



R&D, Innovation and the Economics of California Dairy

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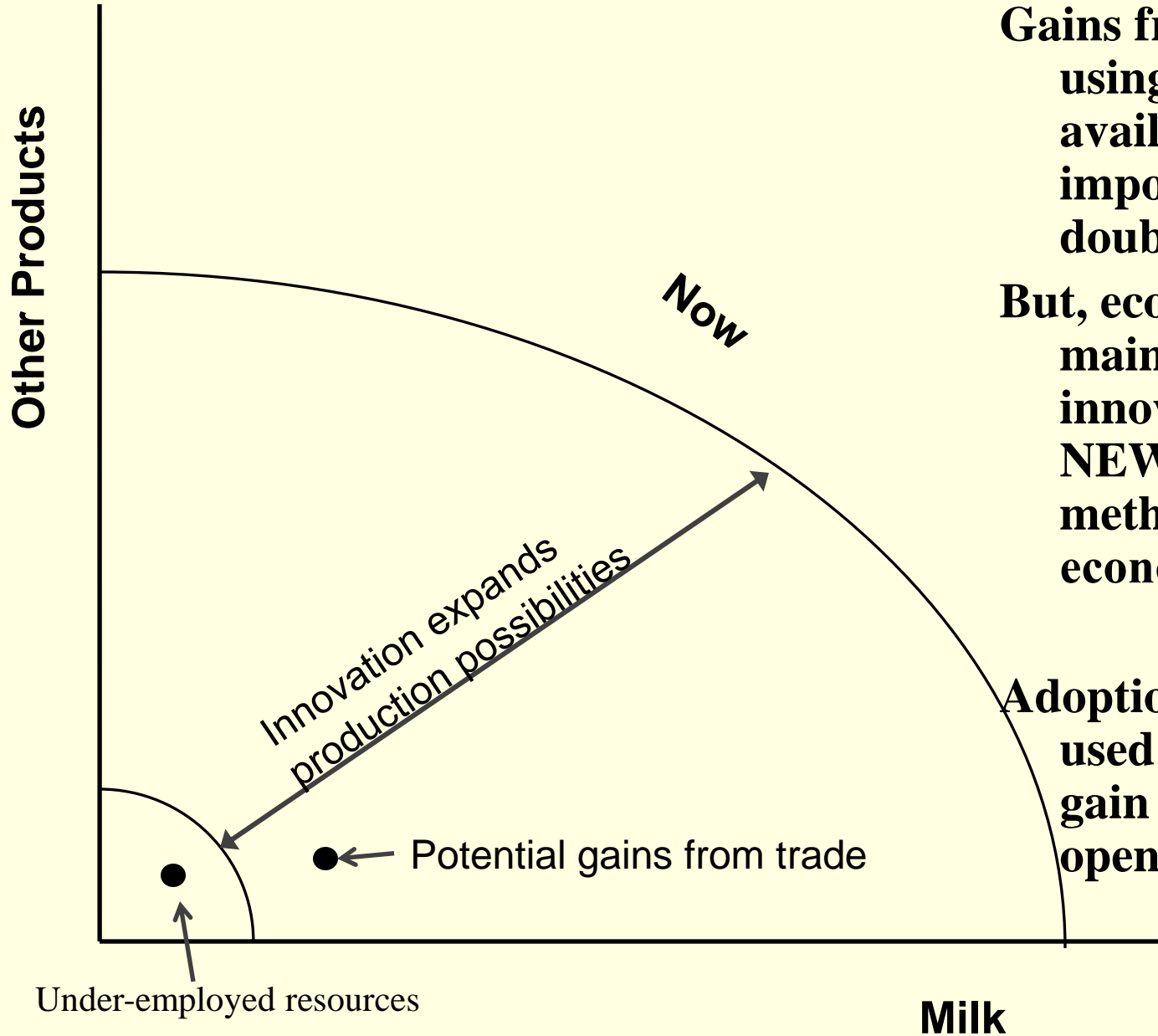
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Innovation, Economic Competitiveness and Development

Economic development and competitiveness of an industry follows from:

- 1. Using resources more fully**
- 2. Investment to increase the effective capital stock including,**
 - Off farm infrastructure,**
 - On-farm assets**
 - Human capital development**
- 3. Specialization to use resources for the highest payoff**
- 4. Innovation to apply knowledge about improved methods and technologies**

Innovation and Economic Development

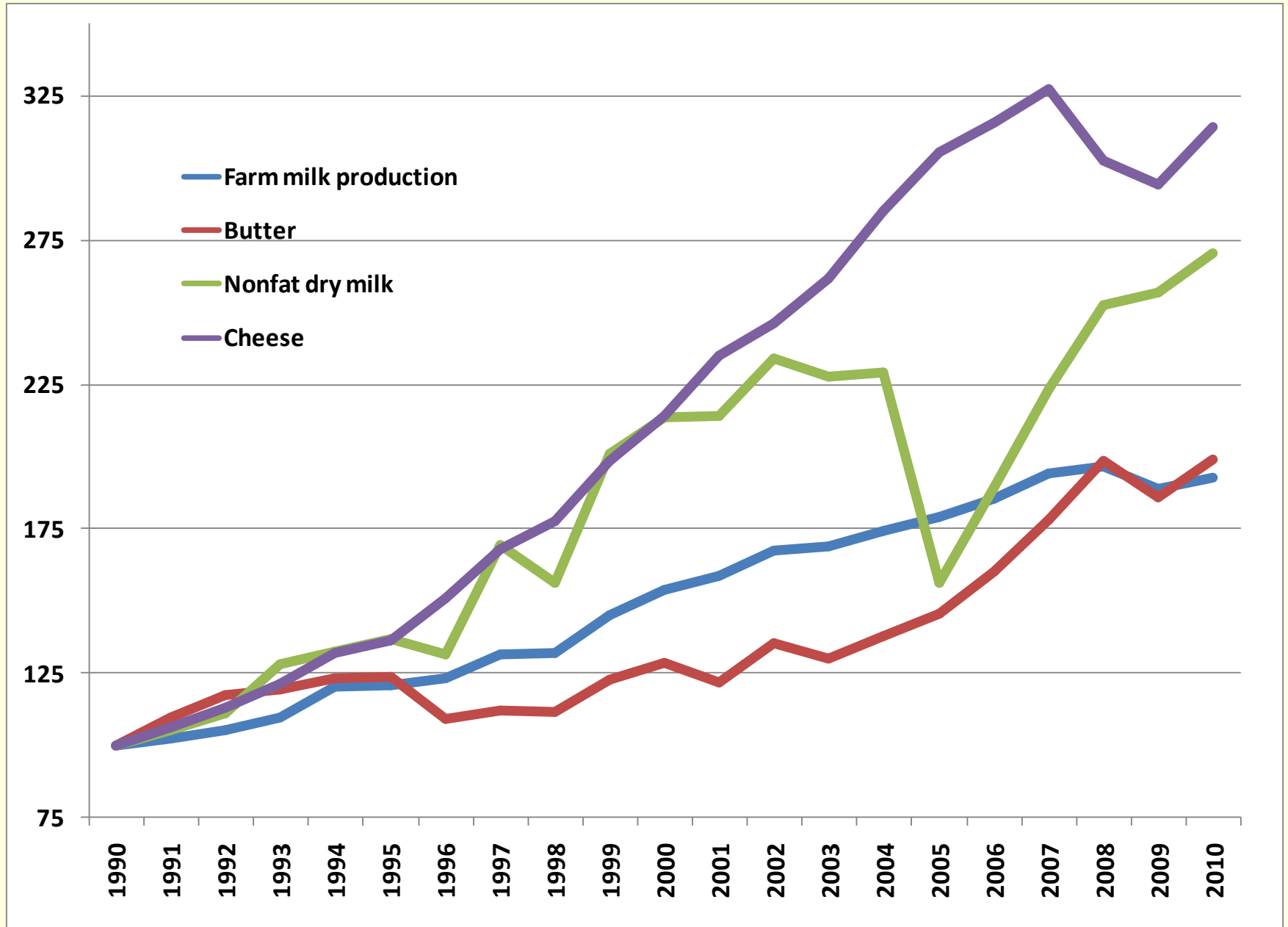


Gains from trade and using all the resources available are important and can double output.

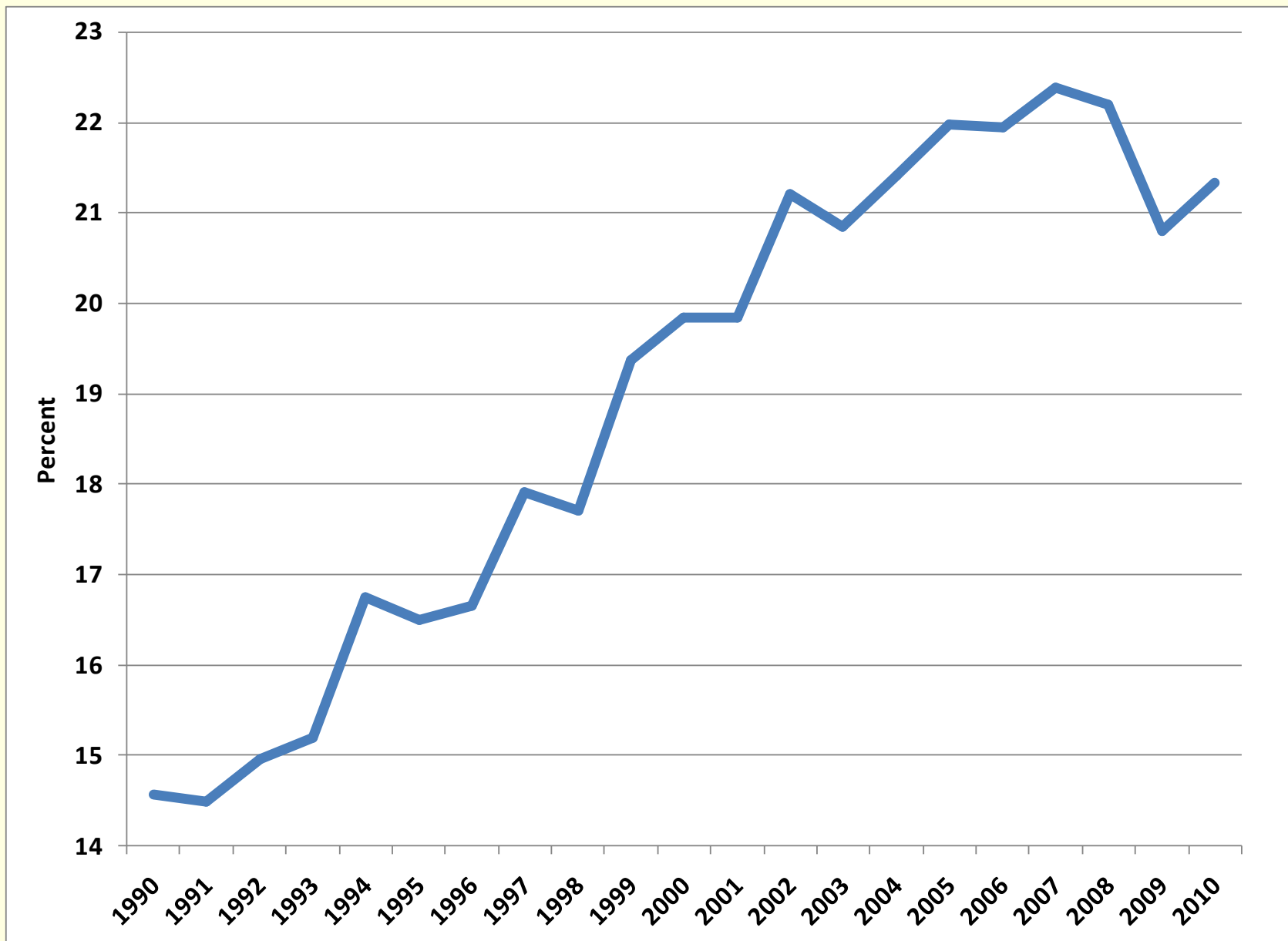
But, economic growth is mainly adoption of innovation, either NEW methods or methods new to the economy,...

Adoption of methods used elsewhere is a gain from global openness.

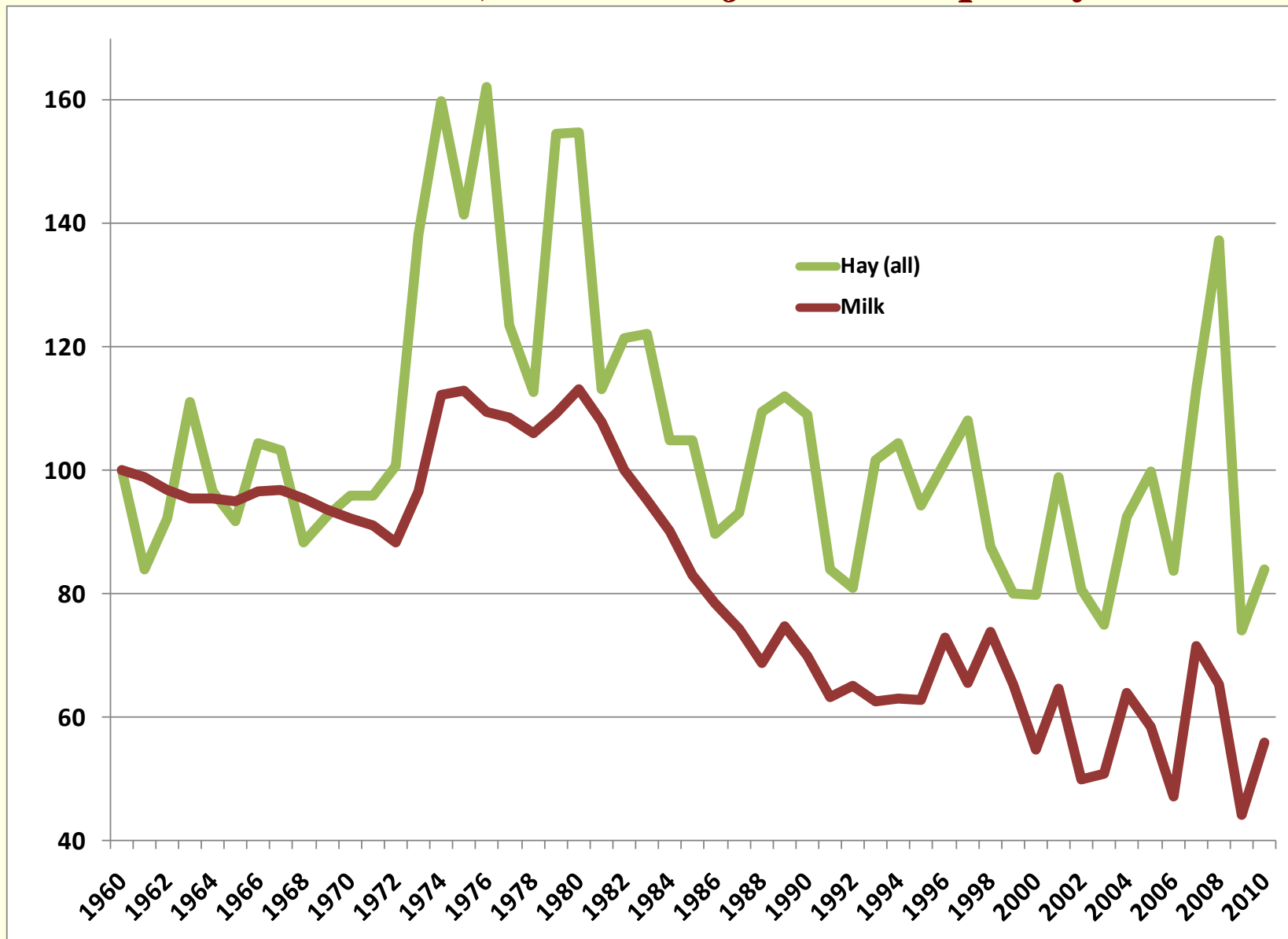
Index of California production of milk and dairy products, (1990=100)



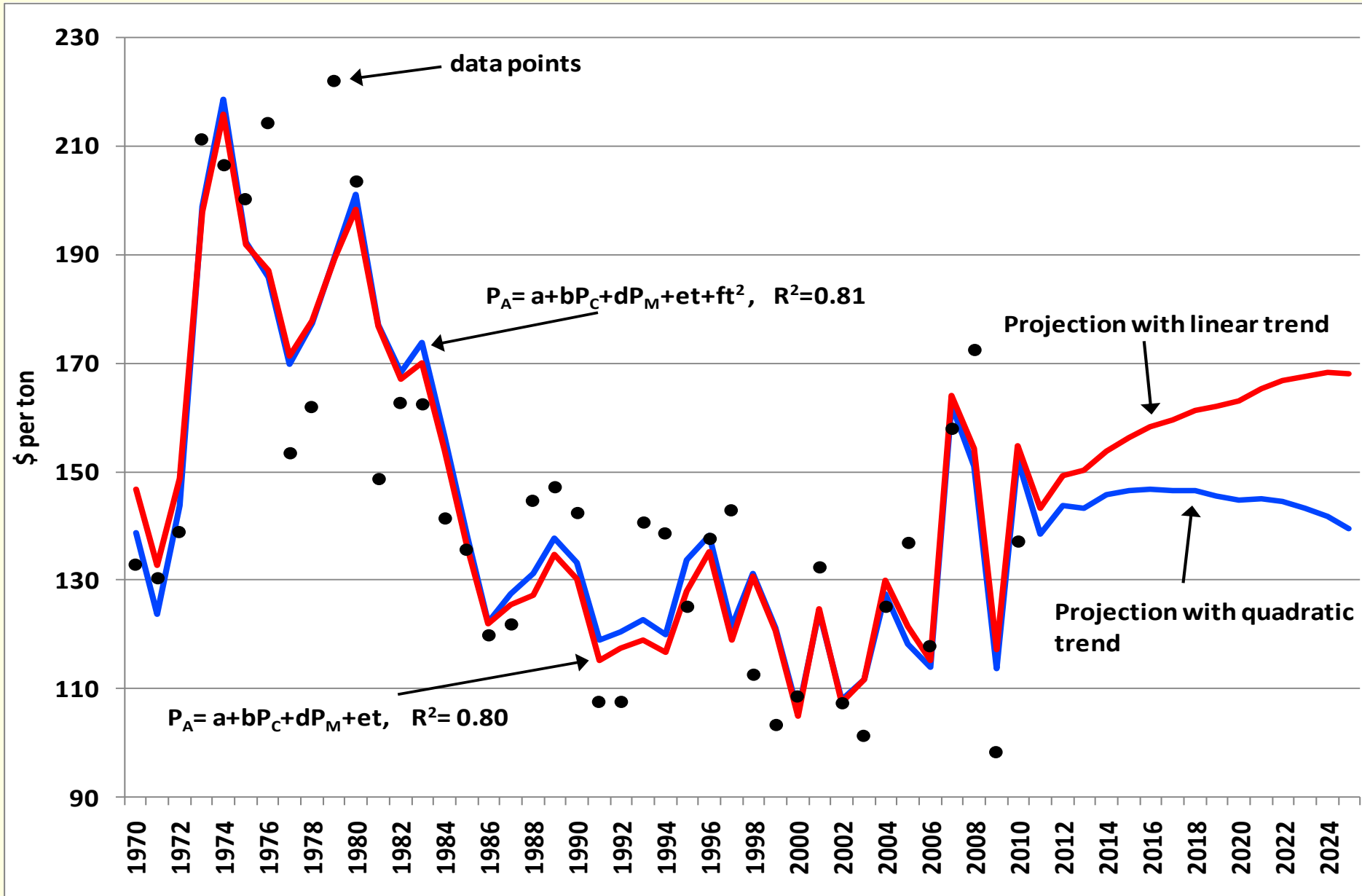
California production of milk as a share of U.S. production



Index (1960=100) of prices received in California, adjusted by GDP deflator, but not adjusted for quality

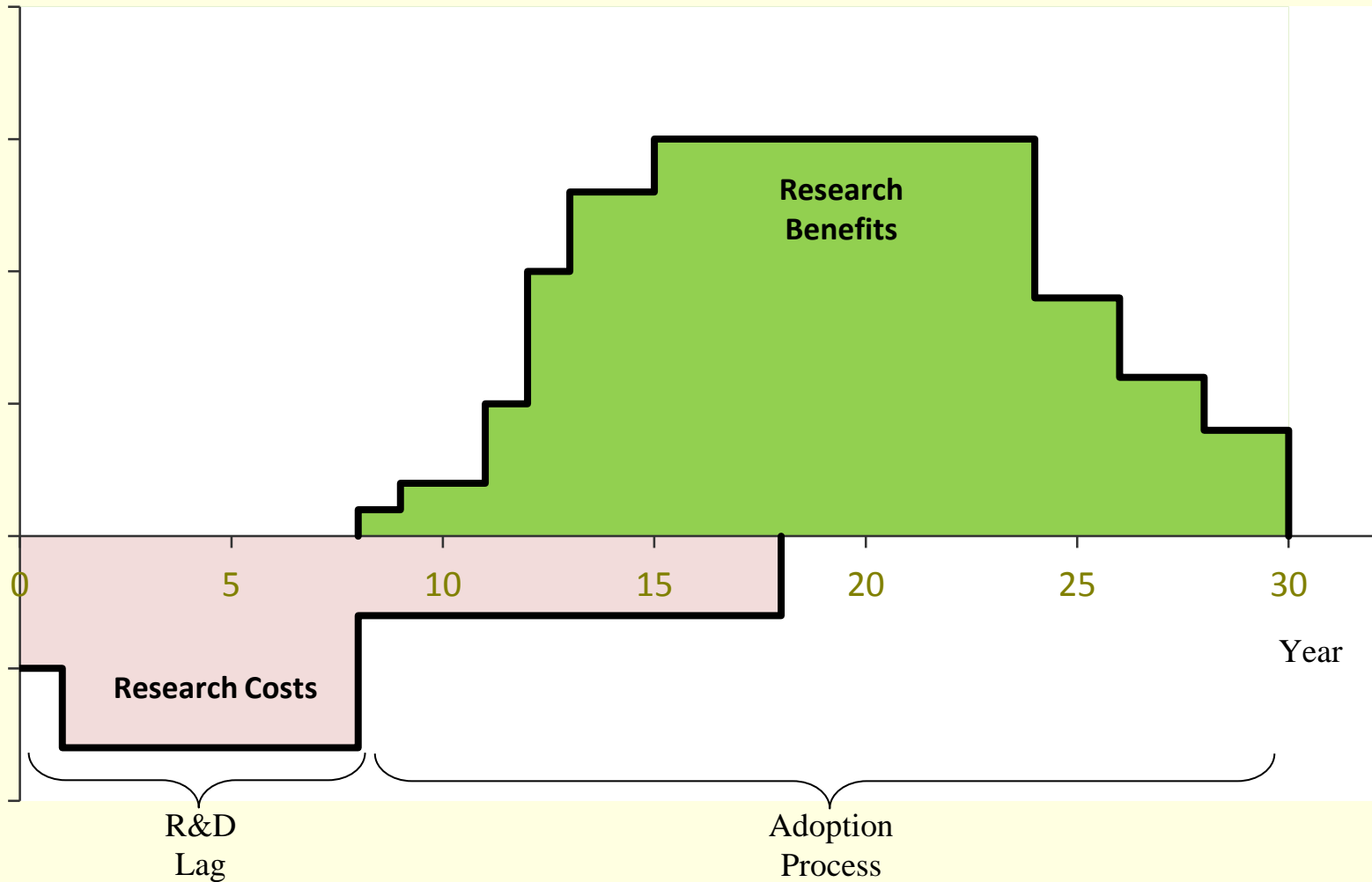


Real Price of California Alfalfa: Data, Fitted Values and Projections



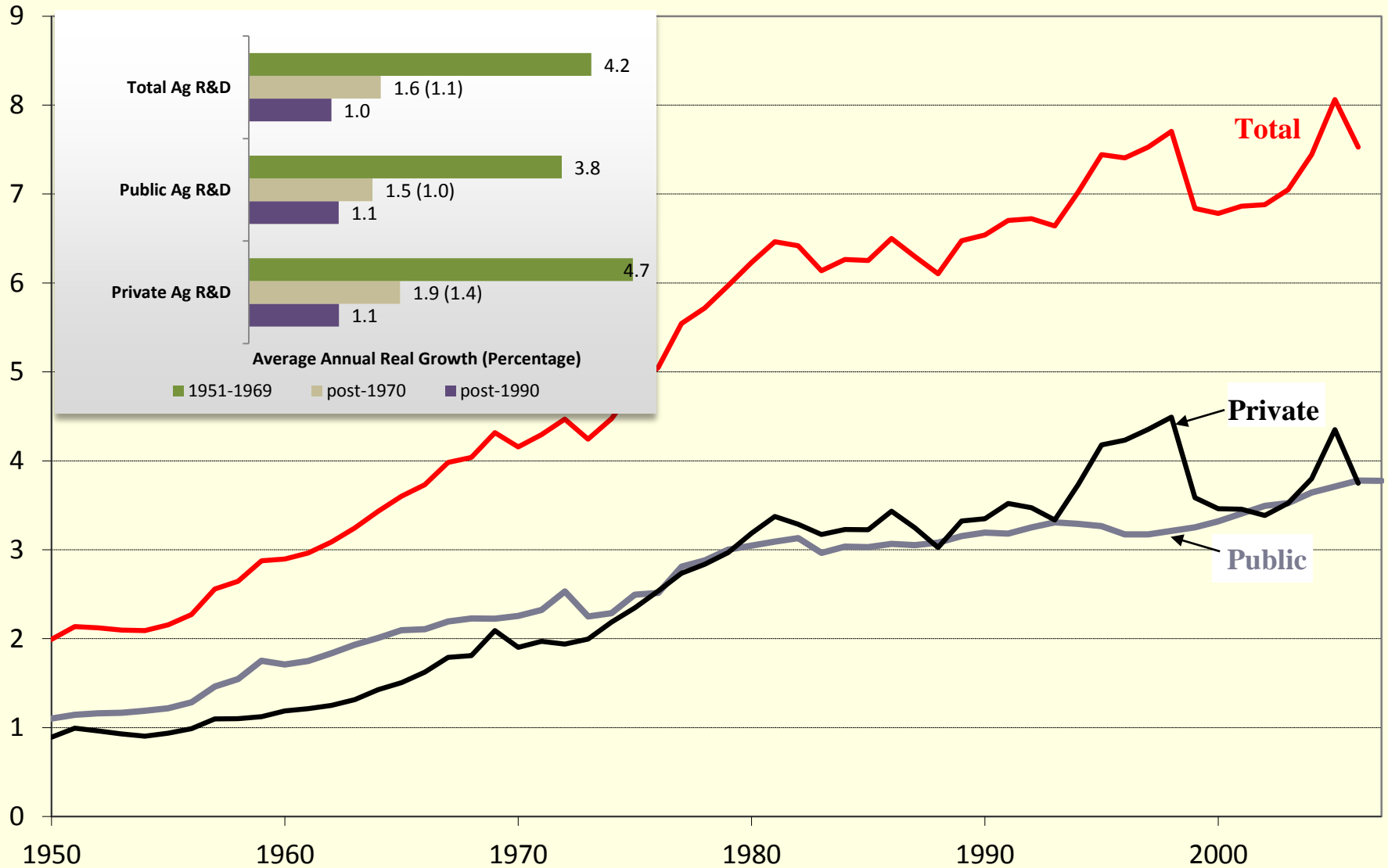
Stylized Representation of Research Benefits and Costs

Gross annual benefits (dollars per year)



U.S. Agricultural R&D Expenditures, 1950-2007

Billions of dollars (2000 prices)



Public versus Private Agricultural R&D

- **Private agricultural R&D focuses on work tied to products that may be patented or otherwise controlled by firms that can capture a significant part of the benefits.**
- **Public agricultural R&D focuses on processes or information for which benefits are broadly dispersed and for which the provider finds it hard to capture a large part of the benefits.**
- **Following these principles, public R&D is less applicable in the short term and more “basic”**
- **Public R&D is often long run and does not obviously contribute profits to a specific firm.**

U.S. Funding Channels for Public R&D

Public agricultural R&D expenditures, 2007 (millions of dollars)

Public Funding Sources		
State governments	\$1,364.7	
Federal government		
For SAES research	\$689.5	
For intramural USDA research	\$1,270.4	
Non-USDA federal funds (SAES = \$666.8 & USDA = \$40)	\$706.8	
Other Funding Sources		
Self-generated	\$228.3	
Industry grants and contracts	\$261.5	
Other non-federal	\$279.8	
		Research Performers
		SAESs and related institutions
		\$3,478.6
		USDA intramural
		\$1,354.4
		TOTAL
		\$4,833.0

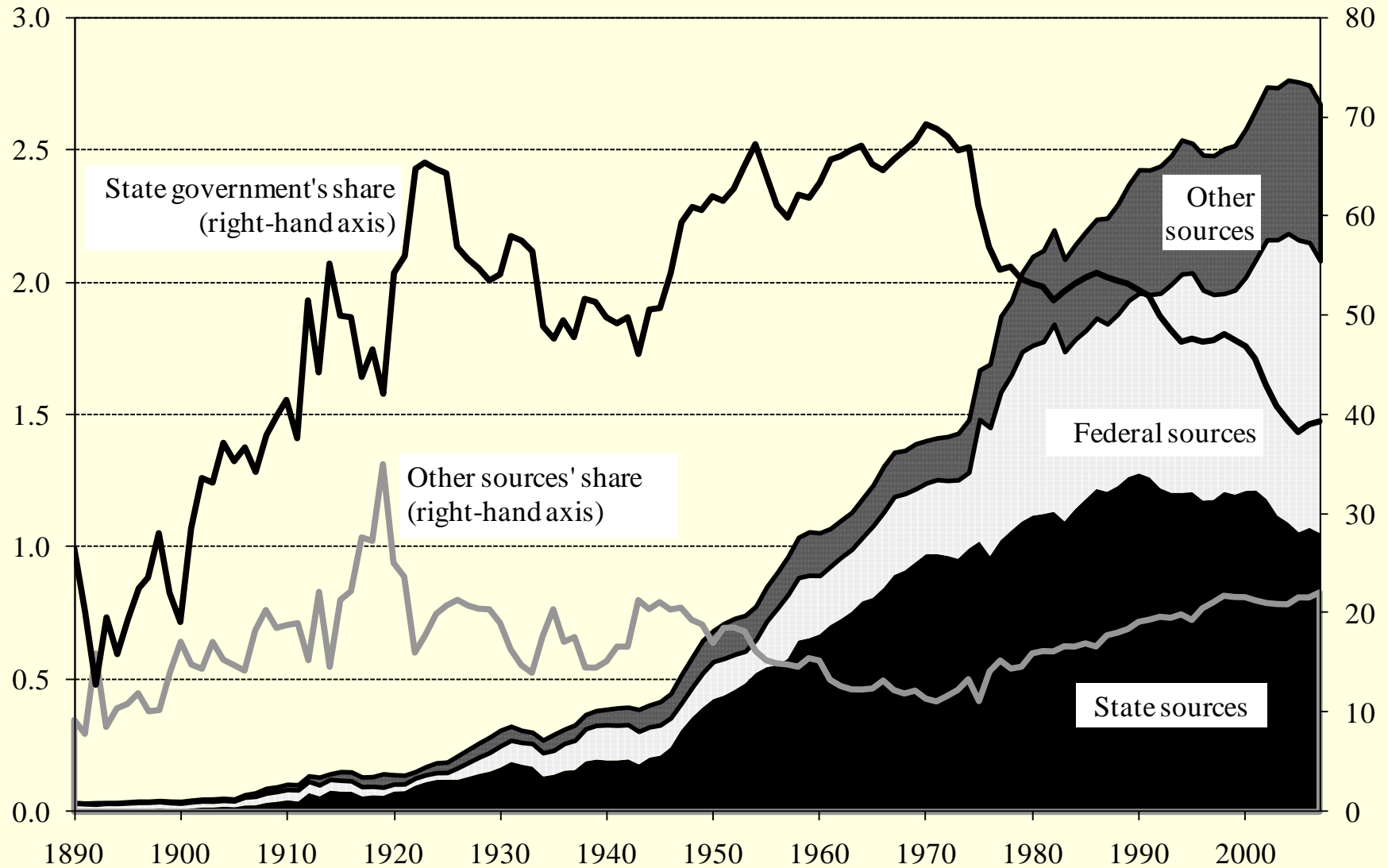
Public Agricultural R&D: Who pays?

- **Much of the R&D performed at UC is funded by outside sources, federal and state governments, but also commodity groups and private firms.**
- **Federal support is oriented to research with substantial national benefits.**
- **In general, R&D funded from public sources is oriented to work that some think is valuable, but would not otherwise be supported because it is difficult for private groups to capture enough of the benefits.**

SAES Expenditures by Sources of Funds, 1890-2007

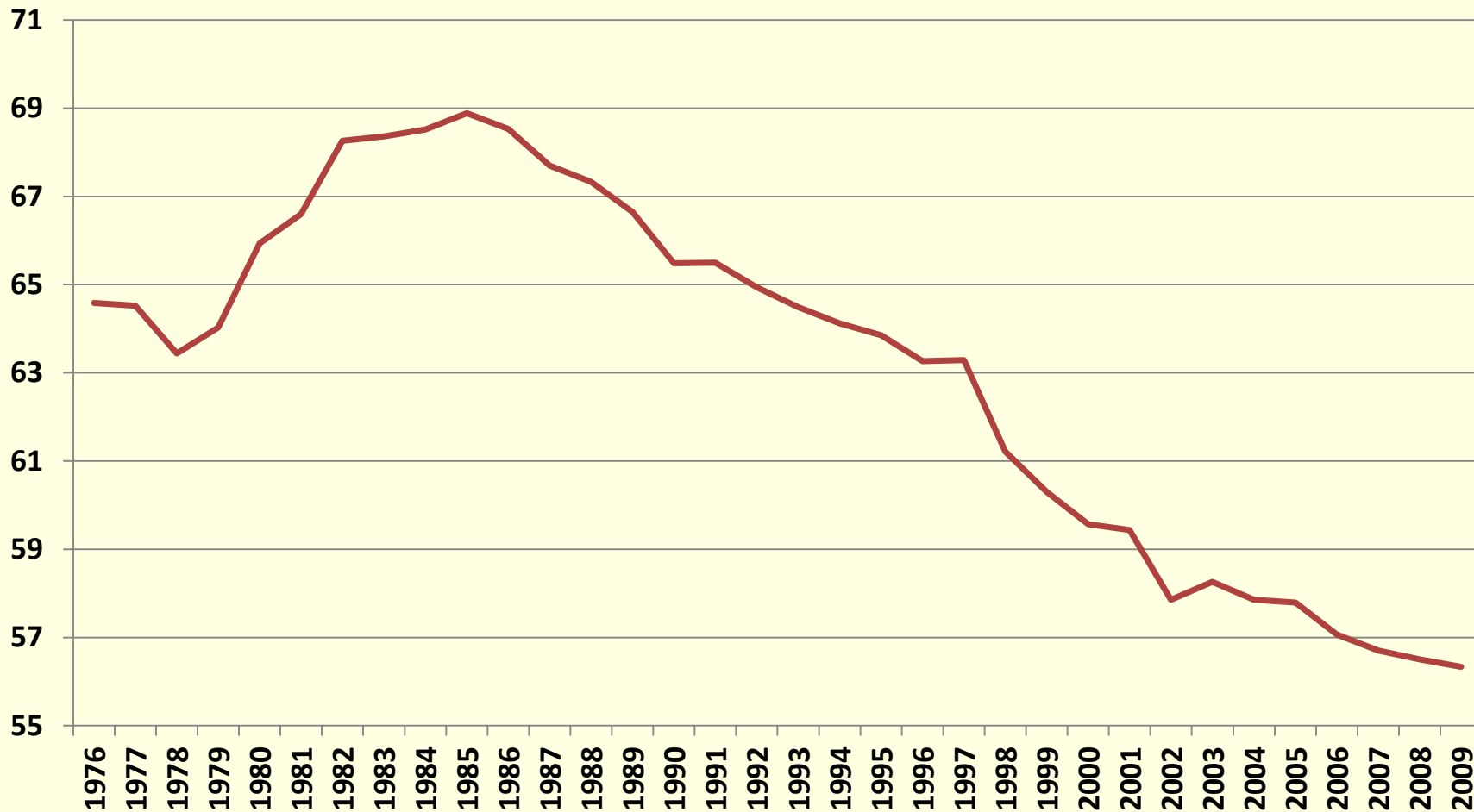
Billions of U.S. dollars (2000 prices)

Percentage



Farm “Productivity” Share of State Agricultural Experimental Station Research

percentage



Source: Pardey et al. (2011) with data from USDA, CRIS (various years)

New Evidence

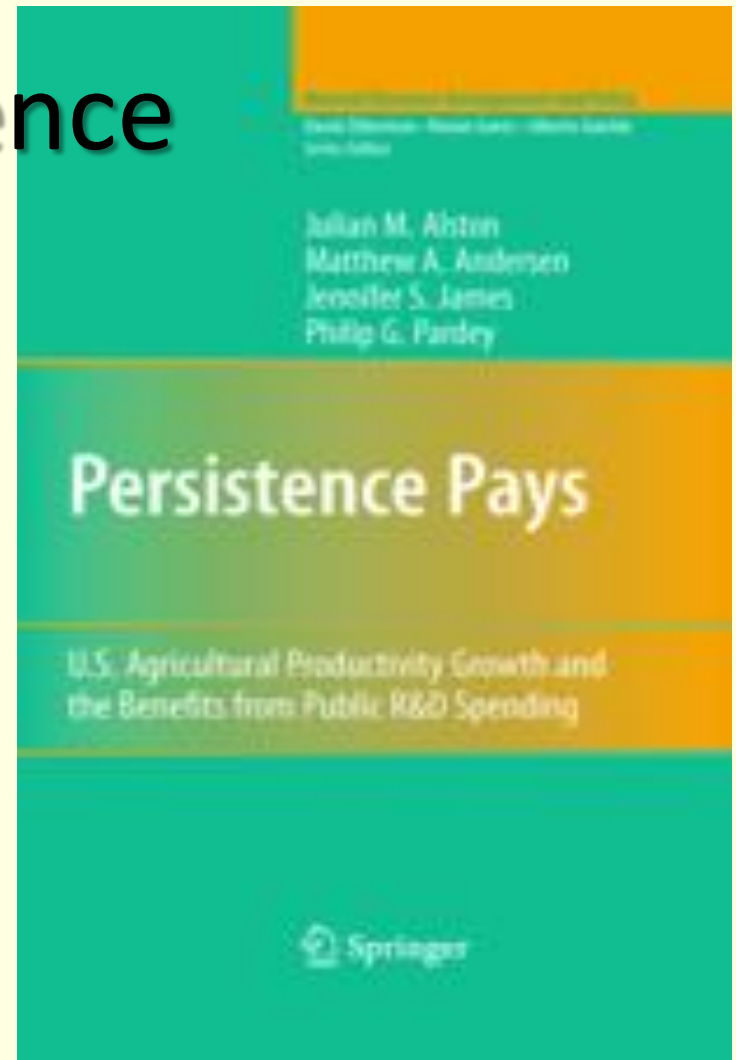
Persistence Pays: U.S. Agricultural Productivity Growth and the Benefits from Public R&D Spending.

J.M. Alston, M.A. Andersen, J.S. James, and
P.G. Pardey

Springer, January 2010

Challenges

- Spillovers
- Long R&D Lags
- Role of maintenance research



Returns to U.S. Public Agricultural R&D

Returns to	Benefit-Cost Ratio (3% real discount rate)		Real Internal Rate of Return	
	Own-State	National	Own-State	National
	<i>ratio</i>		<i>percent per year</i>	
State R&E				
48-State Average	21.0	32.1	18.9	22.7
48-State Minimum	2.4	9.9	7.4	15.3
48-State Maximum	57.8	69.2	27.6	29.1
USDA Research		17.5	18.7	

Benefit cost ratios seem big . . . but the implied IRRs are comparatively modest reflecting the very long lags)

Key Points about Global and U.S. Agricultural R&D and Productivity Growth

- **High rates of return to agricultural R&D**
 - **Implies persistent underinvestment—why is it so?**
- **Shifting patterns of public support for R&D**
 - **High-income countries**
 - **Slowdown in spending growth**
 - **Diminishing share for on-farm productivity**
- **Implications—institutional reform required?**

Enhance rates of research investment, restore productivity growth, reduce pressure on natural resource stocks and environment

Options

Do nothing

- **Wasted opportunity (high rates of return)**
- **Declining competitiveness**
- **Worsening world food supply and demand balance**
(Bad for the world's poor and rural environment)

Reinvigorate public investments in agricultural R&D

- **Enhance government commitment to agriculture**
- **Shift agriculture budget priorities (R&D vs subsidy)**
- **Encourage private investments in agricultural R&D**
 - **Enhance IPRs (e.g., end-point royalties)**
 - **Strengthen co-financing arrangements and institutions**

Check-off or Industry Tax or Levy Funded R&D

- **Collect funds through a industry tax per unit of output (the check-off)**
- **Tax is collected from by first buyers (milk handlers)**
- **Of course, the tax is really ‘paid’ by suppliers and buyers along the supply chain from feed producers to milk producers to final consumers**
- **Funds R&D to improve economic conditions in the industry, which benefits all the same groups**
- **Aligns costs of R&D directly with benefits**

Appropriate for R&D that benefits industry—producers and consumers—rather than general public and taxpayers

100% levy funding is not perfect

Levy funding is fair and efficient along the chain from producer to consumer, if costs are distributed in proportion to benefits, but

- **Might not hold if . . .**
 - **Levy and research apply to different points in the production chain and we have variable factor proportions**
 - **Nature of technological change lowers costs differently than price**
 - **Market power or other market distortions**

100% levy funding is not perfect

Levy funding is fair and efficient across producers, if costs are distributed in proportion to benefits.

- **Costs of levy are borne by producers according to their production, but non-adopters do not gain; if price falls they lose**
- **Research lags => intergenerational inequity**
 - **Current producers pay levy**
 - **Future producers benefit, 10-30 years later?**
- **Mismatch arises when research**
 - **Benefits narrowly defined groups, say one region or size**
 - **Benefits accrue outside the industry (environmental R&D)**

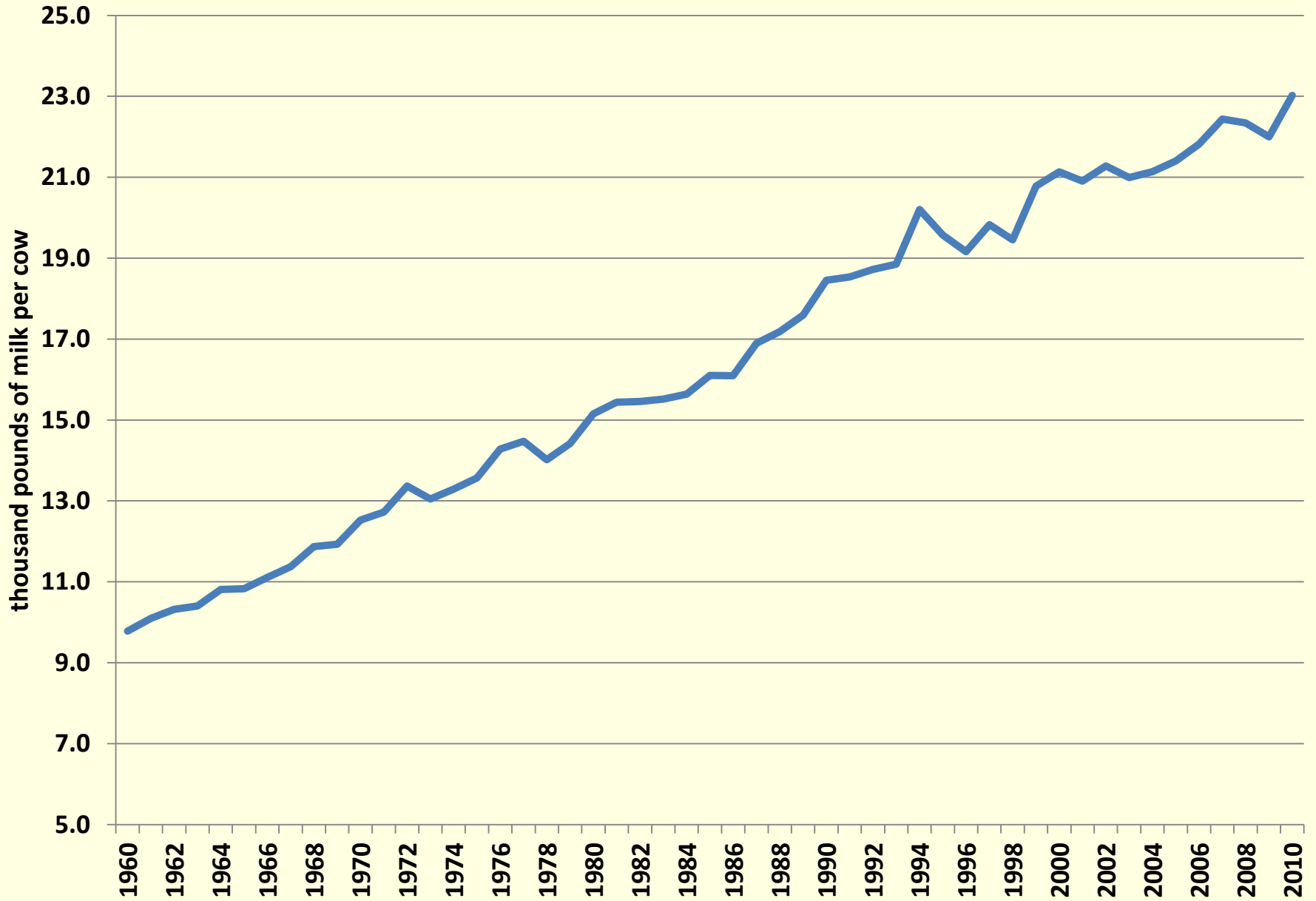
These are reasons for complex check-offs, public matching for some R&D and firm R&D in other cases

Levy or “Check-off” Funded R&D in California

- **California had 61 active check-off programs in 2003-04**
 - **Covered 50 percent of CA agricultural production value**
 - **Collectively spent \$208 million on**
 - **Advertising & promotion \$146 million**
 - **Research \$ 21 million**
 - **Other (incl. admin.) \$ 41 million**
- **Even \$30 million for check-off R&D is small relative to**
 - **California’s agricultural production**
 - **Less than 0.1 percent of \$38 billion of farm revenue**
 - **California’s total public agricultural R&D**
 - **Less than 10 percent of about \$350 million**

Given evidence of general under-funding of R&D, why do producer groups not spend more on research?

Milk production per cow in California, 1960-2010



Dairy California compared to Dairy Australia & Dairy NZ

Dairy Australia

- **1.6 million cows, 20 billion pounds, ~US\$3.5 billion**

Dairy New Zealand

- **4.4 million cows, 37 billion pounds, ~US\$6 to US\$6.5 billion**

Dairy California

- **1.8 million cows, 40 billion pounds, about \$6 to \$7 billion**

California dairy is about the same size as New Zealand dairy and twice Australian dairy.

Australia – “Kerin reforms”

Key Features

- **Enabled industries to establish levy-based R&D funds (like U.S marketing orders)**
- **Committed the government to provide a dollar-for-dollar matching grant up to 0.5 percent of output value**
- **Substantial autonomy, major producer representation on boards that control priorities**
- **Created several non-commodity R&D groups**

Australian Model of Agricultural R&D

Rural R&D Corporation	Industry Contribution	Government Contribution	R&D Expenditure
<hr/>			
<i>Statutory RDCs</i>	A\$ million in 2004-05		
Grains	64.2	35.7	119.5
Grape and Wine	9.7	8.1	16.9
Rural Industries Research Fund	2.7	14.7	21.1
<i>Industry Owned Corporations</i>			
Australian Wool Innovation	42.8	13.5	78.5
Horticulture Australia Limited	31.6	32.9	66.9
Meat and Livestock Australia	39.0	39.0	78.1
Dairy Australia	14.5	14.5	36.1
<i>Total</i>	233.8	204.7	511.3

RDC Spending in Perspective

- **Total public spending on agricultural R&D in Australia is close to A\$1 billion per year**
- **RDCs spend about half this amount, financed**
 - **A bit over half from levies**
 - **A bit less than half from the Commonwealth government**
- **In spending their half, it appears that RDCs significantly influence the other half**
- **Issues arise**
 - **the effects on the research agenda**
 - **whether the rate of matching grant is appropriate**
 - **Fairness?, Efficiency (crowding in or crowding out? additionality?)**

Australian RDC Funding and Expenditure Over Time

	1985	1989	1995	2004/5
<i>Millions of Australian Dollars</i>				
Levy Receipts	26.5	48.5	102.6	233.8
Commonwealth Contribution	23.7	68.5	126.2	204.7
<i>Total Expenditure</i>	<i>47.5</i>	<i>121.2</i>	<i>239.2</i>	<i>511.3</i>

New Zealand Dairy Check-off R&D

- *About DairyNZ:*
- DairyNZ is the **industry good** organisation representing New Zealand's dairy farmers.
- Funded by a levy on milksolids, it secures and enhances the profitability, sustainability and competitiveness of New Zealand dairy farming.
- Research and development creates practical on-farm tools and leads to on-farm adoption of best practice farming

An Industry Good

- **An activity which:**
- **Is financially beneficial to New Zealand dairy farmers**
- **Would not be undertaken by individuals or groups of dairy farmers because either:**
- **It is too expensive for them to do on their own or**
- **the benefits could not be captured by those making the investment.**

DairyNZ

- **The 'Strategy for New Zealand Dairy Farming' provides the basis for our research programme and most of our industry good projects are funded by New Zealand's dairy farmers (through levy collection).**
- **Some projects are funded by various other industry and government agencies.**
- **A governing board of eight members, of whom five are farmer-elected and three are independent, professional directors...**

The New Zealand Levy

- **Who pays the levy?**
- All dairy farmers who produce milk from cows that is supplied to a dairy company will pay the levy. This includes all dairy farmers, sharemilkers, and dairy farm leaseholders.
- The current levy set at 3.6 cents per kgMS (plus GST).
- **How is the milksolids levy calculated?**
- The levy is calculated on the quantity of milksolids supplied to your dairy company. For example, the average dairy farm that milks 376 cows will pay the following:
- ***376 cows x 327 MS = 122,952 MS x Annual Levy 3.6 cents = \$4,426 (+ GST) per year***

- **DairyNZ also accesses alternative sources of funding through other public and private institutions and organisations**
- **DairyNZ collaborates with them to implement key research programmes**
- **Co-investors, such as government, have contributed more than \$2 for every dollar of dairy farmer levy investment.**

Fonterra R&D Example

- **US\$50 million per year on R&D, New Zealand's largest private sector investor in research and development**
- **Innovation Centres in New Zealand (approximately 200 scientists), Australia, China and Singapore working on a range of dairy sciences from forage and bovine genetics to dairy nutrition, flavors, and packaging.**
- **Customer technical centers in Chicago & Amsterdam.**
- **Wholly-owned biotechnology subsidiary for and genomics important to the dairy industry, including pasture, milk production and milk composition.**
- **Joint Venture with Auckland University for bioactive discovery research to support the development of functional food ingredients, health supplements and pharmaceuticals.**

Practical Guidance for California

- **Check-off funds can provide an efficient and fair source of funding for commodity or industry collective goods, including certain types of R&D**
- **Matching government funds may be needed to overcome incentive problems in R&D funding using check-offs,**
- **Australia's levy system appears to have**
 - **significantly enhanced Australia's total agricultural R&D over the past 25 years**
 - **influenced the emphasis within that portfolio**

Practical Guidance for California (continued)

- **Check-off funded research programs have been successful when**
 - **the government provides matching support**
 - **the industry has significant say over the research agenda**
- **Successful introduction of the Australian policy required strong and intelligent leadership from industry and the government**
- **In spite of strong rationale and tangible evidence of its success, the current Australian structure may not survive for long in its present form**