Innovative Finance for Agricultural R&D

William A. Masters
Professor of Agricultural Economics
Purdue University

wmasters@purdue.edu
www.agecon.purdue.edu/staff/masters
www.agecon.purdue.edu/prizes

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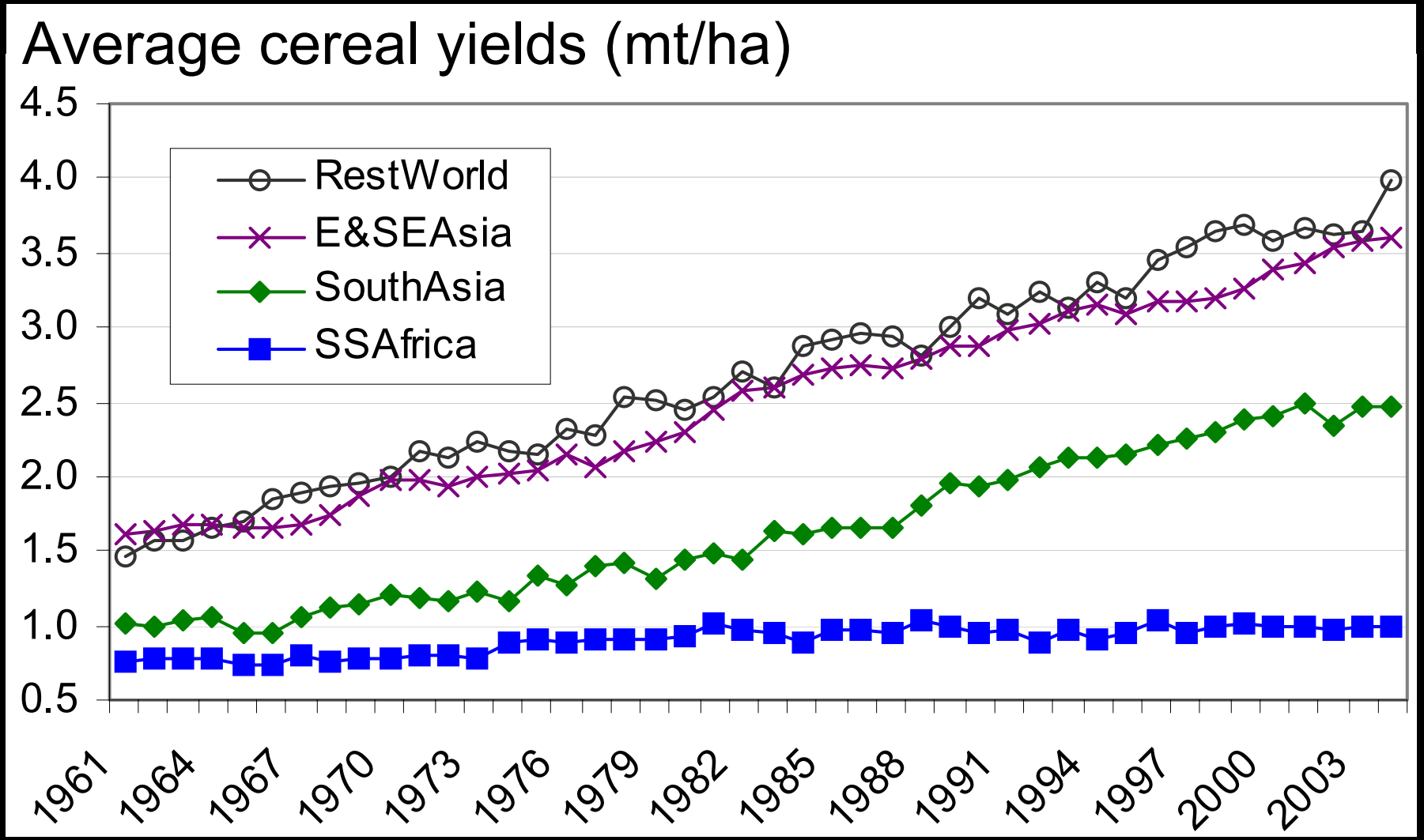
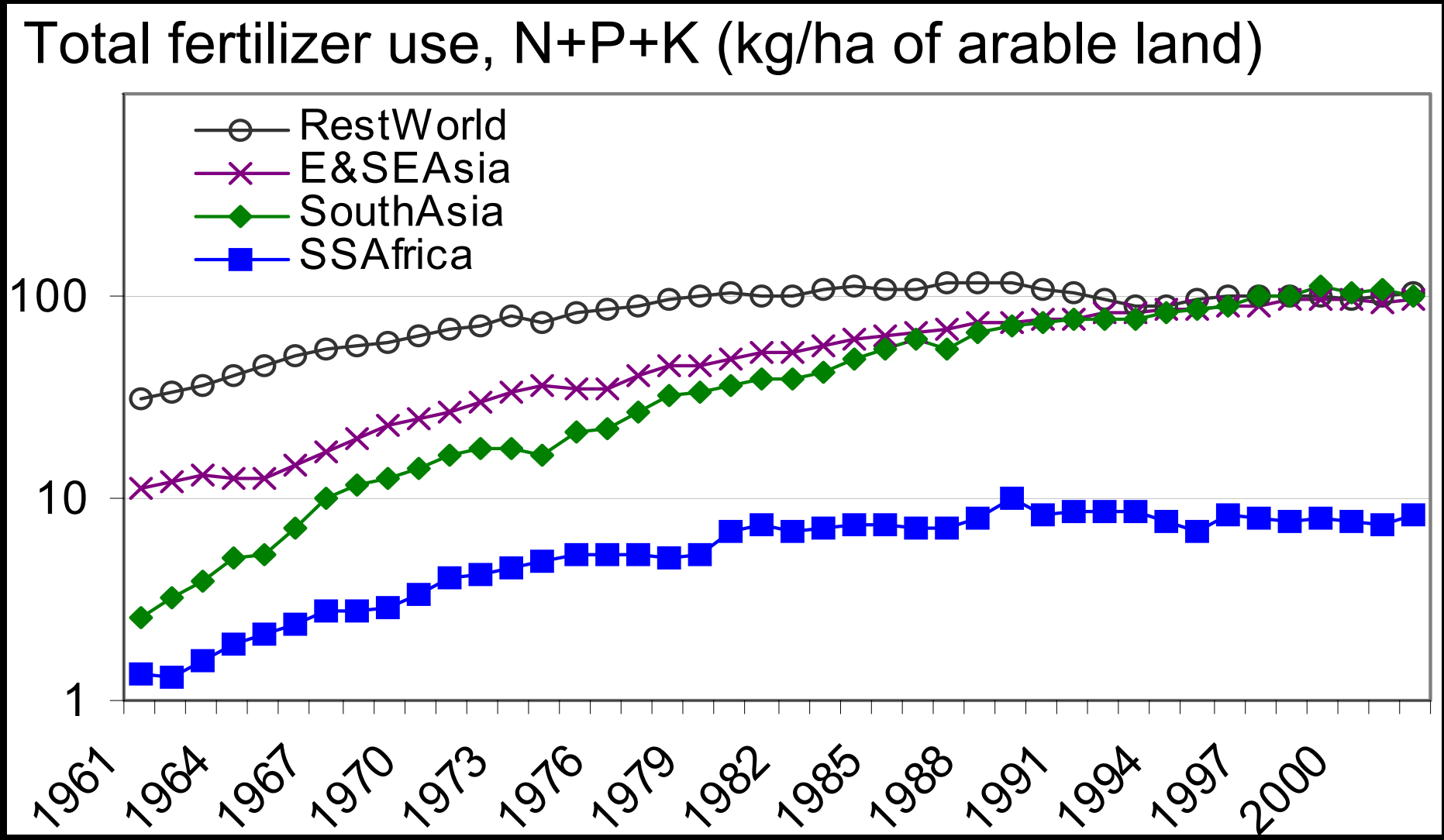
The problem: Regions vary greatly in ag technology



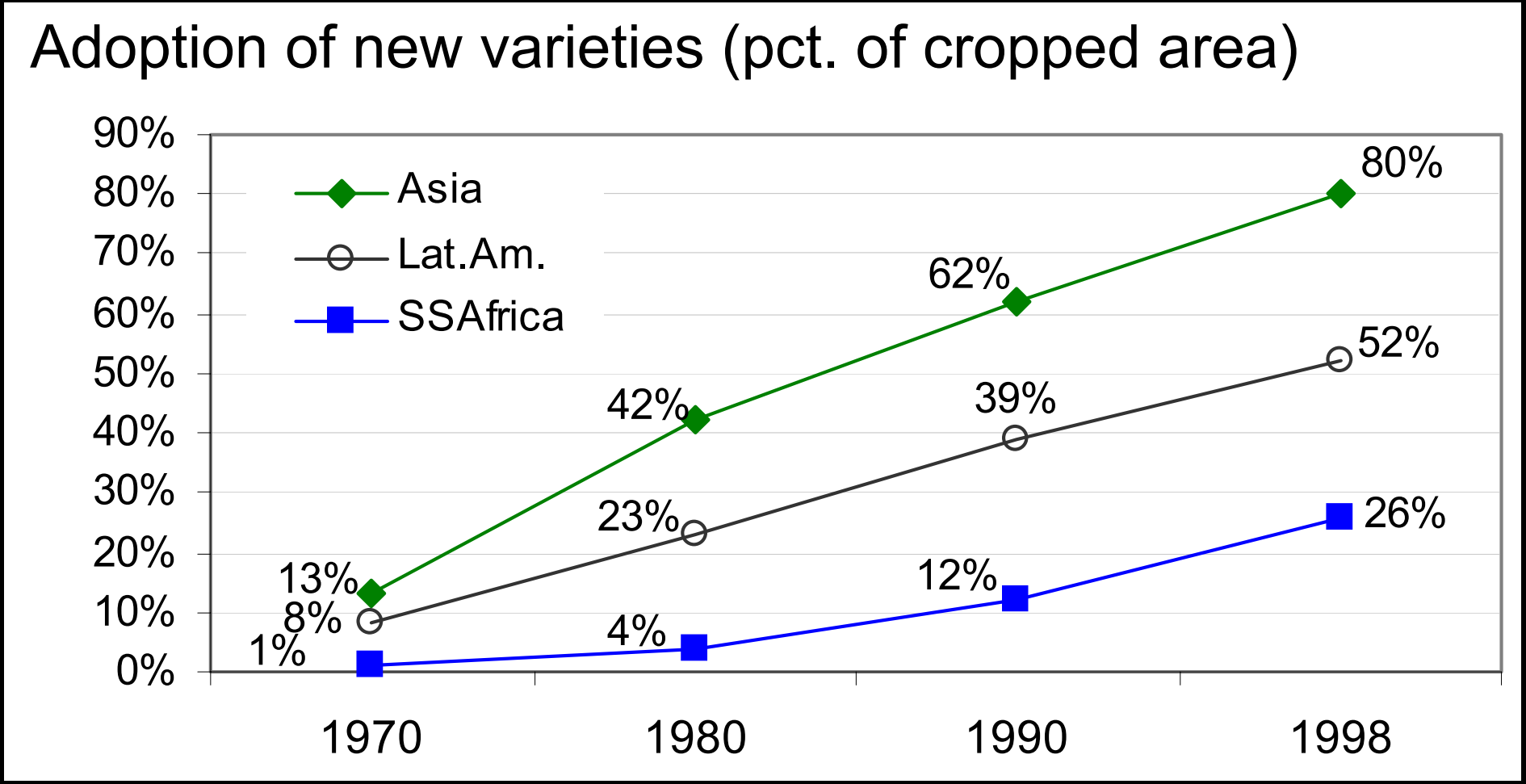
Source: calculated from FAO data, at http://faostat.fao.org.

There are diminishing returns to inputs, e.g. simply adding more fertilizer



Source: calculated from FAO data, at http://faostat.fao.org.

Sustaining growth requires new technologies, e.g. new varieties



Source: Calculated from data in R.E. Evenson and D. Gollin (2003), *Crop Variety Improvement and its Effect on Productivity.* Wallingford: CABI.

New technologies often involve multiple innovations

Genetic improvement

(by researchers, using controlled trials)

Agronomic improvement

(by farmers, using land & labor)

Successful innovations are often surprising

traditional "flat" planting

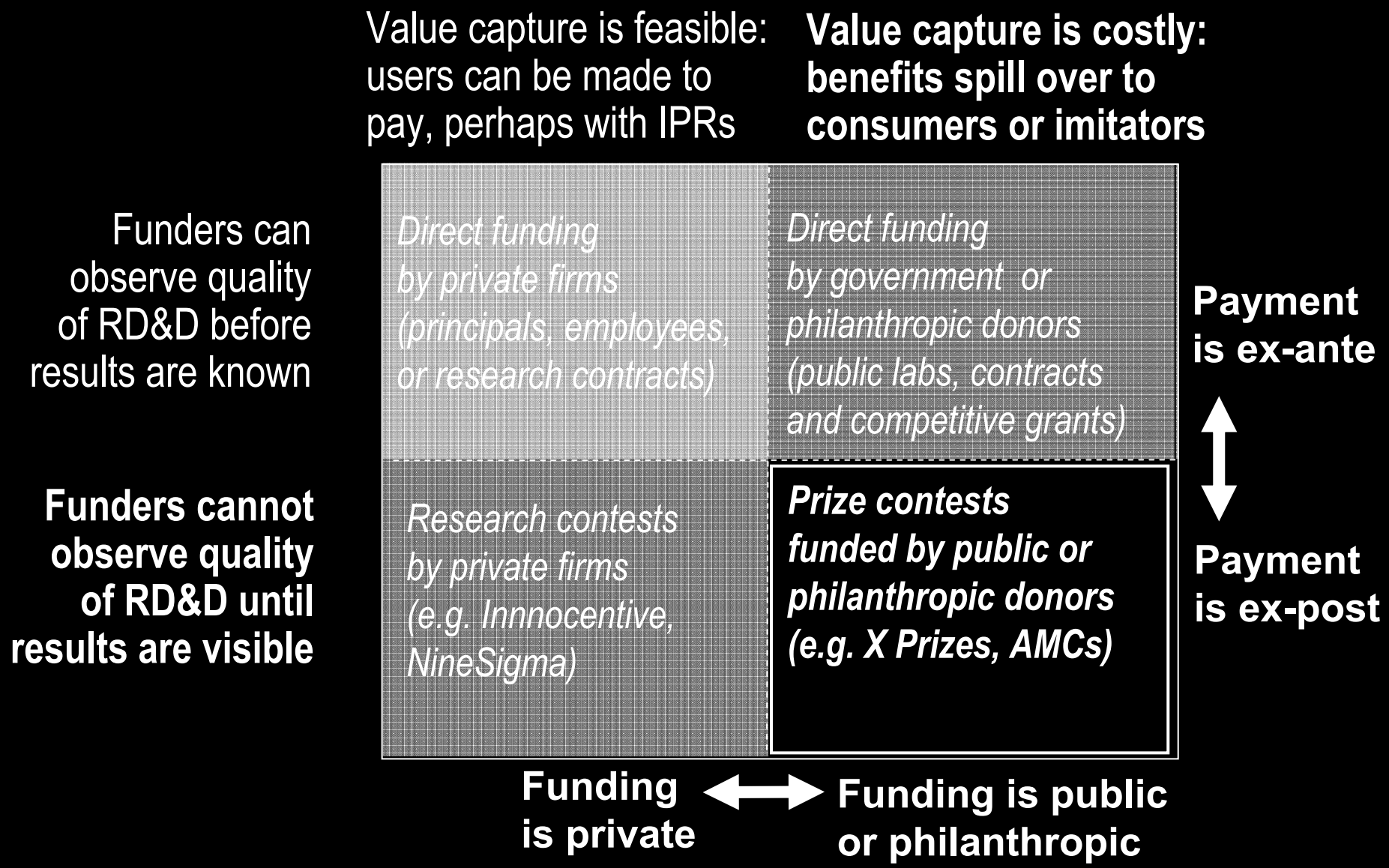
labor-intensive "Zai" microcatchments

For these fields, the workers are:

New finance mechanisms can help

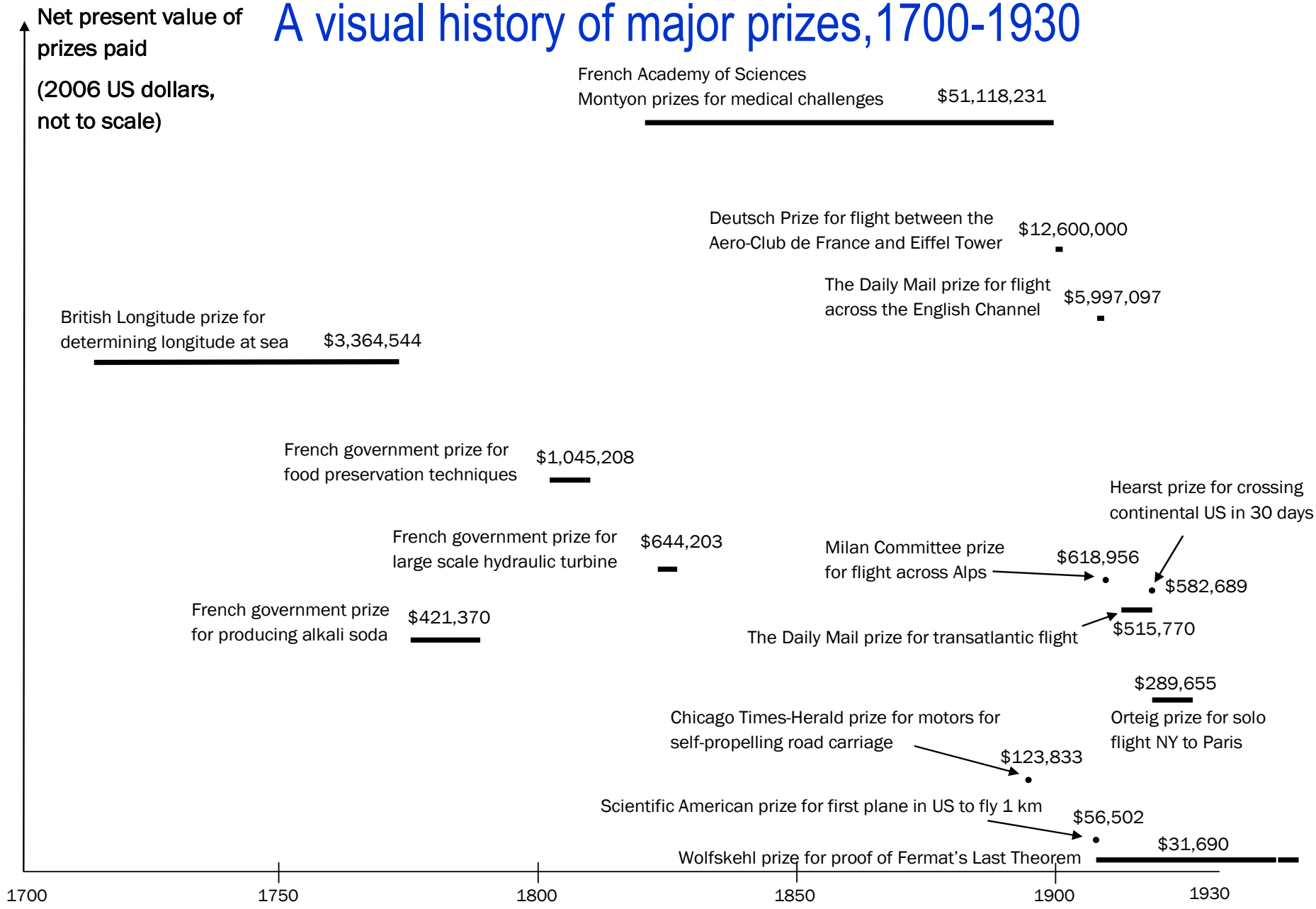
- Agricultural R&D has distinctive characteristics
  - value creation is dispersed among the poor, even with IPRs
    …so private investment is limited by value capture
  - research success is difficult to monitor and predict
    …so public investment is limited to trusted institutions
- The traditional remedy is a third-party "prize"
  - paid by a public or philanthropic donor
  - to reward success after it is observed

Only a few kinds of technology and R&D are best funded with ex-post, third party prizes



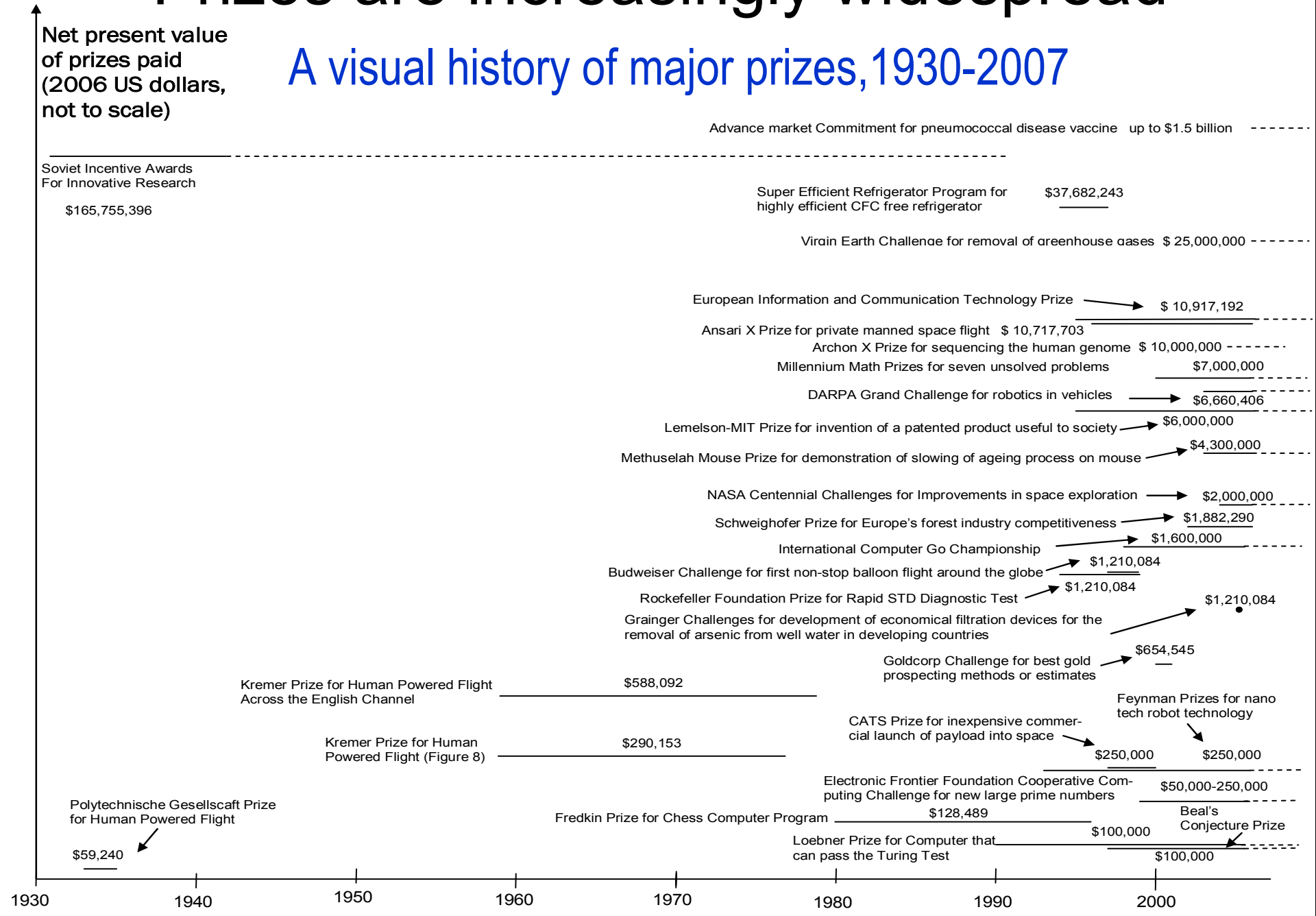
Prizes are an old financing mechanism

A visual history of major prizes,1700-1930



Prizes are increasingly widespread

A visual history of major prizes,1930-2007



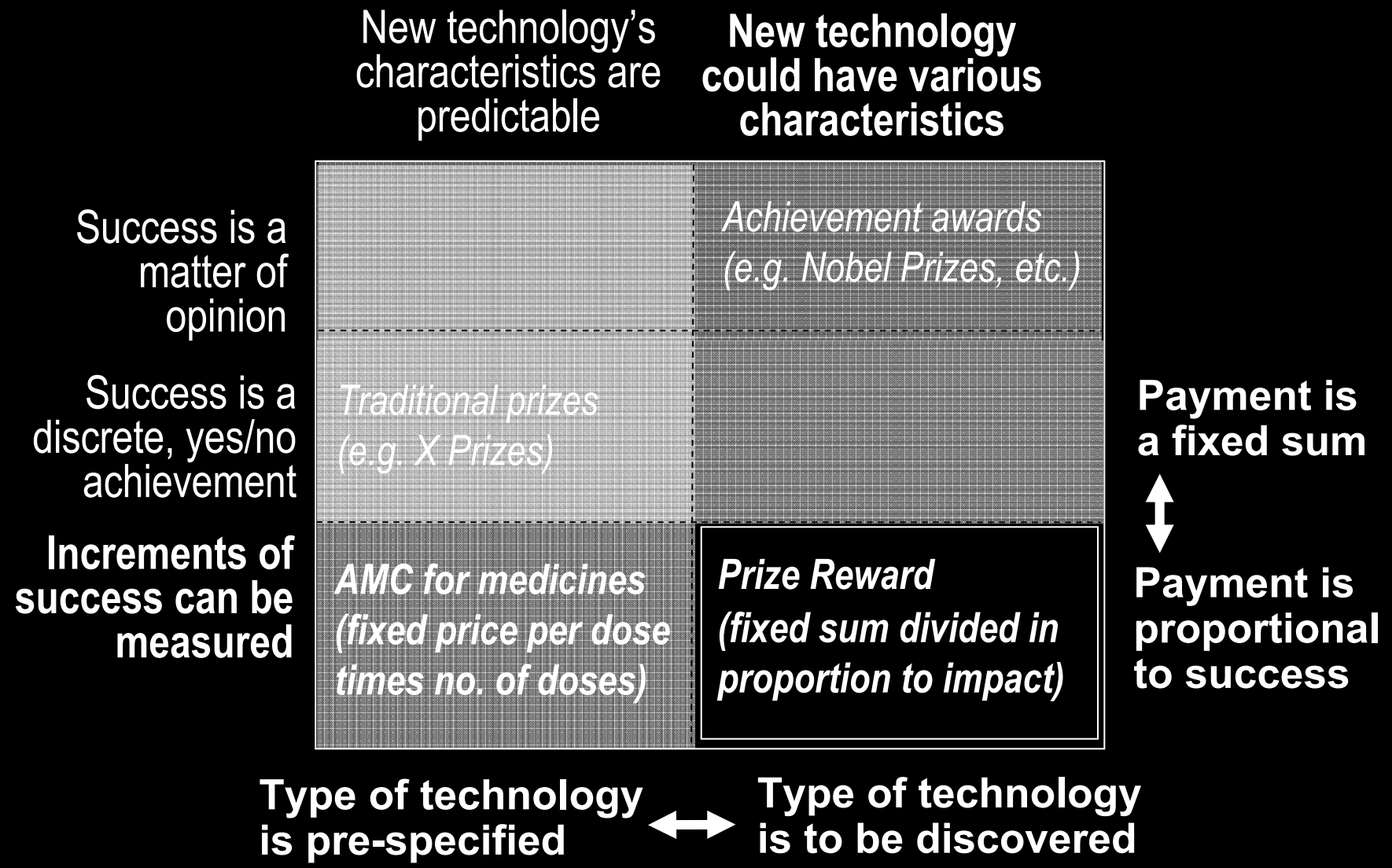
Prizes are an increasingly popular but problematic financing mechanism

- Successful prizes are inherently temporary
  - by revealing what works best, they attract other investment in successful strategies:
    - private investment when innovation is marketable
    - public grants and contracts when it is a public service
- The prize contest itself can be very wasteful
  - fixed awards give nothing for *incremental* achievements
  - prespecified criteria give nothing for *other* achievements

A new type of prize can help

- Kremer (2001) pioneered a new economics of prizes
  - payment is an "advance market commitment" (AMC) for a vaccine, so award is proportional to number of doses sold
  - donor defines effectiveness criteria and price per dose
- But agricultural technology is not like medicine
  - more difficult because don't have "one disease, one cure"
    - instead, we have many localized problems & solutions
  - easier because the value of improvement is measurable
    - product is sold at observable prices
    - gains are measurable using experiments and surveys
- For agriculture, we need royalty-like "prize rewards"
  - donors would pay a lump sum, divided among winners in proportion to value of gains from their innovations

"Prize rewards" could be paid for *any* technology whose gains can be measured



How prize rewards would work to accelerate innovation

- Donors offer a fixed sum (e.g. $10 m./year), to be divided among all successful new technologies
- Innovators assemble data on their technologies
  - controlled experiments for output/input change
  - farm surveys for extent of adoption
  - input and output prices
- Secretariat audits the data and computes awards
- Donors disburse payments to the winning portfolio of techniques, in proportion to each one's impact
- Investors, innovators and adopters use prize information to scale up spread of winning techniques

Implementing Prizes:
Schematic overview

Step 1:
donors specify lines of credit for target domains
(e.g. $1 m. for food crops)

Step 2:
innovators submit data on gains from new techniques after adoption
(e.g. $36 m. over 7 submissions)

Prizes would be a small fraction of total activity, but a key market-like signal of value

Step 3:
secretariat verifies data and computes reward payments
(e.g. 1/36th of measured gains)

Impact:
other donors, investors and innovators imitate successes

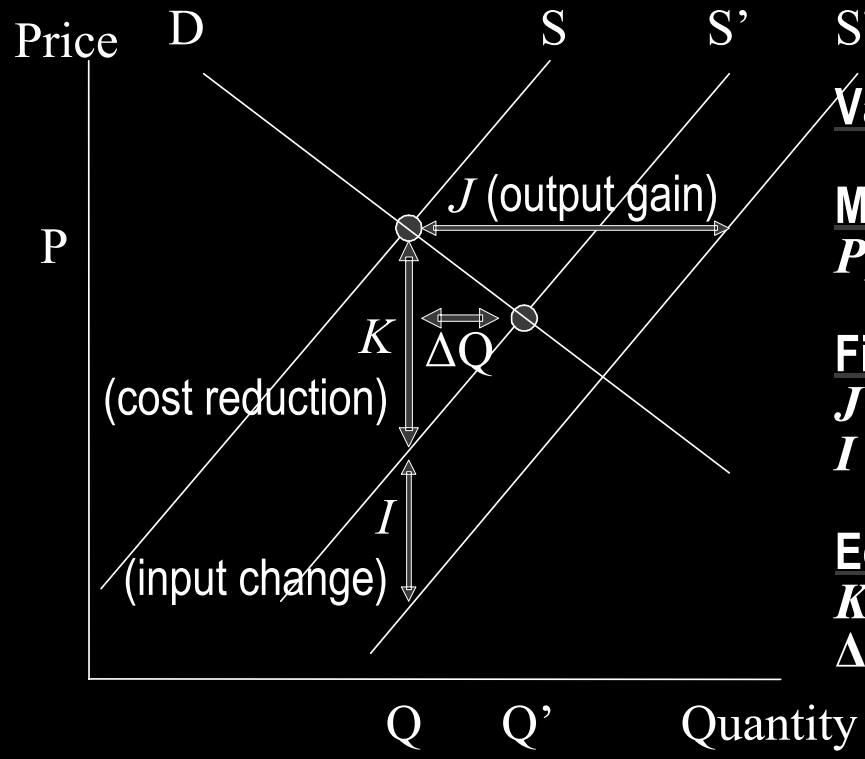
Prize rewards can stimulate any kind of innovation whose value is measurable

improved fish-drying in Senegal

using hermetic bags to store crops

Implementing Prizes:
Data requirements

Data needed to compute each year's economic gain from technology adoption



Variables and data sources

Market data

P,Q National ag. stats.

Field data

J Yield change×adoption rate

I Input change per unit

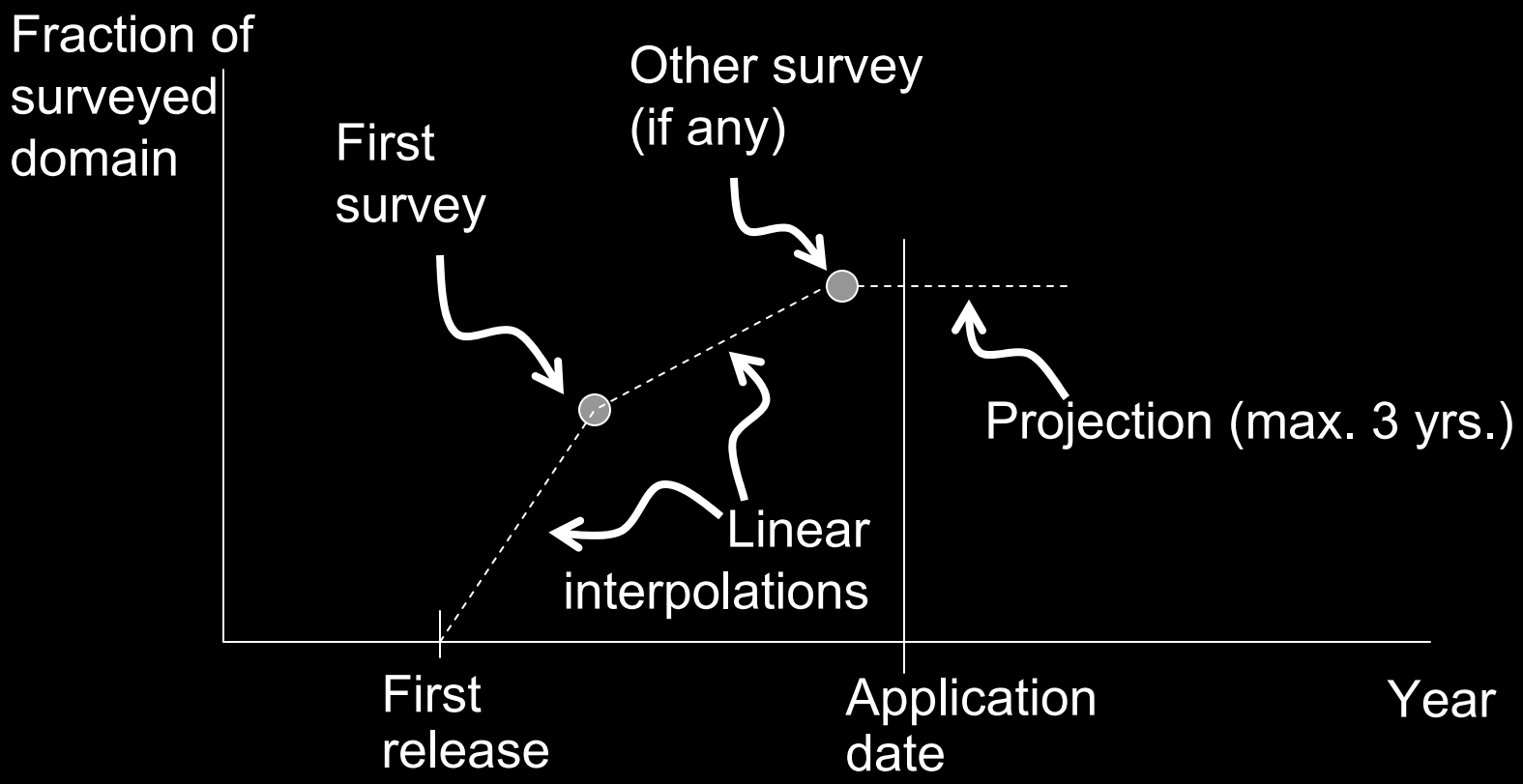
Economic parameters

K Supply elasticity (=1 to omit)

ΔQ Demand elasticity (=0 to omit)

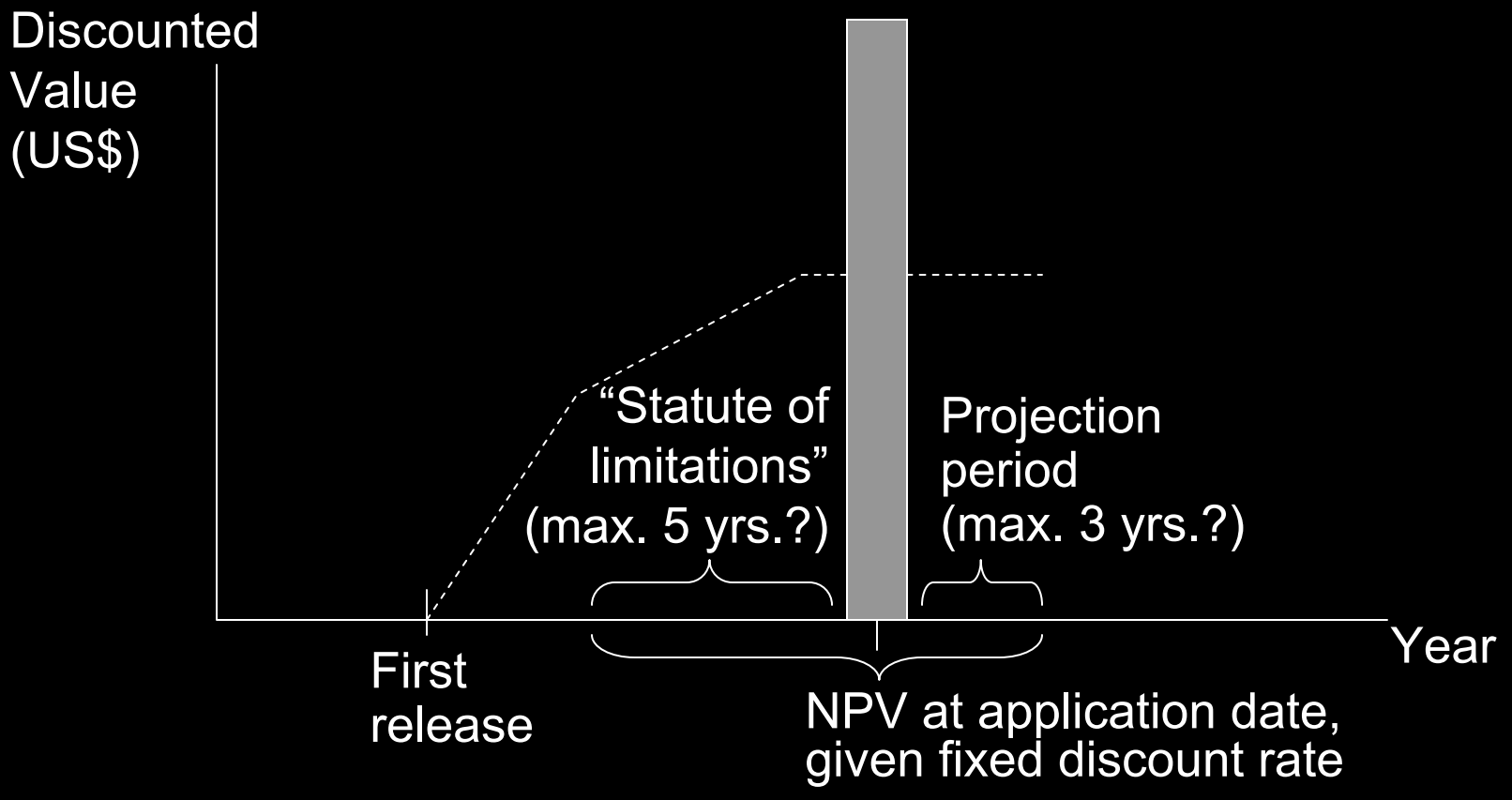
Implementing Prizes: *Data requirements*

Data needed to estimate adoption rates across years



Implementing Prizes:
Data requirements

Computation of cumulative economic gains



Implementing Prizes:
An example using case study data

Example technology	Measured Social Gains (NPV in US$)	Measured Social Gains (Pct. of total)	Reward Payment (US$)
1. Cotton in Senegal	14,109,528	39.2%	392,087
2. Cotton in Chad	6,676,421	18.6%	185,530
3. Rice in Sierra Leone	6,564,255	18.2%	182,413
4. Rice in Guinea Bissau	4,399,644	12.2%	122,261
5. “Zai” in Burkina Faso	2,695,489	7.5%	74,904
6. Cowpea storage in Benin	1,308,558	3.6%	36,363
7. Fish processing in Senegal	231,810	0.6%	6,442
Total	$35.99 m.	100%	$1 m.

Note: With payment of $1 m. for measured gains of about $36 m., the implied royalty rate is approximately 1/36 = 2.78% of measured gains.

Implementing prize rewards: *What's done, what's next*

- Refinement and endorsement of the initiative
  - 3 journal articles, 20 seminar meetings since 2003
  - 9-member Advisory Board formed October 2004
  - FARA as potential Africa secretariat since Sept. 2005
- Funding for project development
  - Adelson Family Foundation (New York), 2004-06
  - IFPRI (Washington and Addis Ababa), 2006-08
- Funding for prize rewards
  - significant interest from various donors
  - could be funded through FARA or other secretariats

For more information…

wmasters@purdue.edu

www.agecon.purdue.edu/staff/masters
www.agecon.purdue.edu/prizes
www.fara-africa.org