Accelerating innovation with ex-post 'prize reward' payments

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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!

prizes	US dollars,	Frer	The major prizes, 1 The Academy of Sciences Intyon prizes for medical challenges	700-1930 \$51,118,231	
			Deutsch Prize for flight b Aero-Club de France and	\$12.60	0,000
	n Longitude prize for nining longitude at sea \$3,3	64,544		Mail prize for flight English Channel	5,997,097 •
		vernment prize for \$1,045,2 ervation techniques French government prize for large scale hydraulic turbin	^{or} \$644,203 Milan Corr	nmittee prize \$6	Hearst prize for crossing continental US in 30 days
	French government p for producing alkali so	Ψ_{+}		for transatlantic flight	• \$582,689 • \$515,770
			Chicago Times-Herald prize fo self-propelling road carriage	r motors for \$123,833	\$289,655 Orteig prize for solo flight NY to Paris
		s	Scientific American prize for first plane Wolfskehl prize for proof of F		\$56,502 • \$31,690
1700	1750	1800	1850	1900	1930

Net present value of prizes paid 2006 US dollars, not to scale)	new priz A visual his		y of major p	prizes,19	30-2007	
oviet Incentive Awards or Innovative Research \$165,755,396				Super Efficient Refrigers	erefrigerator	37,682,243
				nformation and Commu Prize for private manne	unication Technology Pri d space flight \$10,717	7,703 \$ 10,917,192
				Millennium Math Priz	for sequencing the hurr ses for seven unsolved p Challenge for robotics in	
					patented product useful	\$4,300,000
				ghofer Prize for Europe	r Improvements in spac	► €1 882 200
			Grainger Challenges f	first non-stop balloon f tion Prize for Rapid ST	D Diagnostic Test	
	Kremer Prize for Human Powered Fligh Across the English Channel	t	\$588,092		dcorp Challenge for bes specting methods or esti	imates Feynman Prizes for na
	Kremer Prize for Human Powered Flight (Figure 8)		\$290,153		ze for inexpensive comr h of payload into space	
Polytechnische Gesellsca for Human Powered Fligh \$59,240		F	Fredkin Prize for Chess Compute	puting Challe		
<u> </u>	 1950	1960	1970	1980	1990	2000

When are prizes the best funding instrument?

Private funders

Public or philanthropic funders

Direct funding (ex-ante payments)

'Prize' funding (ex-post payments) Direct funding by private firms (principals, employees or research contracts)

Research contests

by private firms

NineSigma)

(e.g. Innocentive,

Direct funding by government or philanthropic donors (public labs, contracts and competitive grants)

Prize contests funded by public or philanthropic donors (e.g. X Prizes, AMCs) Funders can observe quality of R&D before results are known

Funders cannot observe quality of R&D until results are seen

Value capture is easy, so beneficiaries can be made to pay

Value capture is costly, so benefits spread to consumers & imitators

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

New technology's characteristics are pre-specified

New technology's characteristics are to be discovered

Success is a matter of opinion

Success is a discrete, yes/no achievement

Increments of success can be measured

Achievement awards (e.g. Nobel Prizes, etc.) Traditional prizes (e.g. X Prizes) Prize Reward AMC for medicines (fixed sum divided in (fixed price per dose times no. of doses) proportion to impact)

Payment is proportional to success

Payment is

a fixed sum

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)

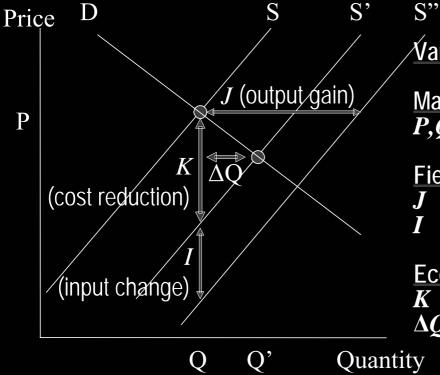
Prizes would be a small fraction of total activity, but a key market-like signal of value

Impact: other donors, investorsand innovatorsimitate successes

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

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

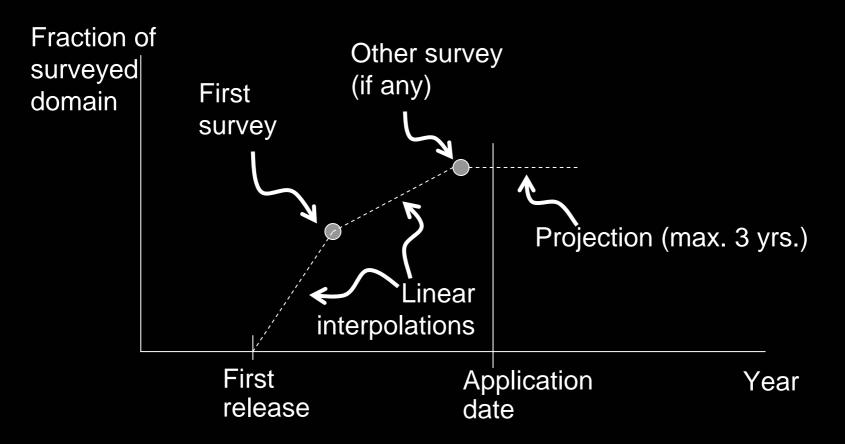
- Vield change × adoption rate
 - Input change per unit

Economic parameters

- Supply elasticity (=1 to omit)
- ΔQ Demand elasticity (=0 to omit)

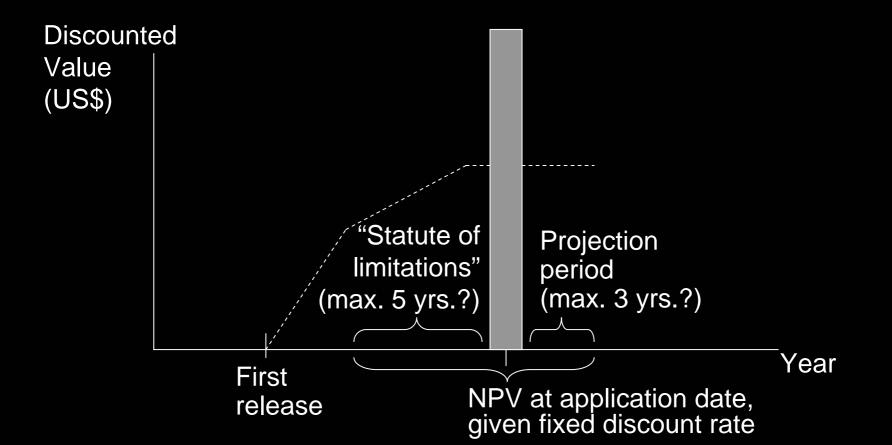
Implementing Prizes: Data requirements

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...

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