Productivity vs Food Security and Sustainability

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Productivity Measurement: What is it?

- Definition: Output/Input
- Single factor, i.e. output/acre, or

  Multi-factor, MFP, (output index)/(input index)
- Anthropocentric – it's what matters to us

  [Thermodynamics assures us the true ratio is 1.000]

Productivity Measurement: What for?

1. Solow (1957) - measure progress, new returns to labor
2. Schultz (1956) - explain where progress comes from

   When explained, productivity growth is gone –

   - No longer a measure of progress
   - where does it go?

   Thermodynamics, again - there is no progress

Productivity Measurement: What we want

1. Gauge progress (Solow)–

   Human welfare from relatively fixed resources,

   such as land, water, climate, ecosystem resilience

2. Explain progress (Griliches)-

   How it is achieved is important for policy

   But don't use the result as a metric for progress

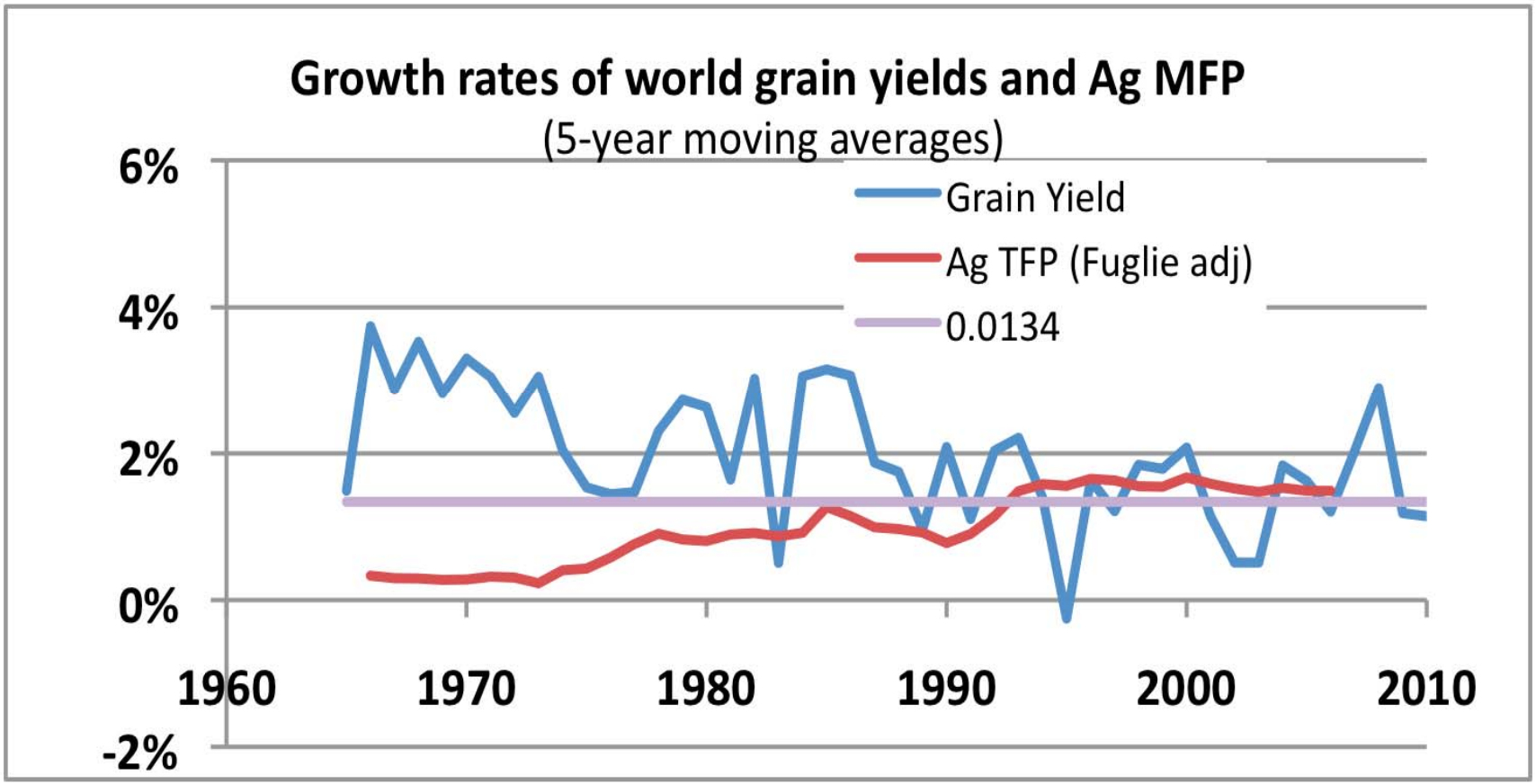
Agricultural Productivity vs Food Security in 2050

- Compare *growth rates* of MFP & demand
- Rate of demand growth

Source of growth	Total Increase	Avg Annual Rate
Population	32%	0.7%
Income	38%	0.8%
Total	70%	1.34%

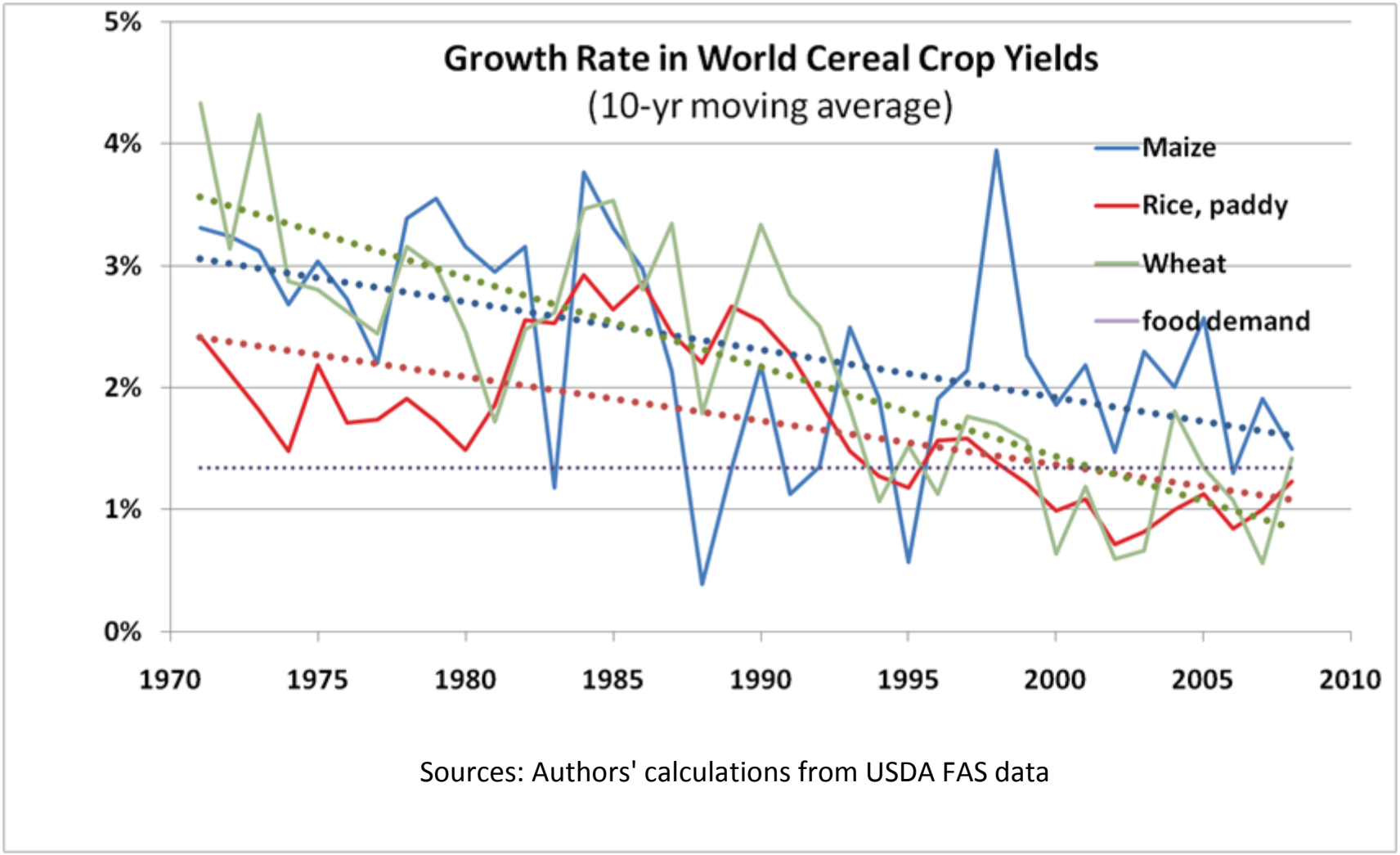
- Can productivity growth rate match that?

Crop Yields vs MFP - world



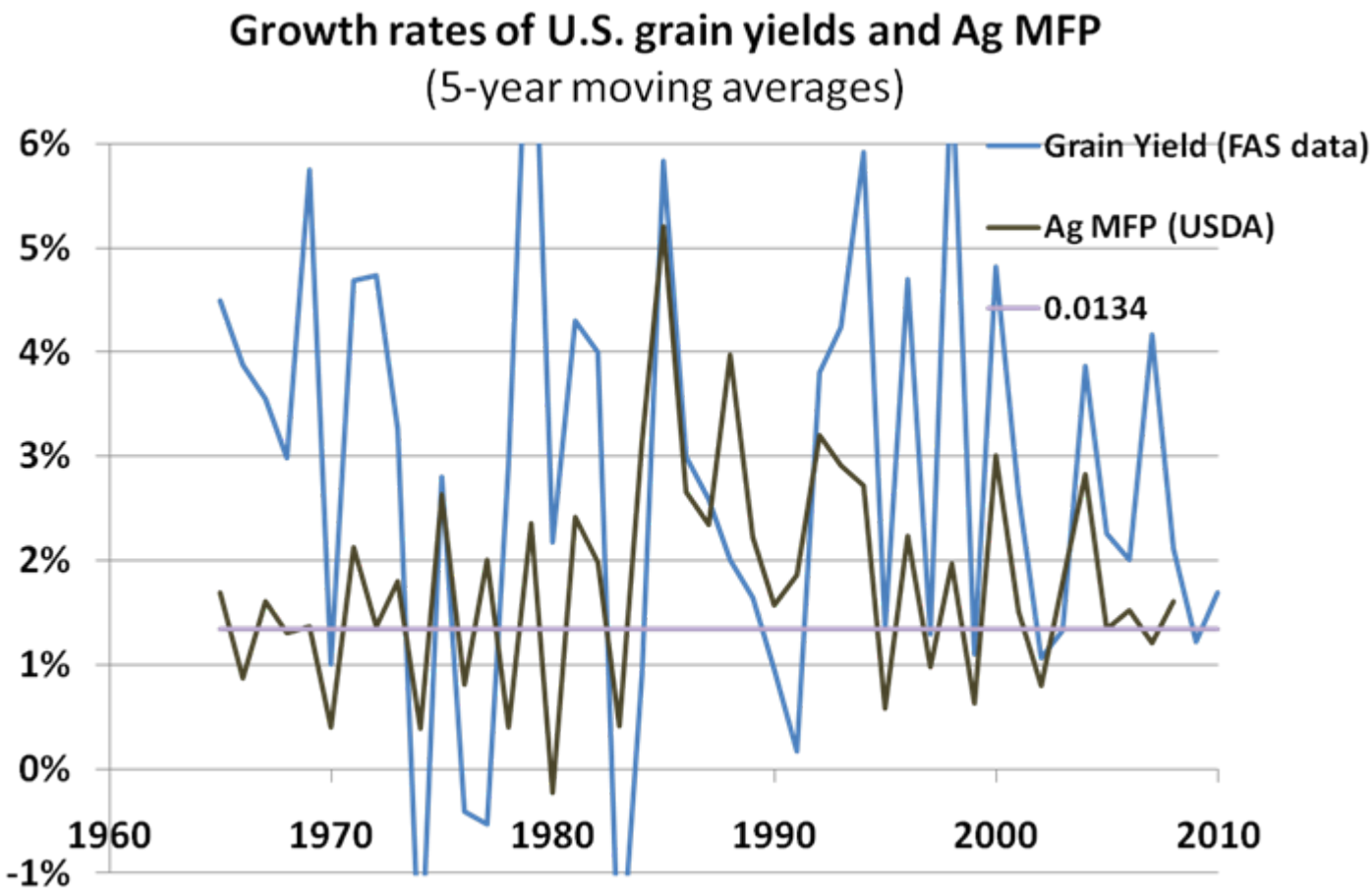
Sources: Authors' calculations from USDA FAS data, Fuglie (2008)

Decline in growth rate of world grain yields



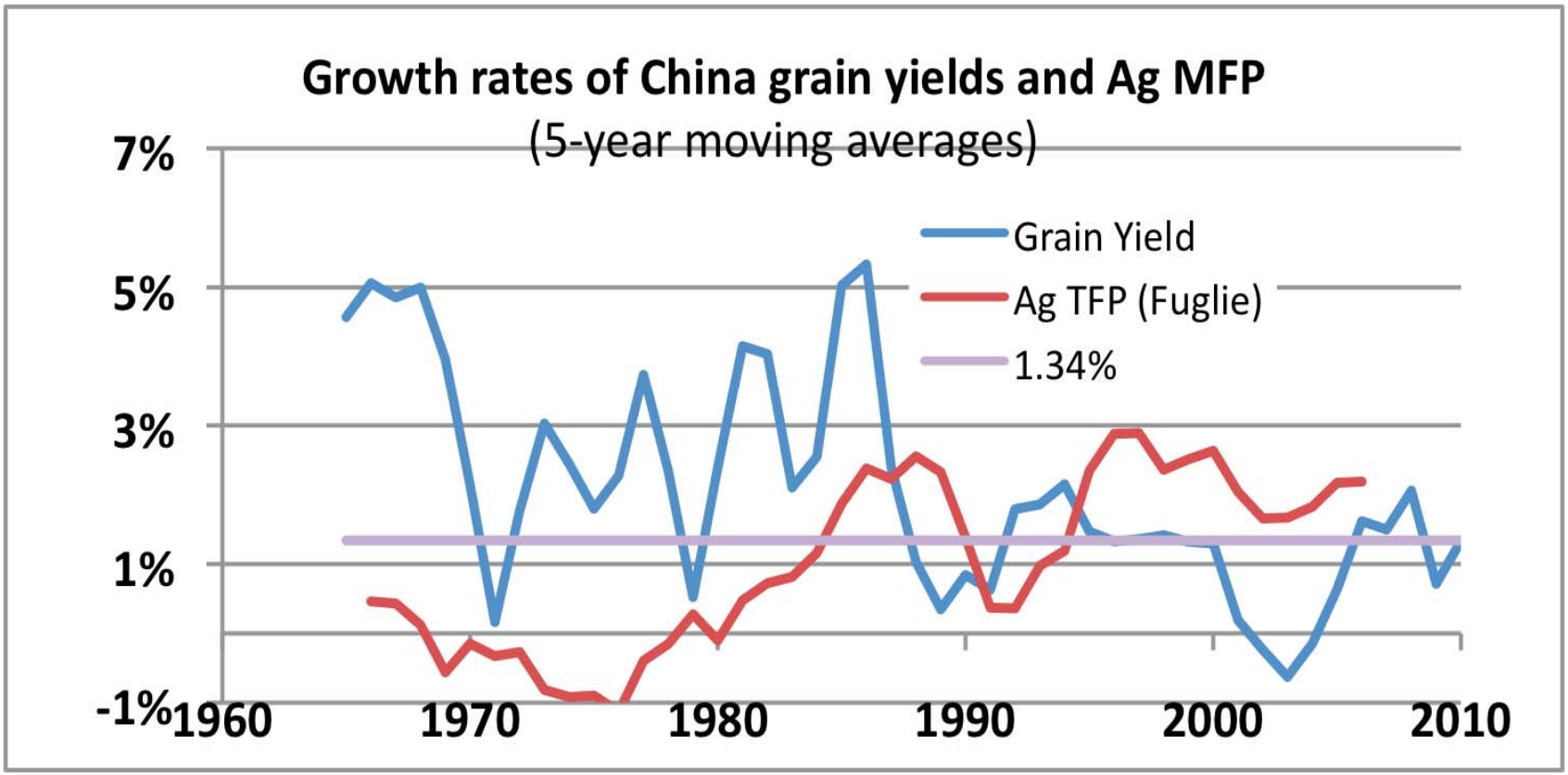
Sources: Authors' calculations from USDA FAS data

Crop yields vs MFP - US



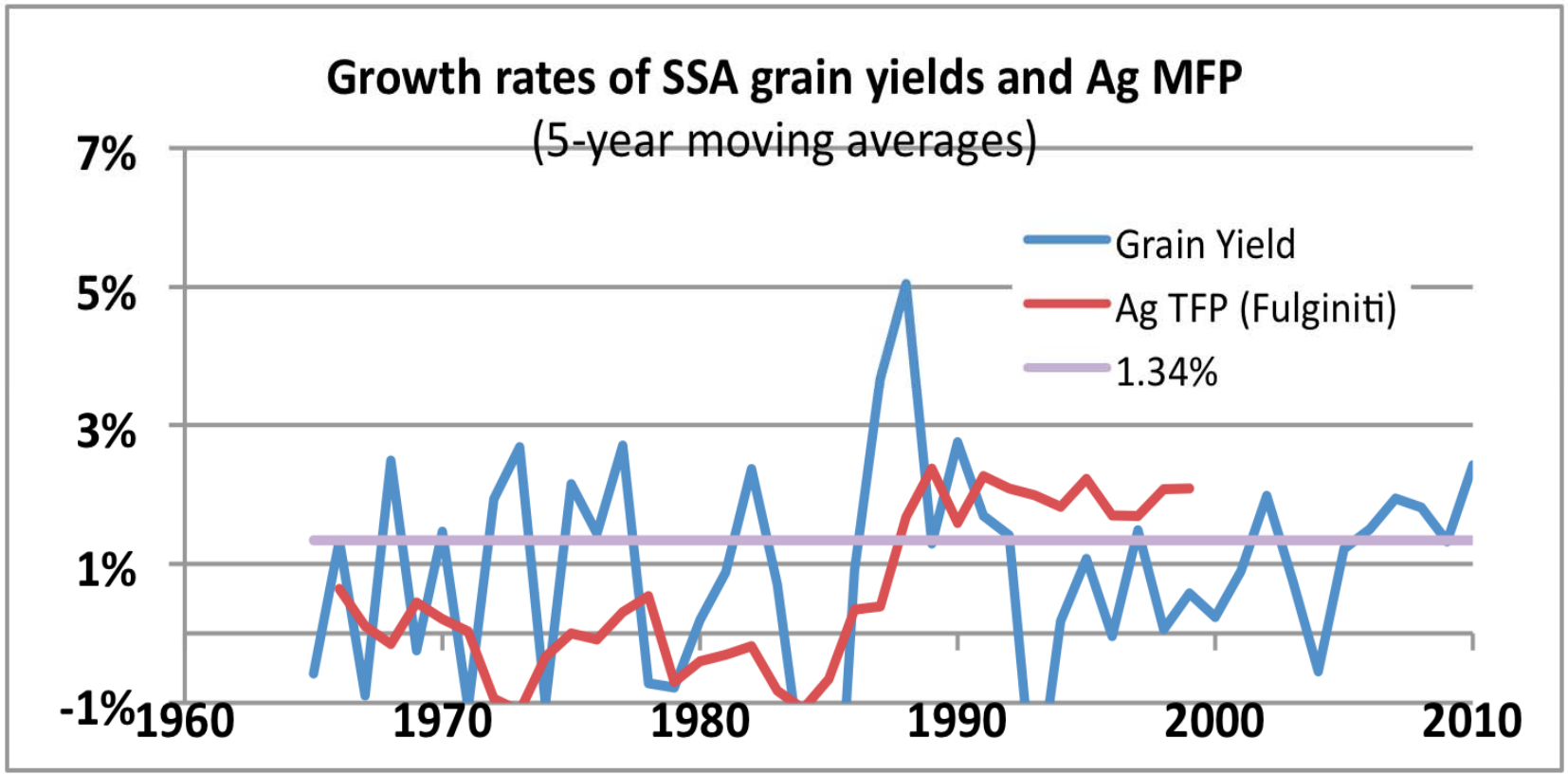
Sources: Authors' calculations from USDA FAS data, USA ERS

Crop yields vs MFP - China



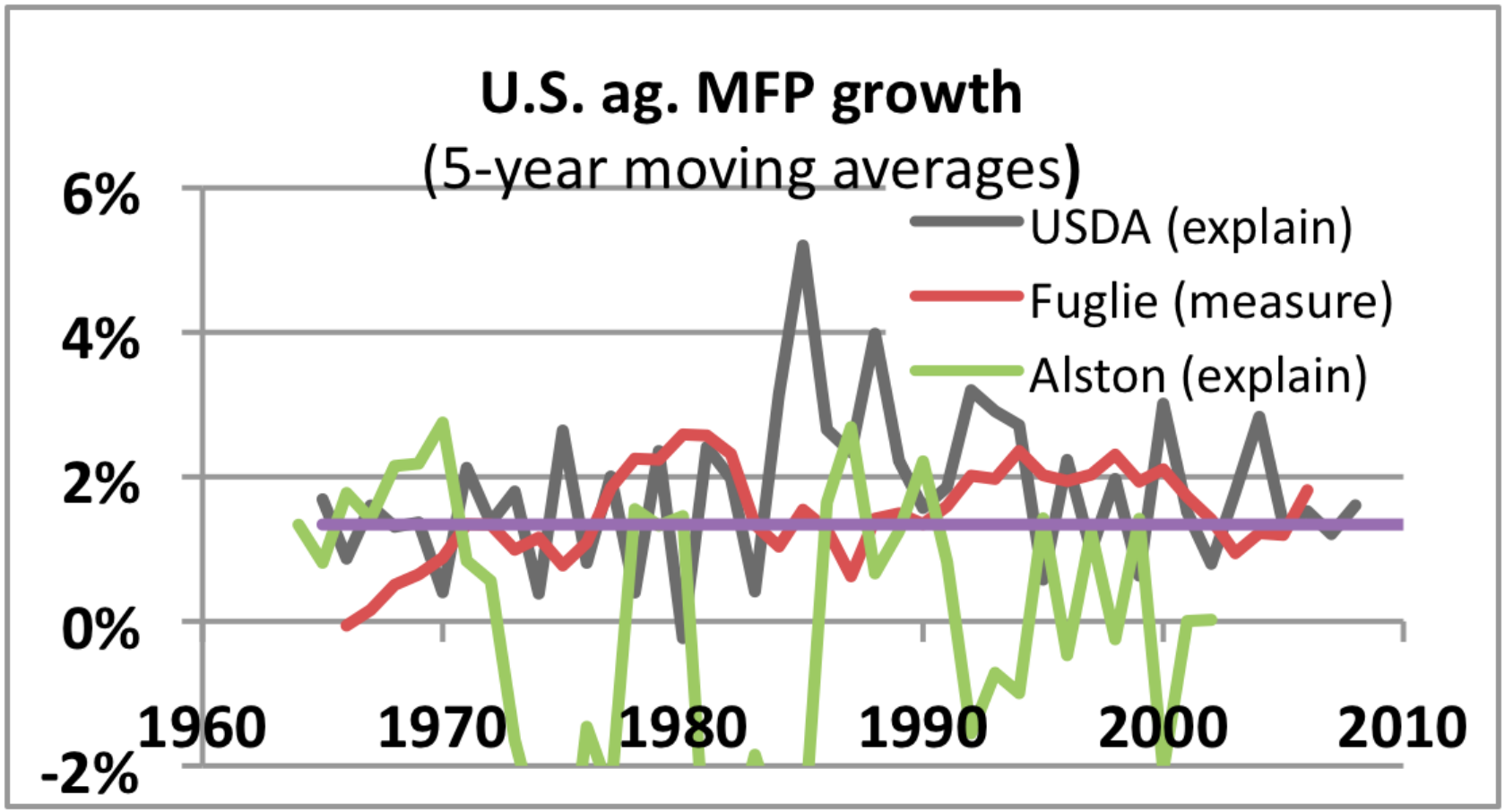
Sources: Authors' calculations from USDA FAS data, Fuglie (2008)

Crop yields vs MFP – Sub Saharan Africa



Sources: Authors' calculations from USDA FAS data, Fulginiti (2004)

Measure it vs explain it – US ag productivity



So what do we learn from this?

- Productivity growth is perhaps declining
  - Yield growth rates certainly near the critical 1.34%
  - Perhaps because of more unpriced outputs (health)
- Is there evidence that it could persist at 1.34%?
  - Monsanto: no problem
  - Lobell, et al: yield ceilings are being approached

So what do we learn from this?

- There are unmeasured/unpriced inputs that have led to bias in measuring productivity:
  - Water
  - Climate
  - Ecological support

So what do we learn from this?

- What if the productivity rate falls below 1.34%?
  - Food prices will rise
  - More inputs will be required, but
    - There's not much more land w/o consequences
    - There will likely be less water
    - Climate change may be a net negative
    - Ecological deterioration may be a net negative
- Research on missing inputs is needed