Accelerating innovation with ex-post 'prize reward' payments

William A. Masters
Professor of Agricultural Economics
Purdue University

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

Lisbon Workshops on Science, Technology and Social Change
November 12-13, 2007

Why do we need a new type of prize?

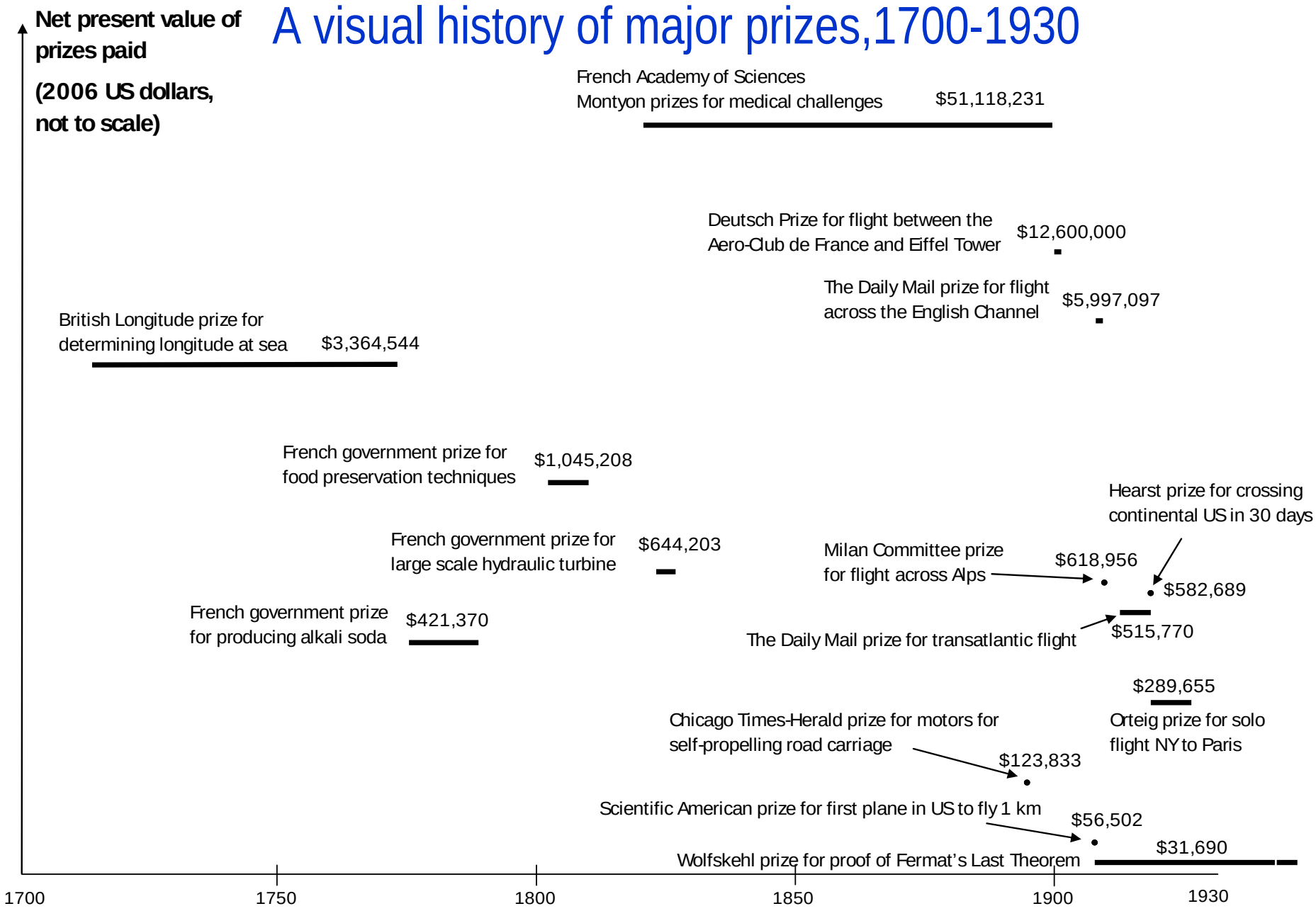
- Why not intellectual property rights?
  - IPRs are good, but only for marketable innovations

    …often value capture is difficult, even with IPRs
- Why not direct grants & contracts?
  - direct funding is good, but only through trusted institutions

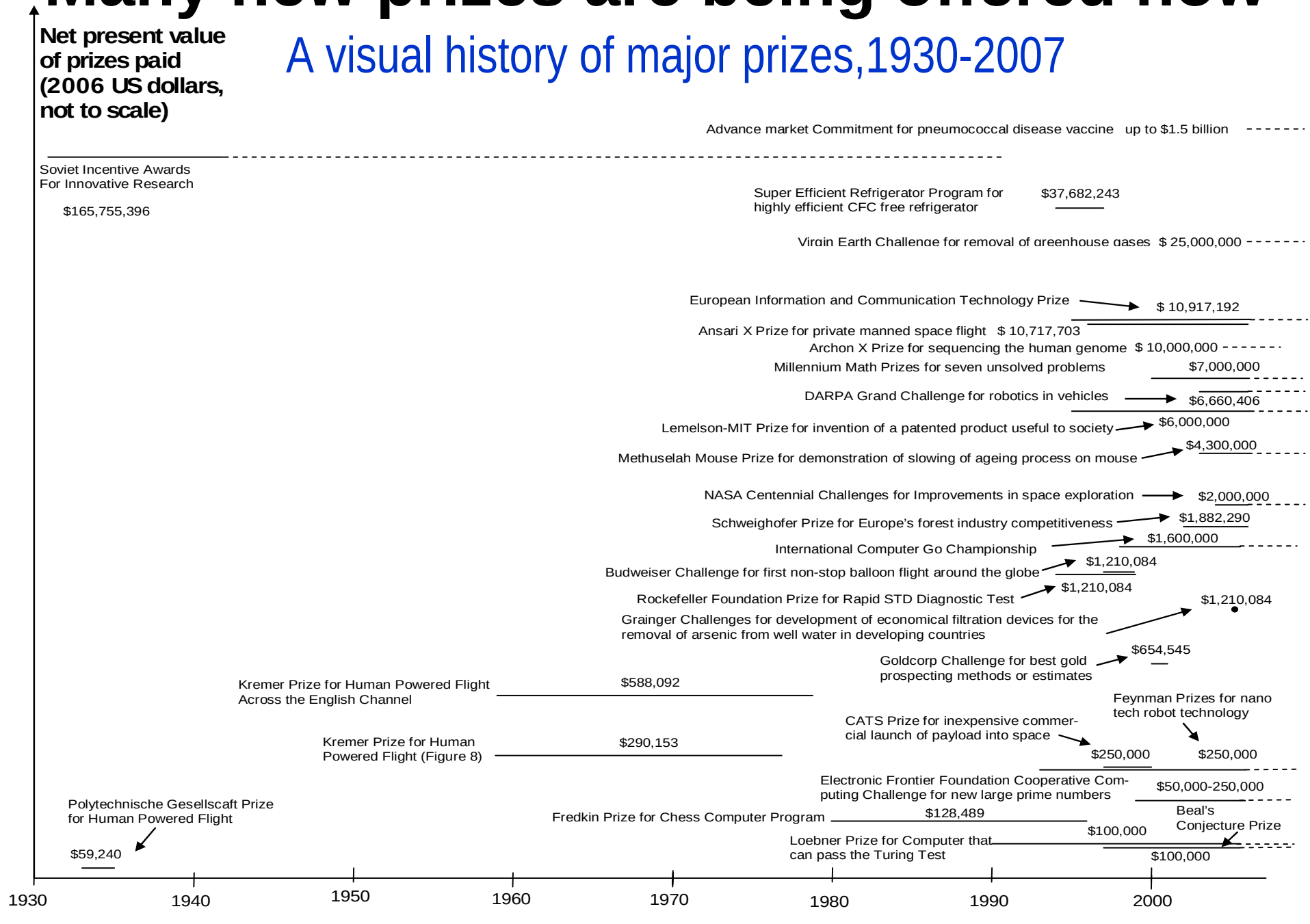
    …often funders cannot select or supervise R&D providers
- Prizes can help
  - to spur innovation where other mechanisms don't work,

    …but prizes have limitations of their own
  - a new type of 'prize rewards' could be more effective

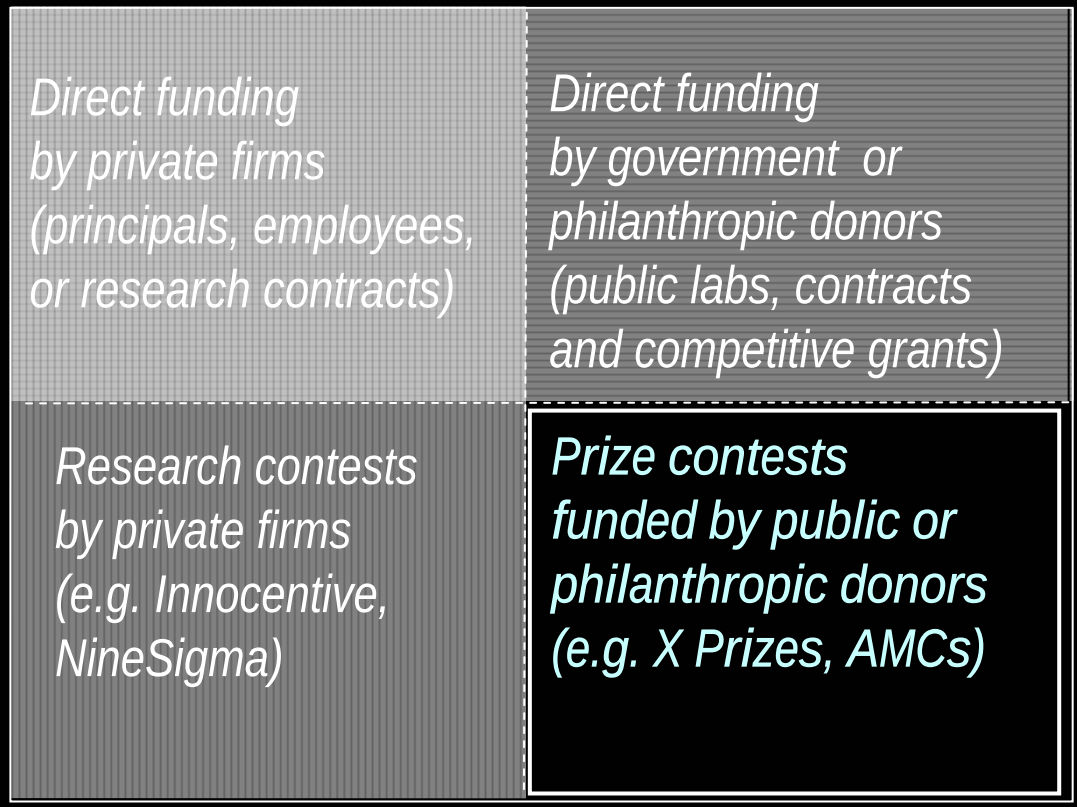
Prizes are a very old funding instrument!



Many new prizes are being offered now



When are prizes the best funding instrument?



Well-designed prize contests offer powerful incentives

- Well-designed prizes offer:
  - An achievable target and clear measure of success
  - An impartial judge and credible commitment to pay
- Such contests typically:
  - attract a wide variety of entrants
  - who often spend more than the prize payout
    - the Ansari X Prize for civilian space travel offered to pay $10 million
    - the winners, Paul Allen and Burt Rutan, invested about $25 million
- Why do prizes attract so much investment?
  - contest provides a credible signal of success
  - so good performers can sell their product to other buyers
    - the X Prize winners licensed designs to Richard Branson for $15 million
    - and eventually sold the company to Northrop Grumman for $??? million

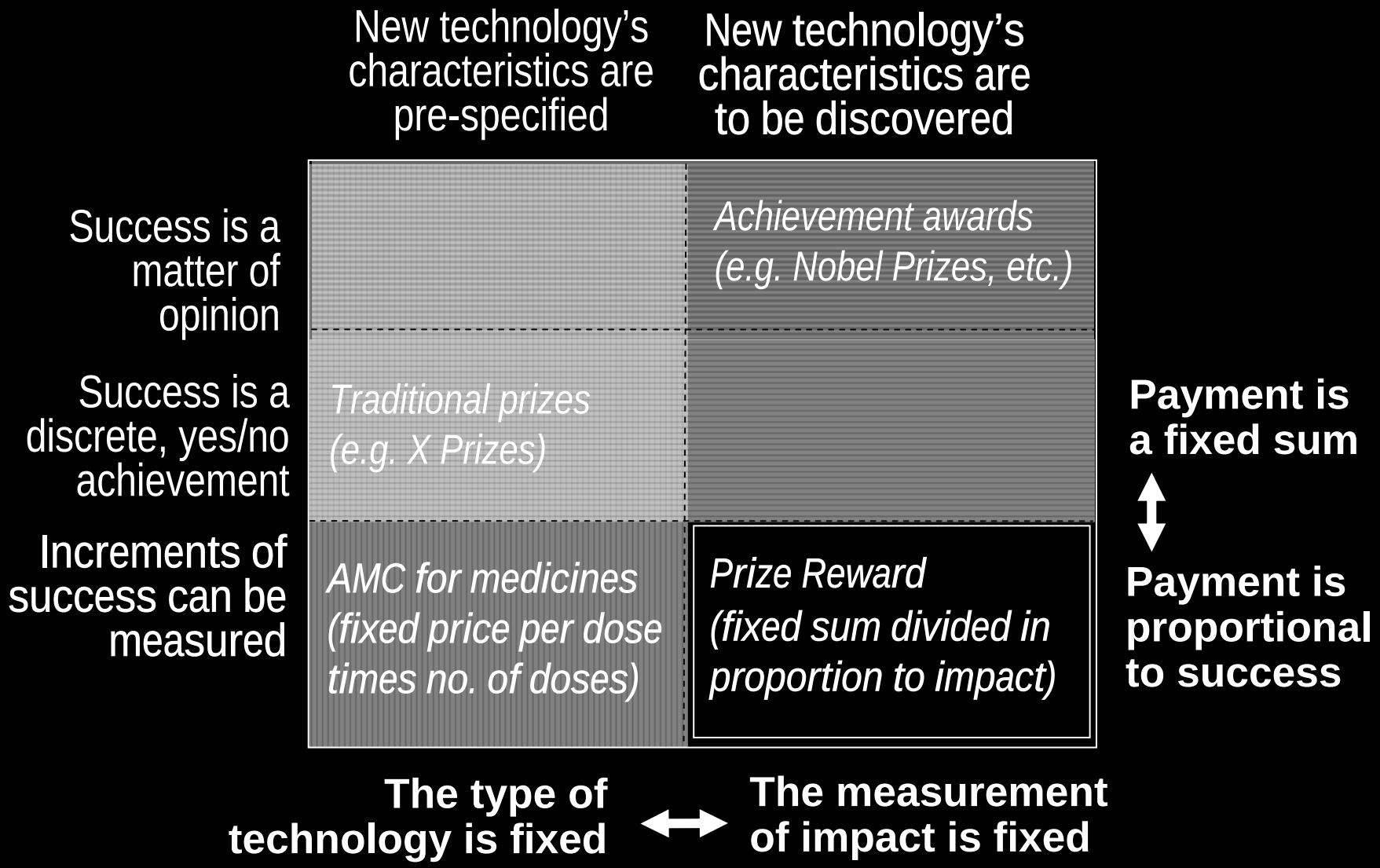
…but even the best prize contests have serious limitations!

- After prize contests, winners are funded by other means
  - commercial sales are pursued under IPRs
  - public services are provided under grants & contracts
- If not needed, using prizes would be relatively inefficient:
  - 'patent race' losses and value dissipation among contestants
    - each contestant's investment reduces other entrants' odds of winning
  - lack of incentive for incremental improvements
    - contestants could have aimed for more or less ambitious goals
  - lack of information about non-winners
    - methods used by the 2nd, 3rd or nth contestant might be very promising
- Can new prize designs overcome these limitations?
  - if we can measure increments of success,
  - we can pay innovators *per unit* of achievement, as markets do

New prize designs are tailored to specific kinds of technologies

- Kremer (2001): per-unit prize for neglected disease vaccines
  - "advance market commitment" (AMC) for pneumoccal disease vaccine
  - up to $1.5 billion, paid proportionally to number of doses sold
  - rewards incremental success above minimum standards
- Masters (2003, 2005): new prizes for agricultural technology
  - in agriculture, we don't have "one disease, one cure"
    - instead, we have many localized problems & solutions
  - but measuring value creation after technology adoption is easy
    - product is sold at observable prices
    - gains are measurable using controlled experiments and farm surveys
- …so donors could offer royalty-like "prize rewards" for impact
  - donors would pay a fixed sum
  - divided among winners in proportion to value of measured gains

Prize rewards allow innovators to discover how best to generate measured gains



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
  - adoption surveys for extent of use
  - 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 W. Africa)

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

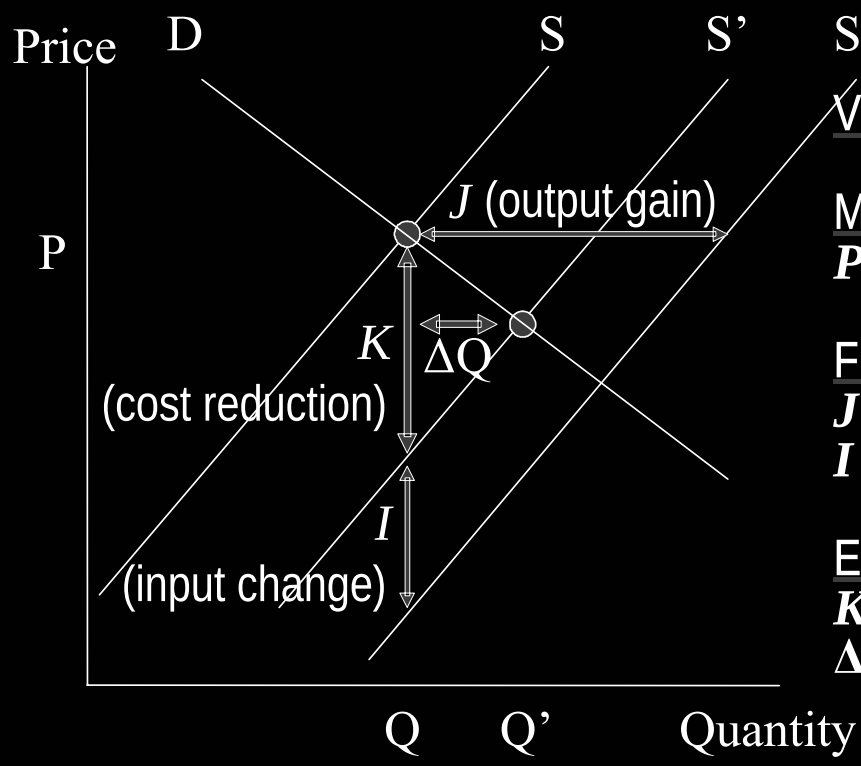
Prizes would be a small fraction of total activity, but a key market-like signal of value

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

Impact:
other donors, investors and innovators imitate successes

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

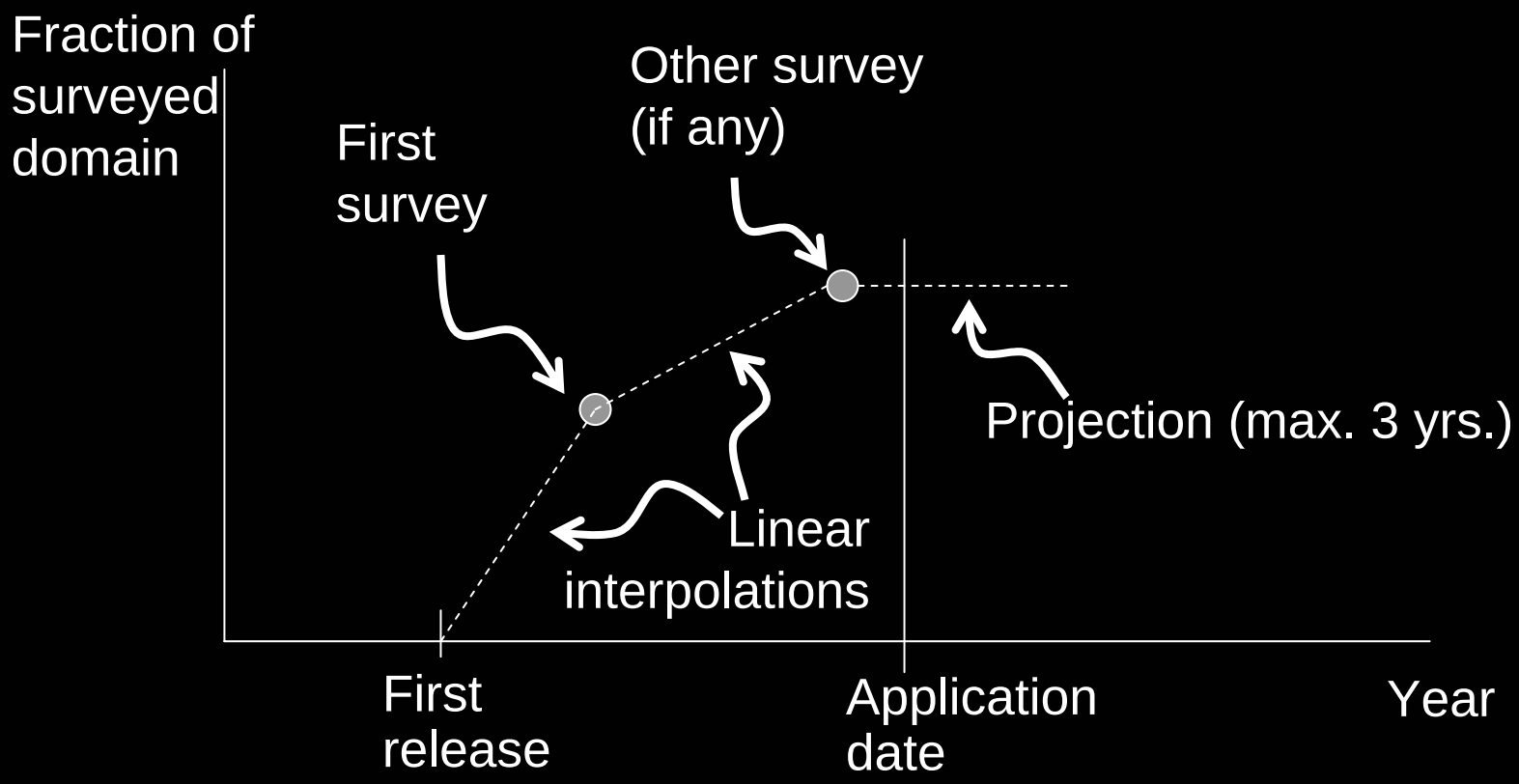
Economic parameters

K Supply elasticity (=1 to omit)

ΔQ Demand elasticity (=0 to omit)

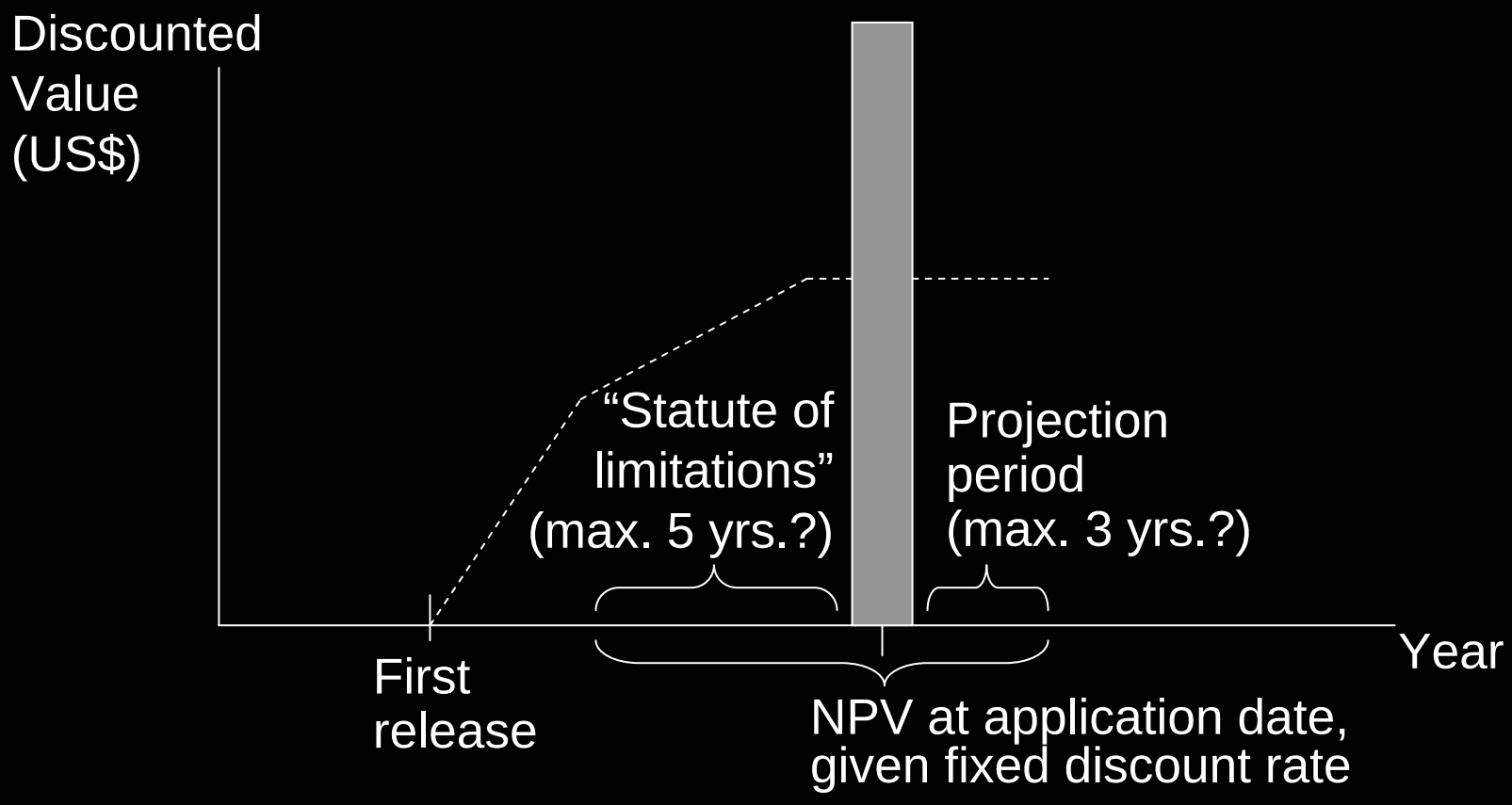
Implementing Prizes:
Data requirements

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