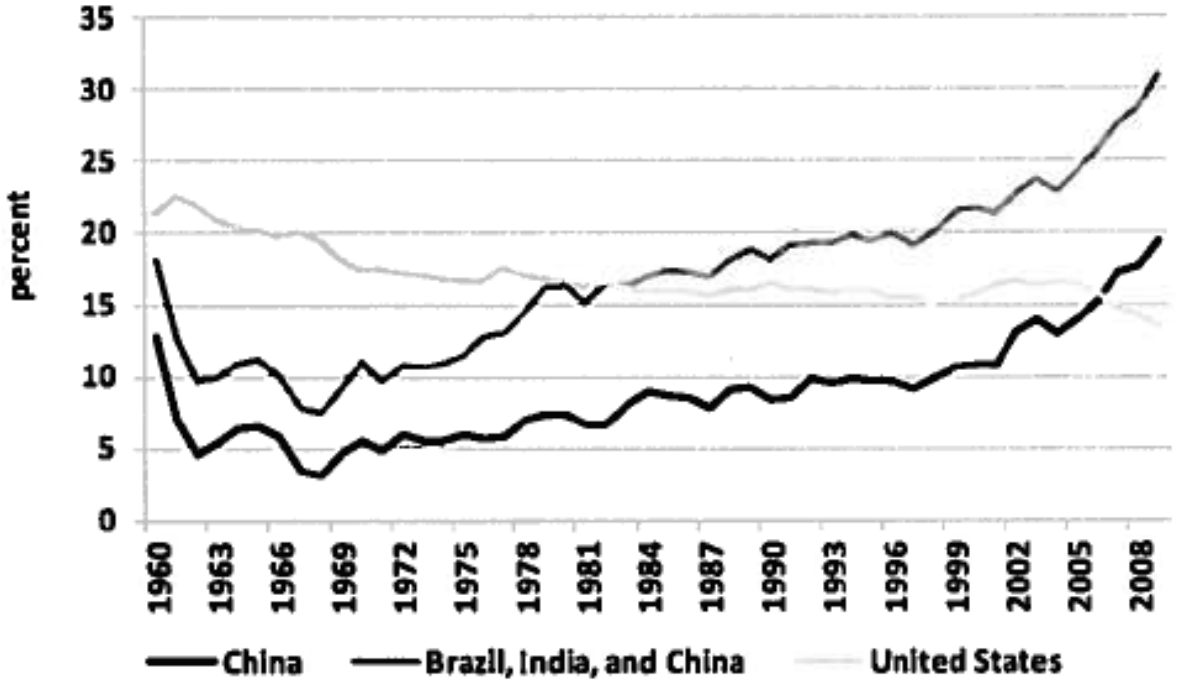
High Income	North-America, Europe, Japan, Singapore, Qatar, United Arab Emirates
Asia&Pacific	including China and India
LAC	Latin America & Carribean
MENA	Middle East & North Africa
SSA	Sub-Saharan Africa



Source: Pardey et al. (2013): Public agricultural R&D over the past half-century: an emerging new world order. Agricultural Economics 44: 105-113

Emerging economics increase their share of global agricultural R&D at the expense of high income countries

Shifting shares of global public agricultural R&D spending (1960-2009)



Source: Pardey et al. (2013): Public agricultural R&D over the past half-century: an emerging new world order. Agricultural Economics 44: 105-113

Need for coordinated R&D policy responses

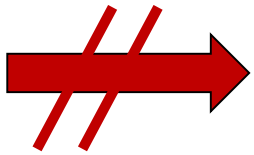
- Think globally – act globally
  - The productivity potential multiplies when moving from Norway to Africa!
- Do not forget intermediate products and technologies (so far disregarded in this analysis)
  - Future feed for livestock may come from algae, insect breeding and timber
  - Biotech may greatly improve digestability of feed and productivity in livestock breeding
  - Biotech is, in general, improving the food output of given biomass
- Do not protect *wealthy* consumers and markets from price changes
- Ensure that new technologies and research maintain real options of great potential values post 2050
- Establish a longer – term, internationally oriented research policy!

Example of a **successfull** national R&D policy to solve a major challenge

- 04.10.1957: Sputnik 1: 1. artificial satellite in orbit
- 17.08.1958: 1. launch of US vehicle to reach moon: Failure
- 23.09.1958: 1. launch of USSR vehicle to reach moon: Failure
- 12.09.1959: 6. launch of USSR vehicle: Success (Moon impact)
- 12.04.1961: Yuri Gagarin: First human in space
- **25.05.1961: Kennedy's «Man to the moon»-speech**
- 28.07.1964: 16. launch of US vehicle: Success (Moon impact)
- 31.01.1966: 1. USSR moon soft landing
- 30.05.1966: 1. US moon soft landing
- **21.07.1969: 1. US manned moon landing**

Example of an **unsuccessful** national R&D policy to solve a similar major challenge

- 01.01.2007: Stoltenberg launches full-scale carbon capture and storage (CCS) plans at Statoil's Mongstad gas plan, and calls it «the moon-landing of our time».
- 19.11.2012: Stoltenberg raises doubt about the «moon-landing».
- 20.09.2013: Stoltenberg gives up CCS plans after eights years and billions of kroners investment.



Example of Norwegian agricultural research priorities

The focus of Norwegian agricultural research to increase Norwegian food production is hardly the appropriate policy response to global agricultural productivity and food security challenges!

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Assumptions

- Total Factor Productivity estimates explain ca. 60 % of output growth 1961 – 2006;
  - crops – high and low growth rates during 1961-2005 + 0,72 – +1,59 (Fuglie, 2012)
  - Livestock: also historically based: +1,61 – +2,75 (Ludena & al. 2007),
  - Processing: historic average + / - 30 % for high and low
- Income growth; UN prospects
- Population: UN high and low
- Production functions; assumptions about elasticities of substitution; land for non-land factors
- Consumption: Ordinary estimates of price- and income elasticities, Armington demand function for substituion of imports for domestic produce
- Biofuels: Business as usual is the IEA (2012) projection, simulations include «no-growth» and all policy-meeasures enacted as of mid 2012

Biofuels;

- First generation, food crop-based, bio-fuels have augmented prices since 2004
- Subsidies and crude prices (USD 100 +) determine future impact
- Current trend:
  - Trim back public support to biofuels
  - More doubts about high crued prices
- Second generation biofuels will lessen the burden on food crops

Source: Baldos and Hertel, 2014

If productivity is key: What should the appropriate policy response be?

- Priorities needed for research
  - National versus global productivity issues
  - Public versus private knowledge and technology
  - 30 years perspective versus returns near term
  - Technology diffusion versus national sovereignty
- Short-term stability may be catastrophic longer-term
  - TFP is likely to be price sensitive
  - Stable and low prices short-term may reduce investment for longer-term solutions
  - Nevertheless a likely scenario