Culling and Indemnities in Management of Infectious Animal Disease

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Outline

- Purposes of and issues with Cull/Indemnify
- How to Pay
- Some economic issues, incl. test quality, business continuity and basis risk
- Behavioral dimensions
- Cooperation, education, trust

Why Cull (Kill) an Animal/Herd?

- Animal at end of production life
- To improve herd production potential, in terms of quantity & quality of output
- To make herd animals more uniform and so easier to manage
- Disease control. Can be
  - Voluntary or mandated by government
  - For endemic or exotic disease
  - Infectious/communicable or noninfectious

Our Interest

- Is in mandated control of endemic and exotic infectious diseases. Culling is a main tool for this, but a few general comments on culling policy
- Little reason for government involvement if noninfectious as private decisions affect only herd owner's profit
- Governments promote decision management tools that can be used to make culling decisions, e.g., DHIA etc., even absent infection
- Could argue against early culling on welfare grounds, e.g., issues with dairy cows living on hard surfaces or animal's body breaks down due to intensive production

Endemic vs. Exotic

- Culling and indemnification in exotic diseases is more crisis management, with procedures made as one goes along
- Comments on culling to remove endemic disease:
  - Can become institutionalized, with sluggish lethargic bureaucracy
  - Political interference
  - Bribery comes in many forms (greyhounds, also lairage)
  - Incentives messed up as public health veterinarians would be out of a job if they succeed in eradication

Why Indemnify?

A. In one way or another, countries generally require that governments pay for ‘takings’
B. Encourage herd owner ex-ante participation in centrally coordinated infectious disease management programs
C. Encourage reporting
D. Ensure ex-post compliance with programs in event of an incident
E. Address fairness issue for those infected through no fault of their own

A. Takings

- Why? Property rights to promote caretaking and investment are cornerstone of market economy
- May extend to matter of quarantining animals, impounding farms, etc.
- In some countries, e.g., US, is constitutionally required when animal is permanently taken. Also U.S. Animal Health Protection Act (2008) covers it
- Requires payment of Fair Market Value, which is price at which property would be exchanged in open market when both parties are reasonably apprised of relevant facts
- Devil is in the details

A. Appraisal with Takings

- Three methods
  - Sales, looks for open market comparisons
  - Cost-based, looks at costs to raise animal to its current age
  - Income, seeks to compensate for lost income
- All would give same result under conditions of simple economic models in competitive markets

A. Sales Approach

- Sales approach would reduce transactions costs, but would be too high unless unincurred costs are removed
- Sales approach is problematic in many animal sectors because there is no open market as
  - Condemned animals not ready for market and might not grade out
  - Integrated production systems intended to reduce food safety and disease risks, promote information flows and reduce coordination costs
  - Specialty animals, e.g., breeding herds
  - Point for comparison is diseased or uninfected animal? U.S. uses uninfected animal as reference

A. Cost Approach

- This approach can be used where there is no market for the animal at issue, but then there are different information issues
- How does government know the costs?
- Costs can differ dramatically with
  - farm size,
  - region,
  - time of year, and
  - input market conditions in that year
- Some costs are not market costs, as in management time and proprietary genetics

A. Income Approach

- Here the animal is viewed as an asset that would have yielded a dividend. Future income is projected where current and future projected costs are removed to obtain lost income
- In the end all approaches require at least some information on costs, and the fine detail can be messy
- Can be issues with, e.g., contractual non-performance

A. Delineating the Costs

Disease Cost	Borne by government
Animal itself	Often, but calculation a problem
Disposal	Often as supervision needed
Cleaning. etc.	Typically not
Damaged equipment	Depends how it was damaged
Opportunity cost of labour	Maybe
Testing	Mostly
Vaccination if relevant	Mostly

A. Delineating, Uncovered Costs

Disease Cost	Borne by government
When all business is down	No
Reputation, long-term loss of markets	No
Loss of skilled labor let go	No
Fixed costs not apportioned during loss assessment	No

B. Encourage Ex-Ante Participation and Precaution

- Biosecurity programs may come as a package, with costs whose bottom line merits are speculative
  - Having workers wash
  - Buying from a premium feed source
  - Hardening perimeter walls
- What if you do all these and there are no benefits?
- Economists think of it as a Principal-Agent problem where government's goal is to encourage actions for public good and farmers must be coaxed to realign their objectives. Insurance can sweeten participation

B. Ex-Ante Participation and Precaution and Information

- The major issues with indemnification, informational
- Moral hazard; little ex-ante incentive for biosecurity
- Adverse selection:
  - ≈ If insurance is voluntary then those signing up will be those taking least care
  - ≈ If growers pay large fraction of insurance cost then those taking best care get a bad deal and drop out
  - ≈ When you subsidize something you will get more of it
  - ≈ Cost to tax payer

C. Encourage Reporting

- Why report when you can ‘shoot, shovel and shut up’?
- Reporting laws may be in place, but
- Stick approach is problematic here because
  - disease maybe hard to detect so farmer may only suspect
  - even if there is an issue, others may have had disease at almost same time so that the waters are muddy
- In some countries it may be difficult to jail someone for failing to report a suspected reportable disease
- So carrot it is

C. Reporting and Biosecurity

- Items B (participation) and C (reporting) are linked (Gramig et al.). If one indemnifies to encourage reporting (form of adverse selection issue) then cost of not biosecuring is not fully incident on farmer (moral hazard issue)
- One instrument exists to achieve two goals; need a second instrument
- Farmers must face at least some loss to motivate biosecurity
  - Differentiate indemnification depending on whether reporting occurs, or fine people who are found not to have reported
- Need to condition insurance on actions if observable, i.e., insurance part of a stapled biosecurity package

C. Reporting and Dynamics

- A two period model can be like problem of car lemons
- If diseased animals cannot be sorted from disease-free animals then there is no incentive to take ex-ante biosecurity actions
- A test can change that. Those who feel confident their animal is disease-free can take the test and then provide a certificate in order to a get higher price
- All who expect to gain more from market than test costs will do so, so that many are incentivized to biosecure and reporting is less necessary because biggest risks self-identify by not having reporting good tests and they may not stay in business

C. Reporting and Dynamics

- Will people take a test and then report in the event of disease identification? Yes if sufficiently indemnified
- But what if the ‘game’ is multi-period where failure to take test causes costs later on?
- Then payment to encourage reporting would have to be very high, perhaps so high that healthy herds are reported (Sheriff and Osgood)
- Limiting indemnities to current period losses will be insufficient to elicit reporting

D. Ensure Ex-Post Compliance

- In the event of a severe infectious disease problem then scarce resources must make critical decisions on detection, culling, vaccination, etc., very quickly
- On-the-spot decisions conflict with the spirit of *due process*. Traumatic given that livelihoods are at stake
  - What alternatives do many farmers have, with assets and human resources and family connections tied into one business?
  - Many farmers tend to be wary of government in the first place

D. Compliance and Related Issues

- Financial economists extol merits of rapid trade clearing so that resources involved in exchange are efficiently used while informative price and other data becomes public information

Legal systems have long enshrined and sought to deliver the right to impartial, deliberated and expeditious adjudication of laws and regulations for “justice delayed is justice denied” and ROI delayed is ROI denied

D. Compliance etc., Continued

- Point here is that due process ameliorates social stress. There is an economic tradeoff between timely adjudication and careful deliberation
- In stressful times the trade-off tilts toward timely adjudication, but this may come at the cost of
  - civil discord, and
  - loss of respect for authority and processes, especially if adjudications are viewed as arbitrary or prone to favoritism

E. Address Fairness

- Many healthy animals may need to be slaughtered just to protect against the risk of disease spread. Hard to explain why a healthy herd needs to be removed
- In any case, government may be on the tab
- Conditioning payment on metrics for good biosecurity may be problematic as there may be a dynamic inconsistency problem
  - Once a disease issue emerges it may no longer be politically optimal to carry out a threat to not indemnify those who don't take an action. Owners may half see this coming and so not take actions
  - Organics and emerging markets may create further issues with specific biosecurity practices, e.g., keeping birds indoors

How to pay?

  - Government?
  - Insurance markets
  - Industry self-insurance
- Idea is unfamiliar to insurance companies and there would be high loading as, unlike crop insurance, risks are very hard to quantify
- Also many losers are likely to be nonagricultural and much of the loss may be due to price decline (trade issues) and not quantity losses

Insurance, Regulatory Moral Hazard

- On insurance markets, suppose a firm opened up such a market. But who decides whether there is an emergency and what should be paid for?
  - Absent insurance, government may decree certain lower cost actions as government pays
  - With insurance, government may decree more expensive and more politically expedient solutions, e.g., dump testing and clean-up costs onto insurer
  - In U.S. many health insurance companies favored 'Obamacare' as mandates would increase demand. Government decrees have ensured high costs and few insurers intend to remain in now

INDUSTRY SELF-INSURANCE

- This is a possibility and I believe it has taken place through fund created from consumer levies on sales
  - ≤ Hard to justify large funds just in case of a 50 year event of uncertain magnitude
  - ≤ Not sure why the industry can do the job any better than can insurance specialists. Maybe industry can best lobby government not to be unreasonable in a disease event?
  - ≤ Also issue of dynamic inconsistency, with view that government will pay if we don't
- Related 'industry club good' issue has to do with business continuity risk, to be addressed later

Kuchler, Hamm Paper

- US APHIS has used indemnity programs to control endemic diseases such as brucellosis, TB, hog cholera and scrapie (in sheep)
- Indemnity price was re-set periodically over period 1952-1995, sometimes fixed, sometimes a proportion of appraisal price
- In 1993 farmers told that program would be replaced by certification program. There followed a turn-in spike
- (Kuchler & Hamm) Number of animals ‘found’ & turned in increased with (indemnity price/market price) ratio
- Response to price ratio was elastic

Kuchler, Hamm Paper

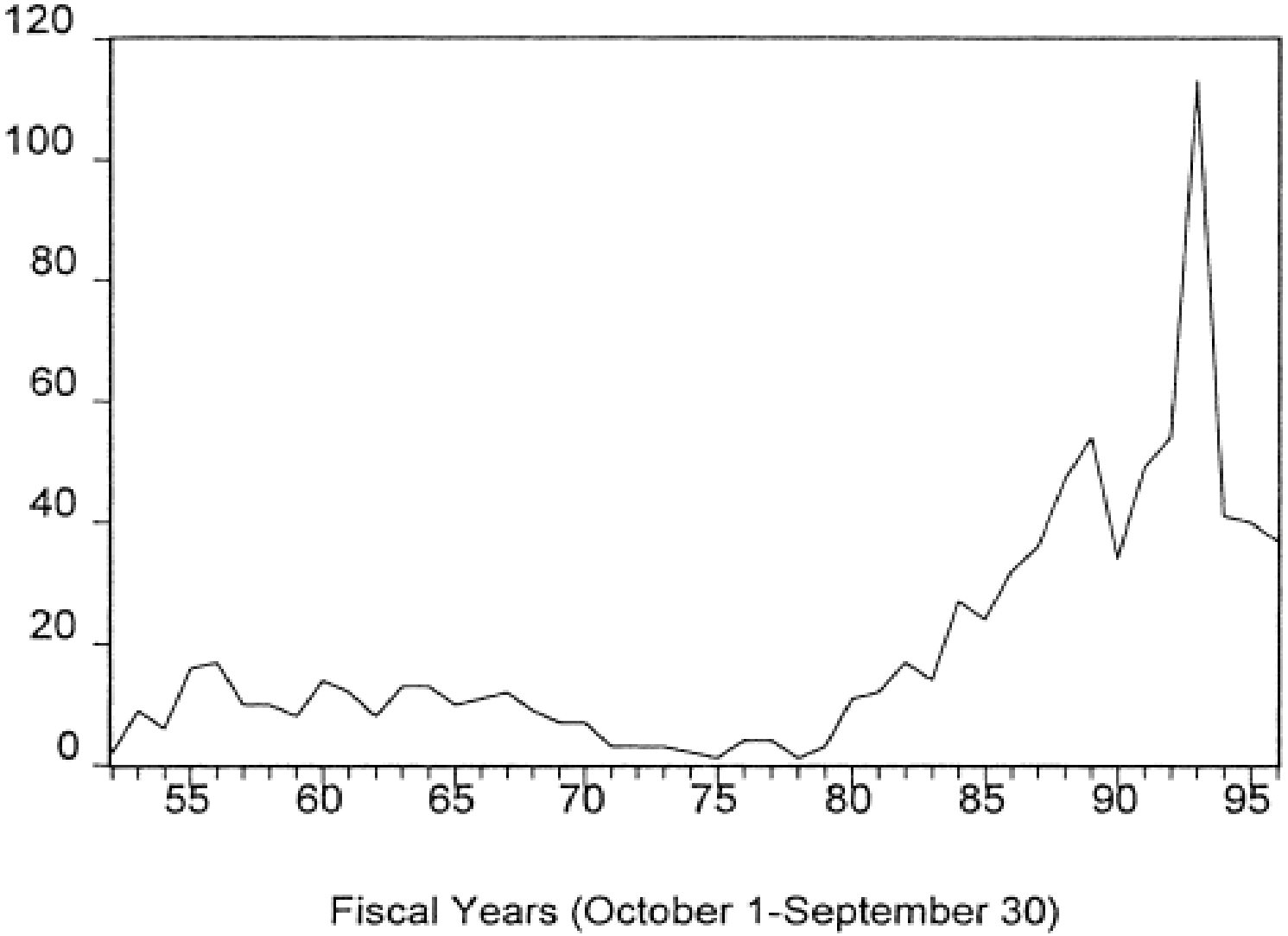


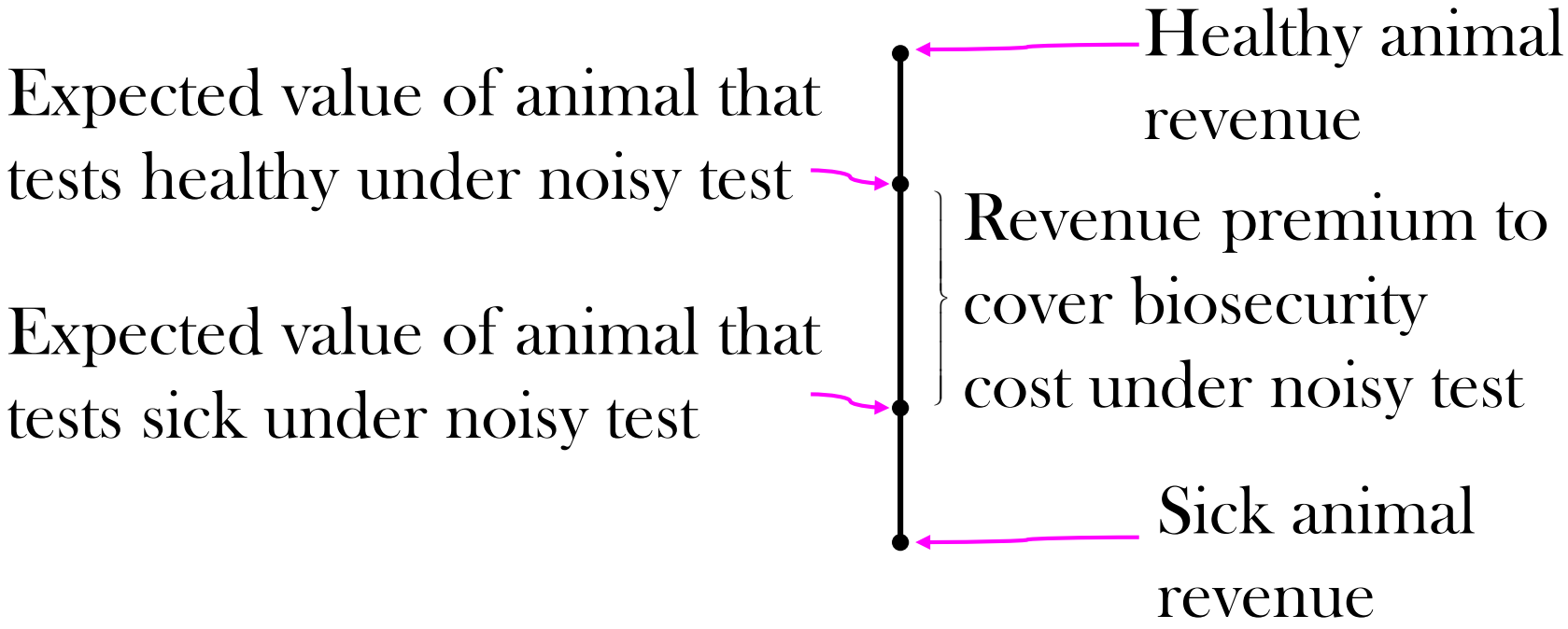
Fig. 1. Annual number of confirmed scrapie cases, 1952–1996.

Test Quality

- Tests for animal diseases can be very noisy. If a positive test is often wrong then either
  - more costly tests need to be done, or
  - healthy animals will be culled
- If a negative test is often wrong then either
  - more costly tests need to be done, or
  - sick animals remain to infect the herd
- A bad test may be worse than useless given farmer bad will it may generate

Test Quality and Biosecurity

- Also consider impact on ex-ante biosecurity



Does smaller premium cover cost?
Point is that a noisy disease test reduces incentive to act to prevent disease.

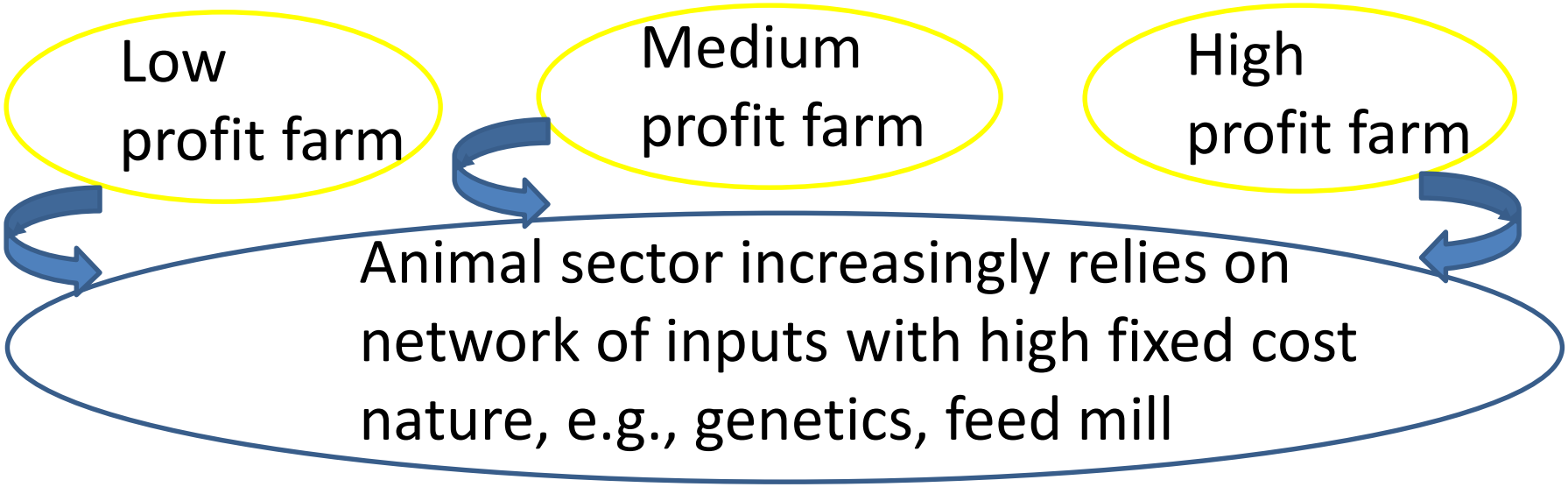
Taiwan, FMD and Pigs

- Taiwan was world's third largest pork exporter during mid-1990s, exporting about 30% of production to Japan. A 1997 FMD outbreak there closing off export markets. Since then Taiwan suffered sporadic recurrences and never regained lost market share
- Sector's production structure changed dramatically, in large part because sector players lost confidence that any investments will be adequately rewarded
- Will discuss issue of spreading fixed costs over sufficient production, business continuity and role for insurance

Networks & Shared Fixed Costs

- Suppose that there are N firms producing a product in a region and fixed costs exist (scale economies will do). They amount to F and are shared as F/N
- Disease hits a region and time until it is resolved is uncertain
- Conditional on disease, firm expected net present value (including cost F/N) declines and some (say n_1 may decide to quit. Now fixed costs for each to cover are larger at $F/(N-n_1)$
- Under larger fixed cost charges, still more drop out, leaving charge $F/(N-n_1-n_2)$, etc., etc.

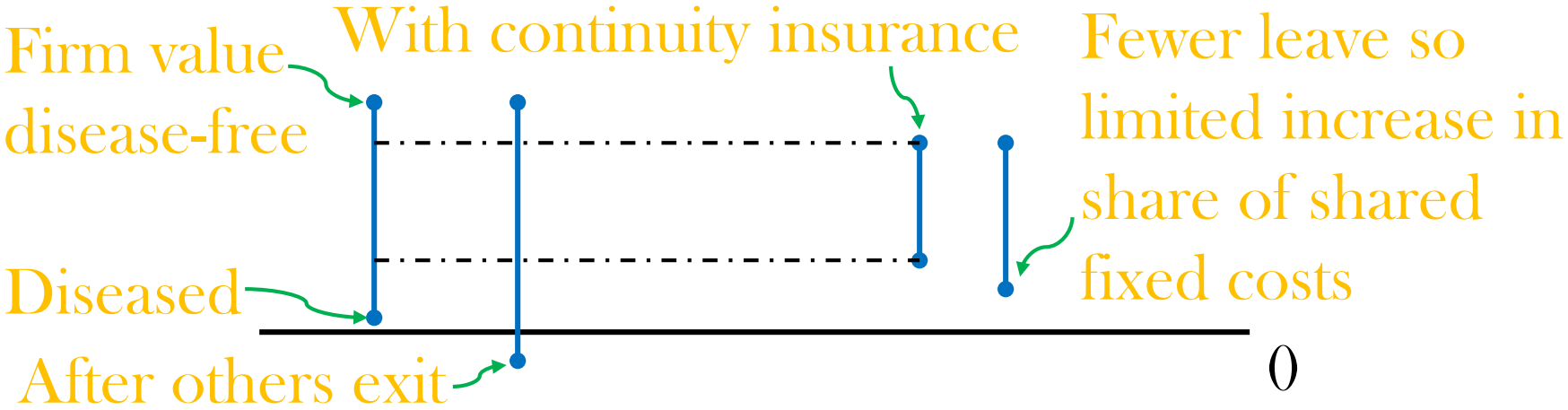
Neglected point on Insurance



- If an infectious disease hits and it looks as if it will take time to sort out then low profit farms may exit
- Others left to cover fixed costs of input/output network. Medium may exit, and then high
- Insurance endeavors may be partly to avoid unraveling

Business Continuity Insurance

- To see how, suppose that when disease-free the industry entered an actuarially fair insurance contract that guaranteed to compensate indefinitely for revenue loss in the event of a disease period. We ignore moral hazard issues
- Some firms may exit in disease-free state due to premium, but fewer drop out if disease hits

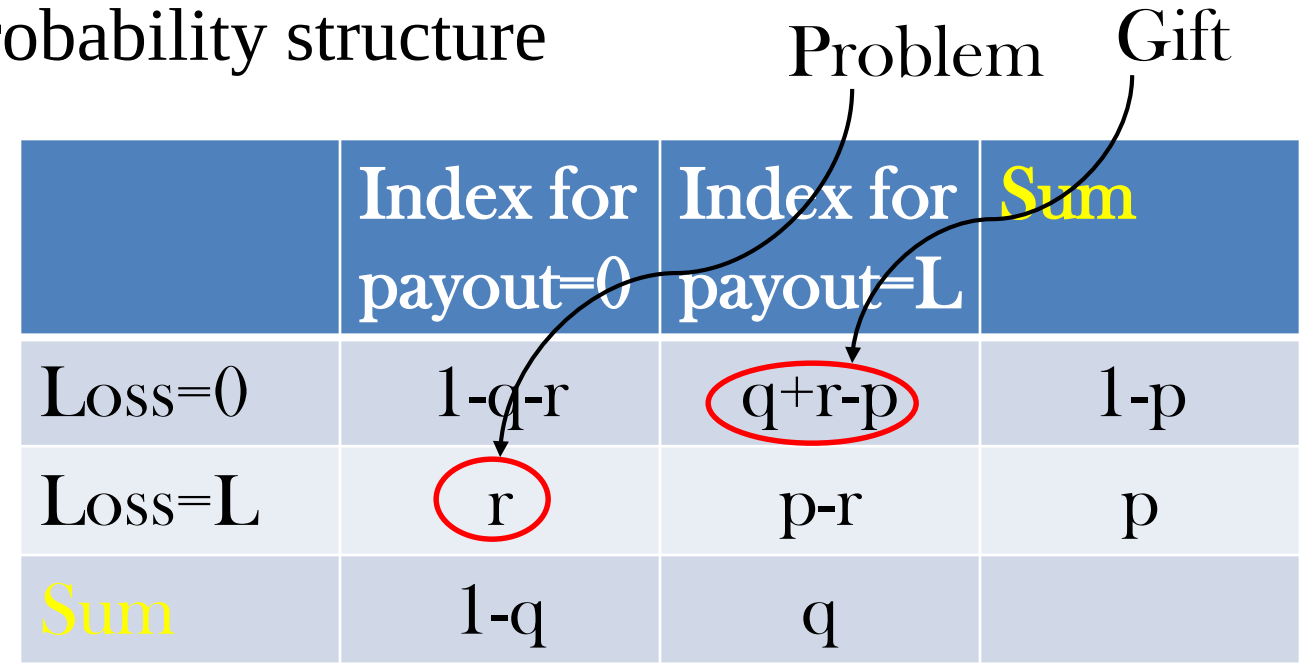


Basis Problems with Insurance

- Indemnification is crude as, for a variety of reasons, those who need it may not get it even if covered. There is what is called basis risk
- Poor uptake of area crop insurance and weather-based insurance. Clark, theoretically, and Vargas Hill and others empirically have studied basis risk effects
- Problem is that can be hit with disease loss and premium cost at same time
- If either very risk averse or very risk vulnerable then that is problematic

Basis Problems with Insurance

- Probability structure



	Index for payout=0	Index for payout=L	Sum
Loss=0	1-q-r	q+r-p	1-p
Loss=L	r	p-r	p
Sum	1-q	q	

- There should be perfect correlation whereby r=0 and p=q. But there is not, i.e., there is basis risk
- Care much about 'problem' box; little about 'gift'
- May see little demand for market insurance unless user is assured it is well-targeted

Thinking Fast

- Kahneman ‘Thinking, Fast & Slow” sees two selves; one lazy, effort-conservating, associative, emotional and heuristic; the other calculating when aroused
- As far as animal health events go there are cognitive issues
  - o can be rare with poorly understood causes
  - o interconnected with behavior of others
  - o may falls into box the ‘heuristic self’ deals with
- Availability bias: ascribe likelihood to events one can think of and so subjective probability declines as one goes further from last comparable event

& Seldom Slow

- Prone to anchoring and most likely anchor is normal year so edit out this risk
- ‘What You See Is All There Is,’ ignoring information not presented to you. When told a story that someone is shy and bookish then assumed to be librarian, not factory worker even though far more of latter
- We like sorting out a simplistic narrative for cause and effect and going with it so that we can function in business
- We are horrible at Bayesian statistics, which is a problem for insurance demand because we can’t take conditional expectations

Bayes' Rule

- Suppose that a farmer sees a signal on disease status as follows

	True state	
Signal	Healthy	Diseased
Good	q	1-q
Bad	1-q	q

- Unconditional probability of being diseased is p and the signal is informative in that $q > 0.5$. Then

$$\Pr(\text{Dis} \mid \text{Bad}) = \frac{pq}{pq + (1-p)(1-q)} > p;$$

Base Rate Adjustment

$$\lim_{p \to 0} \Pr(\text{Dis} \mid \text{Bad}) = 0;$$

$$\lim_{p \to 1} \Pr(\text{Dis} \mid \text{Bad}) = 1;$$

$$\Pr(\text{Dis} \mid \text{Bad}) \mid_{p=0.5} = q.$$

- When base rate p is 0 then all ‘bad’ signals are errors
- When base rate is 1 then no ‘bad’ signals as there is no base ‘healthy’ population to test in error

Base Rate Adjustment

$$\frac{d\,\Pr(\text{Dis}\,|\,\text{Bad})}{dp} = \frac{q(1-q)}{[\,pq+(1-p)(1-q)]^2}$$

$$\frac{d\,\Pr(\text{Dis}\,|\,\text{Bad})}{dp}\Big|_{p=0} = \frac{q}{1-q} > 1;$$

$$\frac{d\,\Pr(\text{Dis}\,|\,\text{Bad})}{dp}\Big|_{p=1} = \frac{1-q}{q} < 1.$$

- As base rate increases, probability of being diseased given bad signal increases. But how it does so is not trivial
- We are not very good at making this adjustment. We generally don't factor base rate into conditional probability updating

Kunreuther et al.

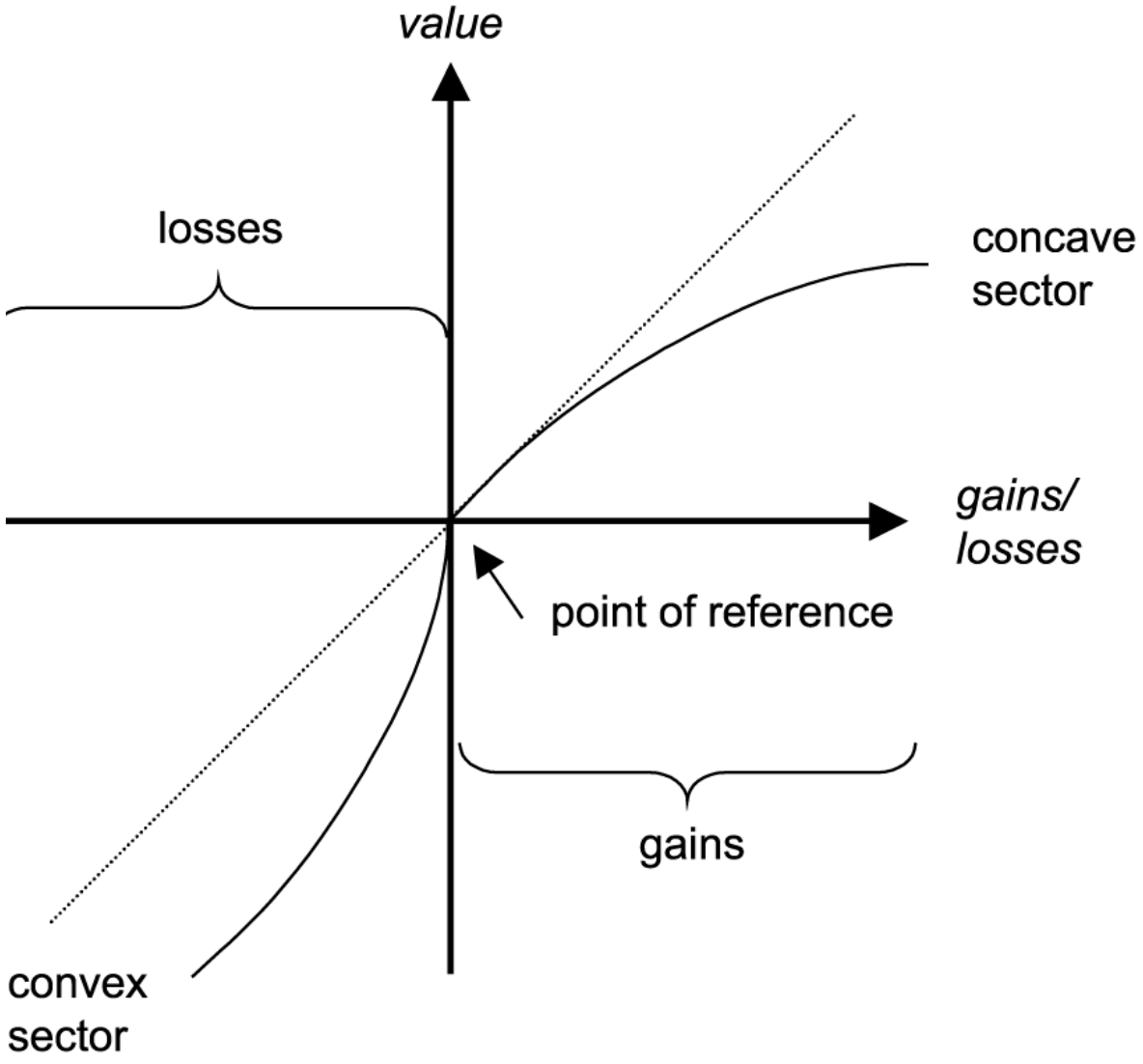
- Kunreuther et al. document the following demand-side insurance anomalies in high income country markets
  - Failure to protect against low-probability, high-consequence events
  - Purchasing insurance after a disaster occurs
  - Cancelling insurance if there has been no loss
  - Preference for low deductibles
  - Status quo bias
  - Preference for insurance on highly salient events such as cancer and death/maimed while flying insurance

Barnes et al. Review

- Little empirical research on infectious animal disease economics. Disease data limited/messy
- In economics literature, some highlighted items are
  - risk of public action crowding out private action, + concern about perverse response to excess payment. Latter is overblown; farmers face uncovered costs and still have 'skin in the game'
  - Condition payments on early reporting?
  - Importance of information and education
  - Scale economies and large-scale farming
  - Bureaucratic nightmare of being flagged as diseased herd can promote biosecurity
  - Insurance schemes operationally problematic
  - Need to think about how neighbors are thinking

Barnes et al. Prospect Theory

- Prospect theory and loss averse behavior suggests problems for insurance as farmers may not demand it. Further, covering losses may deter farmers from aversion to loss



Barnes et al. Sociological Literature

- For disease reporting there is *habituation effect* (complacency over time) + unclear awareness of purpose
- For reporting, Elbers et al. interviewed Dutch pig farmers. Reasons for not reporting include
  - Don't know signs
  - Guilt, shame and fear of prejudice
  - Haven't bought into control measures in place in general and for reporting farms
  - Opaque reporting procedures
  - Distrust in government bodies

Barnes et al. Trust, Transparency and Cooperation

- Trust may be an issue
  - Are neighbours pulling weight?
  - Is government technically competent in design and management?
  - Is program designed for farmers like me or for other (e.g., larger, or more mainstream) farmers?
  - Have viewpoints of people like me been incorporated into program design?
  - Will indemnities be paid?
  - Has government other goals, such as seeking to impose environmental regulations, to tax or to steal?

Barnes et al. Trust

- Trust will be stronger when farmers
  - are better educated and technologically sophisticated,
  - are already embedded in complex production systems such as contracting, and
  - have evidence that schemes are effective
- Trust is a funny thing. If you are thrust into someone else's arms you may learn to trust, at least at a functional level. EU and US have used farm commodity subsidies and environmental payments to leverage cross-compliance on other issues

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Questions