ECO 199 – GAMES OF STRATEGY
Spring Term 2004 – March 23
ADVERSE SELECTION – SCREENING AND SIGNALING

EXAMPLE 1 – FAILURE OF EQUILIBRIUM – Akerlof's Lemons

Private used car market
- Car may be worth anywhere between
  - 0 and 5000 to current owner; equally likely
- 1.5 times that in the hands of the prospective buyer
- But owner knows true value, prosp. buyer does not

Suppose price of car is x
- Then only owners who value it less than x will sell
- Average of that = x / 2
- Average in the hands of the buyer = 1.5 x / 2 = 3 x / 4 < x
  - So no trade – collapse of market?

More general point – in trade, think about other side's motives:
- "Why are they selling? Do they know something I don't?"
- There may be good answers, but don't ignore the question

Need other signaling/screening devices, but most are problematic
1. Anyone can offer to let the buyer test car
2. If seller gets car tested, buyer may not trust
   seller's mechanic, and vice versa
3. Private warrantees hard to enforce; owner may disappear

General point – for successful screening or signaling
need differences in cost of action across types

Examples – [1] Assembling good transcript with tough courses
harder for less-skilled students

[2] Putting up one's own money for a project is less risky
for an innovator who knows his own idea to be good

[3] Accepting less than full insurance is less of a problem
to a driver with a lower risk of accident

EXAMPLE 2 – SCREENING: Air fares

Unrestricted v. restricted tickets as
device for screening by self-selection
Two types of travelers with different willingness to pay

		Unrestr. (U)	Restricted (R)
Cost to airline (per passenger)		150	100
Willingness to pay	Business (B)	700	400
	Tourist (T)	220	200

So profit per passenger

	Unrestricted (U)	Restricted (R)
Business (B)	550	300
Tourist (T)	70	100

So if airline could identify individual customer type
and if it is legal to discriminate between types,
Airline would ideally like to sell to
each B a U seat for (just under) 700
each T an R seat for (just under) 200
Suppose a fraction b of customers are business type
Average profit (Per Potential Customer)
= 550 b + 100 (1-b) = 100 + 450 b

If airline cannot identify the type of each individual passenger
(but knows proportion b of B-types in population)
it can try a screening strategy: offer different fares
designed to reveal types by self-selection:

1. Separation of types by self-selection (Case S)

Consider prices x for U, y for R

Incentive-compatibility constraints (IC) :

Want T to self-select R : $220 - x < 200 - y$, OR $x - y > 20$

Want B to self-select U : $700 - x > 400 - y$, OR $x - y < 300$

Participation or "Individual rationality" constraints

(IR or PC) : $x < 700$, $y < 200$

Average profit $= b\,(x-150) + (1-b)\,(y-100)$

$= (y-100) + b\,(x-y-50)$

To max this, want to make y and (x-y) as large as possible,

subject to the IC and IR/PC constraints

So $y = 200$, $x - y = 300$ and then $x = 500$

Can't raise x to 700: that would require $y > 300$.

Average profit $= b\,(300) + (1-b)\,100 = 100 + 200\,b$

This is less than profit with perfect identification & discrimination

If b is large, airline's reduction in profit is large,

so it may try other fare structures:

2. Pooling of types – various possibilities

Label	Fare	Customers served	Price	Profit margin	Average profit
UA	U	All	220	70	70
UB	U	B only	700	550	550 b
RA	R	All	200	100	100
RB	R	B only	400	300	300 b

Compare profits: Regardless of b, S > RA > UA, and S > RB

This leaves S (separation) and UB (high price, only B served)

UB is better if $100 + 200\,b < 550\,b$, or $b > 2/7$. 0.29

In other situations, comparisons may work out differently
In reality airlines compete using different fare structures –
    cream-skimming or mass-market approaches
Or one airline may switch over time as conditions change
    Can have “cycling” of strategies and no equilibrium

General results –
Profit from best self-selection scheme (100 + 200 b or 550 b)
    < Profit from perfect price discrimination (100 + 450 b)
This is cost of information asymmetry borne by firm
    In separation case, offsetting benefit for business travelers
    In other case there is no offsetting benefit

EXAMPLE 3 (Ch. 9, Exer. 6) – JOB MARKET SIGNALING

Economy has two types of jobs, Good and Bad
Two types of workers, Qualified and Unqualified
In the population, 60% of workers are Qualified
Each worker produces: In Bad jobs, 10 regardless of type
    In Good jobs, 100 for Qualified, 0 for Unqualified
Workers must be hired and paid before output is known
Competition between firms ensures that
    wage = expected output of worker
Workers can signal being Qualified by becoming educated
Education here has no productivity-raising value at all,
    only a signaling role. But the two can coexist.
Cost of n units of education (time, effort, perhaps also money)
    Qualified: $0.5 n^2$ Unqualified n^2

To achieve separation, the incentive compatibility conditions are:
    Qualified workers: $100 - 0.5 n^2 > 10$, so $n^2 < 180$, or n # 13
    Unqualified workers: $10 > 100 - n^2$, or $n^2 > 90$, or n $ 10
Note possibility of multiple equilibria with signaling,
    each can be sustained by its own expectations

Even if the best (least cost) among these is somehow chosen,
the qualified get income of 100 but incur cost
$0.5(10^2) = 50$ for education, so net payoff = 100 - 50 = 50.
The unqualified get payoff of 10
If very few Unqualified workers, then all the Qualified ones
incur heavy cost to credibly prove (signal) their quality
Might it be better for everyone to ban this rat race?
If the signal is not available, then
every worker is treated like a random draw from the population
The expected output on a good job is: 0.6 (100) + 0.4 (0) = 60
On a bad job, the expected output is 10.
Therefore, good jobs will offer 60 and everyone will take them
Bad jobs will go unfilled
We have pooling of worker types, and here
both sides fare better when the signal is unavailable
More generally, if Qualified types are fraction Q of population,
then expected output on good job = 100 Q + 0 (1-Q) = 100 Q
So Qualified types prefer to have the signal available if Q < 0.5
(But Unqualified types are made worse off)

But if signal is available, then it is in the interests of
any one Qualified worker to use it:
Suppose initially everyone is being treated alike,
hired on a good job, and paid 60
One Qualified worker can get n of education,
approach a few employers and say:
"no one who is Unqualified would do this, so
recognize me to be Qualified and pay me 100
Need $100 - 0.5\ n^2 > 60$, $60 > 100 - n^2$, so n = 7 or 8 will do
Thus pooling cannot be an equilibrium under competition –
cream-skimming will upset it
Of course as more and more Qualified workers try this,
the pooling employers' pool of workers will worsen
Those jobs will pay < 50, and then higher n needed to separate
Eventually converge to separating equilibrium (n = 10 to 13)

SUMMARY OF SIGNALING AND SCREENING

1. Cheap talk works only if players' payoffs well aligned
   Else need costly action to Infer information (type)
   Cost of action must differ across types to get separation

3. "Bad" types have incentives to mimic "good" types
   So separation requires excessive costly action
   This is a negative spillover from bad types to good

4. Signaling – action is initiated by informed player
   Screening – action is taken by informed player at the
   initiation of the less-informed player

5. "No news is bad news" principle of signaling
   If signal of good type is known to be available
   and you don't send that signal
   then others will assume you are bad type
   Example – PDFing a course in your major

POLICY ISSUES

1. Market may fail completely or partially
   No equilibrium (competitive screening) or
   multiple equilibria (signaling)
   Role for government to remedy market failure. But
   facing the same information problem + political constraints
   government may implement bad or expensive policy

2. Bad outcomes possible:
   pooling may be better but separating may result
   because of cream-skimming competition
   Government can avoid this by restricting competition