The Drivers of U.S. Agricultural Productivity Growth

Philip Pardey and Julian Alston

University of Minnesota and University of California, Davis

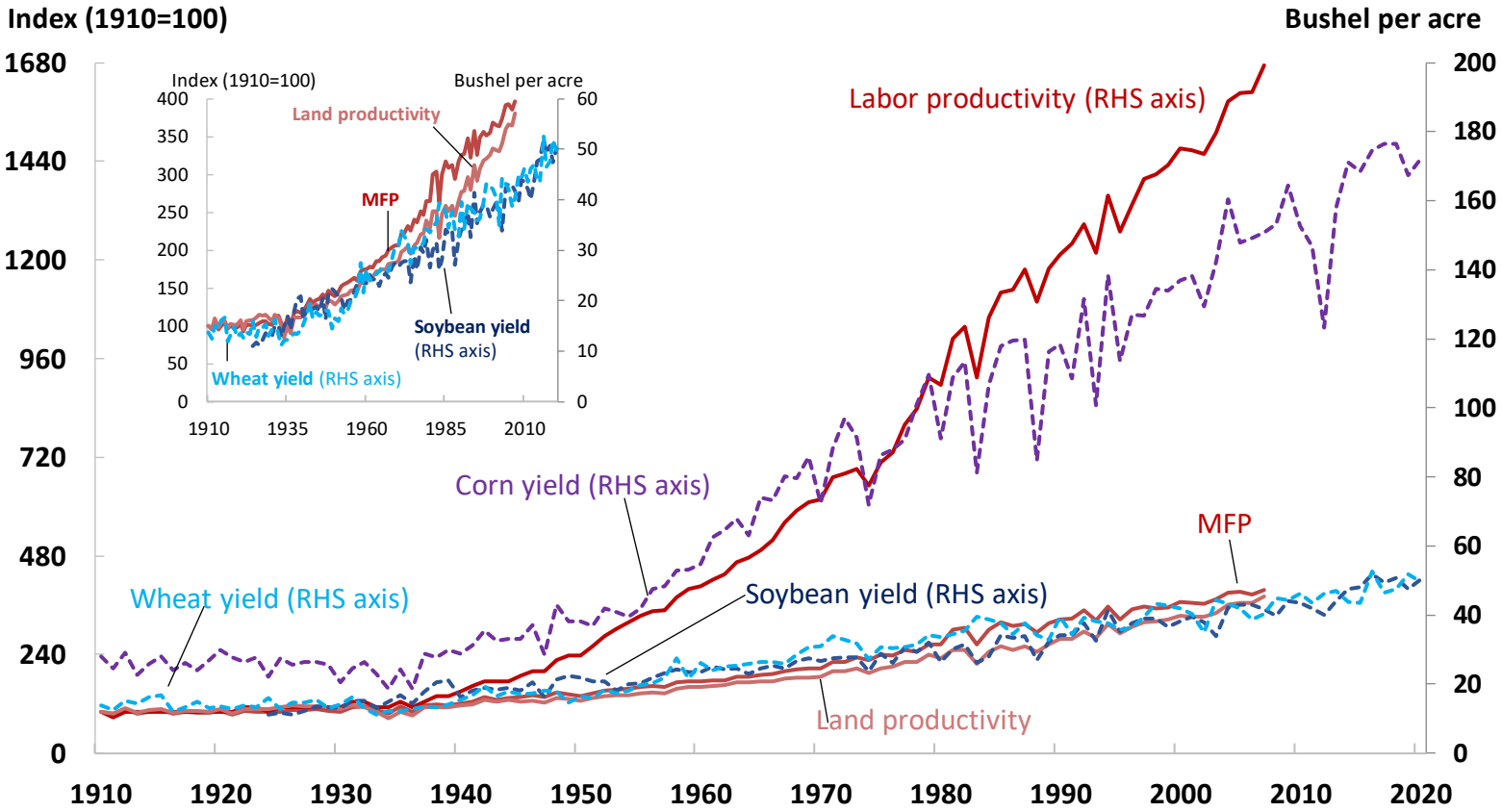
UNIVERSITY OF MINNESOTA
Driven to Discover℠

UCDAVIS
UNIVERSITY OF CALIFORNIA

Patterns, Causes and Consequences of Ag. Productivity Growth

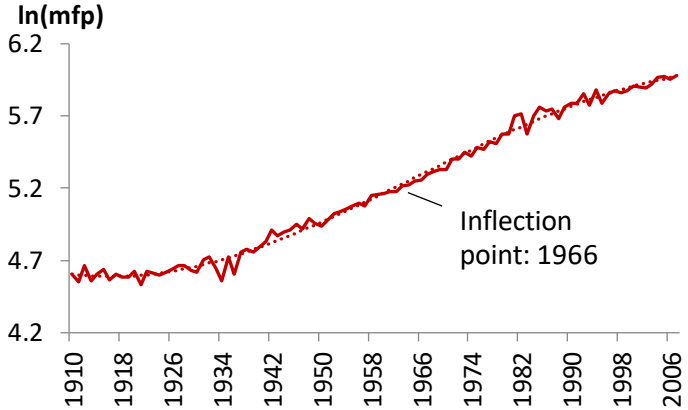
- Has the pace of U.S. agricultural productivity growth changed over time, and if so how?
    - Pattern of U.S. non-farm vs farm productivity growth
- What are the main drivers of ag. productivity growth?
    - Ag. R&D spending and stocks of knowledge
    - Waves of technological progress, innovation clusters
    - Structural transformation
- Implications, Looking Forward

Long-Run Productivity Trends in U.S. Agriculture, 1910-2020



Cubic Trend Models of Productivity Indexes in Natural Logarithms, 1910-2007

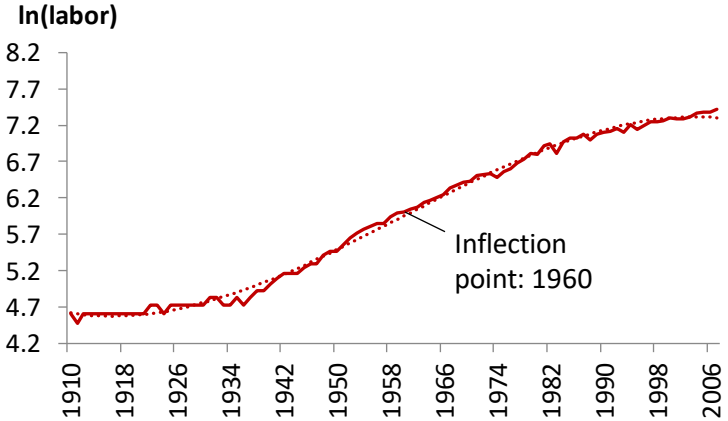
Multi-Factor productivity



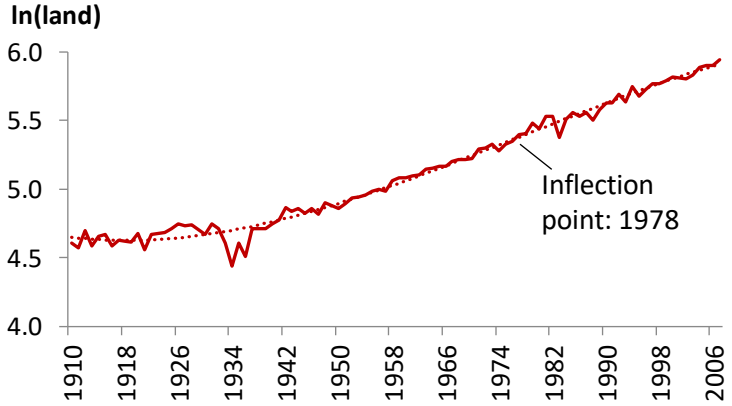
Accelerating growth peaking in the 1960s or 1970s, followed by a progressive slowdown

Visibly apparent in plots of the data and statistically significant after 1980

Labor productivity



Land productivity

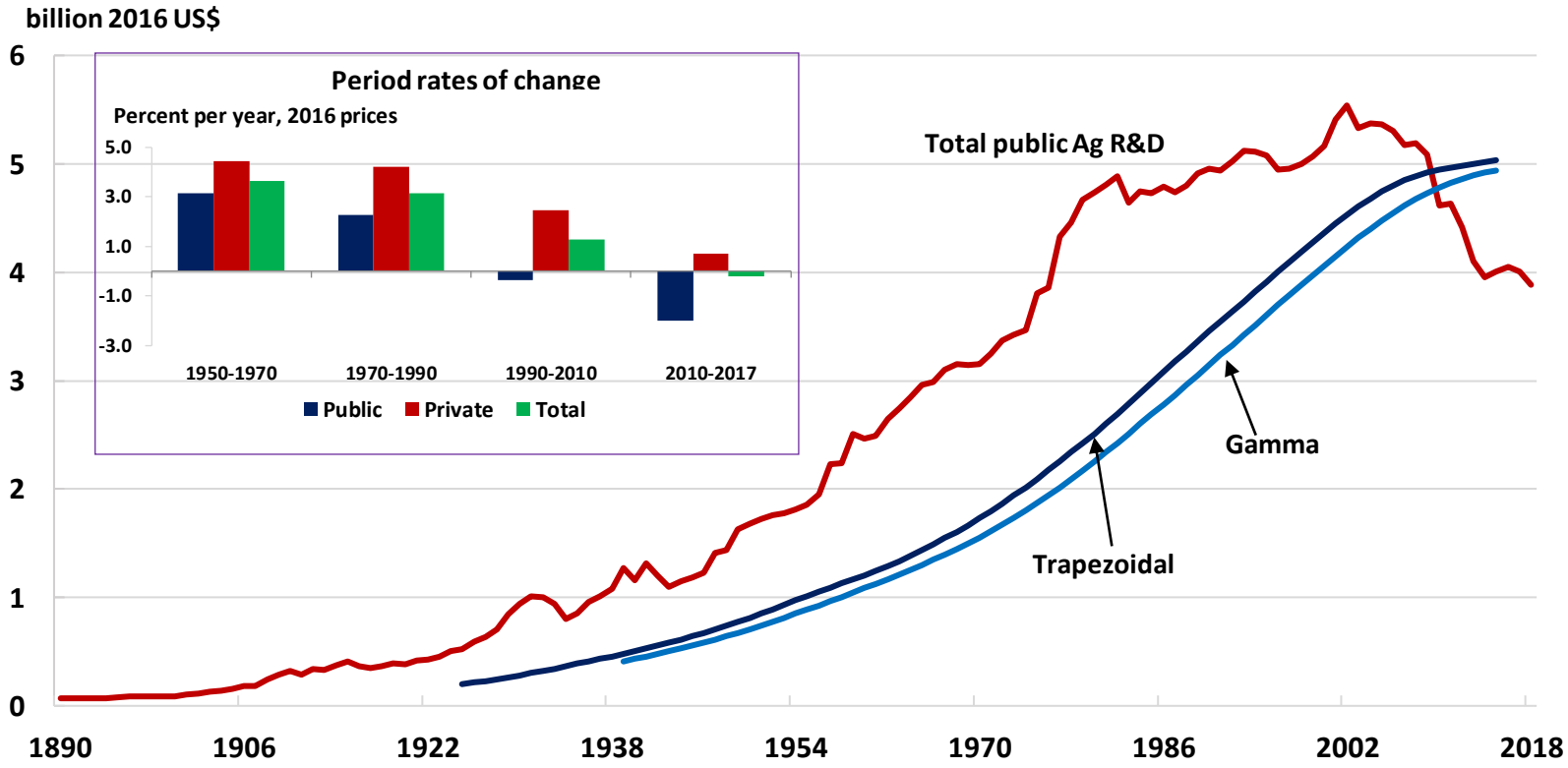


Annual Average U.S. Farm and Nonfarm MFP Growth Rates, 1910-2007

Period	Private business sector MFP Growth		Agricultural GDP as a share of GDP	Farm labor share of total
	Non-Farm	Farm		
	Percent per year		*Percent*	*Percent*
1910 – 1920	1.61	0.21	15.8	27.4
1920 – 1930	1.56	-0.07	9.9	23.1
1930 – 1940	2.52	1.71	7.5	22.9
1940 – 1950	2.05	1.47	7.3	15.9
1950 – 1960	1.31	2.25	4.8	10.8
1960 – 1970	1.76	1.69	2.8	6.6
1970 – 1980	0.88	2.46	2.5	4.1
1980 – 1990	0.55	2.08	1.7	2.7
1990 – 2000	0.97	1.25	1.3	1.7
2000 – 2007	1.39	1.03	1.0	1.4
1910 – 2007	1.46	1.42	5.6	12

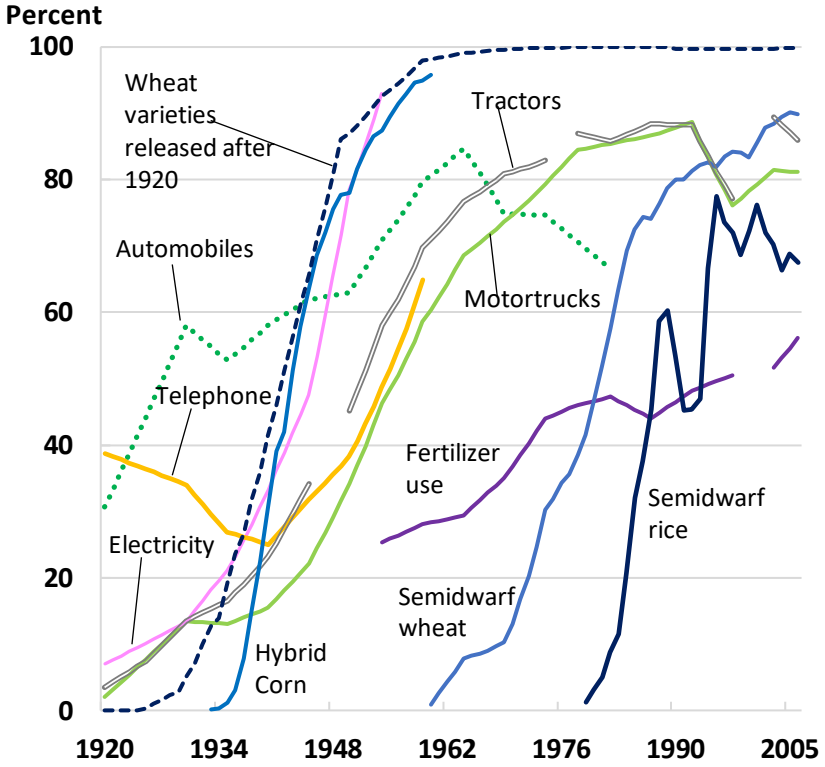
Notes: Green shading indicates period rates of growth above the long term average

Public Ag. R&D Spending and Stocks of Knowledge Trends, 1890-2018

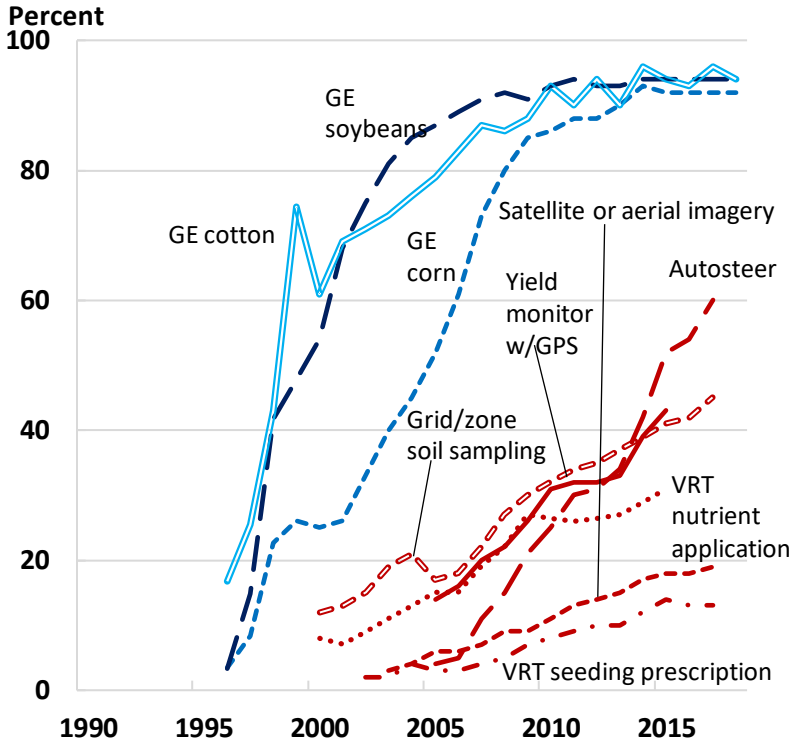


Adoption Paths for U.S. Farming Innovations, 1920-2018

Panel a: Mechanical, chemical and varietal improvement technologies

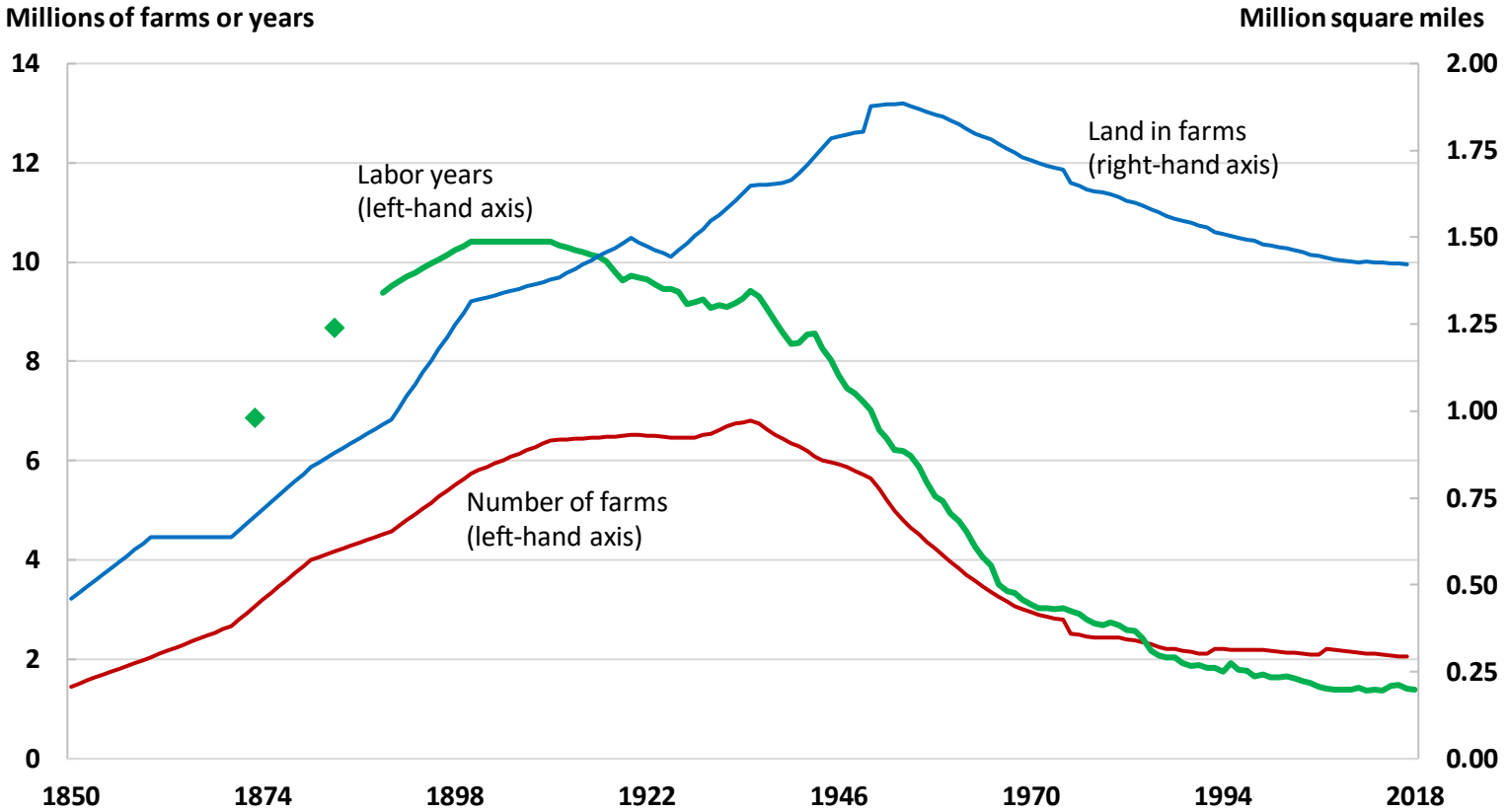


Panel b: Modern genetics and precision ag. technologies



Note: Plots indicate U.S. crop area or production share using the designated technology

Key Elements of the Structural Transformation of U.S. Agriculture, 1850-2018



Implications, Looking Forward

- Promoting new versus preserving past productivity gains
  - Digital and data technologies
  - Maintenance research
  - Room to move – i.e., where, when (and how) to grow crops
- Regulatory and IP headwinds
  - Public and private technology and production related restrictions
- Productivity growth versus risk reduction
  - Climate change, pest and disease pressures
- Retreat from public investments in ag. R&D
  - Total spending (back to mid-1970s)
  - US has much reduced share of global total
  - Reduced share focused on productivity (1976, 63.1%: 2018, 49.8%)

Thanks

www.instepp.umn.edu