Selection Markets

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Oxford, 2nd Year MPhil IO, updated: February 6, 2015

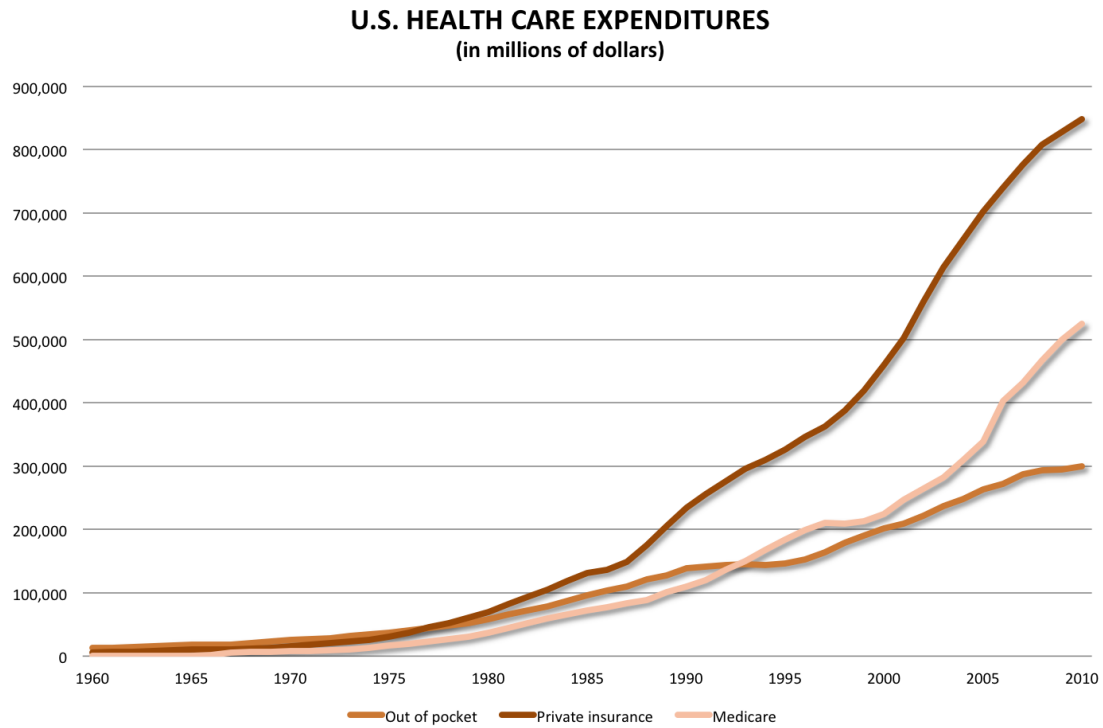
Outline

What are selection markets?

- Players have heterogeneous and non-contractible "values"
  - some consumers have elastic demand, others inelastic
  - only car salesmen know the quality of their cars (Akerlof (1970))
  - some insurance buyers are exercise, some don't
  - health insurers are often not allowed to price pre-existing conditions
  - social networks cannot directly target the most popular consumers
- Demand and cost are closely linked
  - often the costliest consumers have higher demand (adverse selection)
  - firms must treat in the same way heterogeneous individuals

Health

- We will focus on health provision and health insurance
  - tools and lessons generalize to other markets
- A 3 trillion dollar issue:



Lots of controversy

Print Close

Death spiral? Short-term health plans grow as cheap alternative to ObamaCare

By Maxim Lott

Published October 29, 2014 | FoxNews.com

A fast-growing, short-term alternative to ObamaCare that allows customers to get cheap, one-year policies could put the government-subsidized plan into a death spiral.

The plans, the only ones allowed for sale outside of ObamaCare exchanges, generally cost less than half of what similar ObamaCare policies cost, and are increasing in popularity as uninsured Americans grapple with the requirements of the Affordable Care Act. The catch -- that the policies only last for a year -- is not much of a deterrent, given that customers can sign up for ObamaCare during open-enrollment periods if their short-term coverage is not renewed.

"Applications rose 30 percent compared to last year," eHealthInsurance.com Enrollment Specialist Carrie McLean told FoxNews.com.

Lots of controversy

Print Close

'Repeal every word': Potential GOP 2016 rivals hammer ObamaCare, IRS at Iowa summit

By Barnini Chakraborty

Published January 25, 2015 | FoxNews.com

DES MOINES, Iowa – Conservative heavyweights joined with up-and-comers in hammering President Obama Saturday over everything from the health care law to his immigration policies as they played to a sold-out Iowa crowd in what amounted to the opening bell of the Republican presidential campaign.

They spoke at the Iowa Freedom Summit in Des Moines, held in the first-in-the-nation caucus state at a time when big-name Republicans are getting close to announcing whether they'll seek the presidency.

While nobody at the summit has definitively declared a 2016 bid, nearly a dozen of the summit's speakers are flirting with one. Testing their message on the conservative Iowa crowd, they took a hard line in their prescriptions for the country.

"The most important tax reform we can do is abolish the IRS," Texas Sen. Ted Cruz told the fired-up audience.

Lots of controversy

Daily Intelligencer / THE NATIONAL INTEREST

4 New Studies Show Obamacare Is Working Incredibly Well

By **Jonathan Chait** Follow @jonathanchait

Photo: Linda Davidson/The Washington Post

A week ago, Sen. Charles Schumer said his party made a political mistake by passing the Affordable Care Act rather than some unspecified economic measure. Put aside the dubious political logic (in reality, Congress's appetite for additional stimulus had been completely exhausted with the passage of the original version). Also put aside the brutally cold moral logic (that politicians should prioritize keeping power over enacting

Outline

WTP

- This derivation is in the Appendix of Veiga and Weyl (2014)
- Utility $U(w, \theta)$
  - final wealth w
  - U increasing concave
  - vector θ: risk, risk aversion, initial wealth, cognitive ability
- Consumers face a verifiable wealth shock $l \in \mathbb{R}$ with density $g(l, \theta) > 0$
- Insurer pays $G(l, x)$ if loss is l
  - x parameterizes the generosity of insurance
  - $G \equiv l$ is full insurance
  - $G \equiv 0$ is no insurance
  - $G < 0$ or $G > l$ would give perverse incentives if l was not verifiable
- No moral hazard: $g(l, \theta)$ independent of x
  - important issue, not the focus of these lectures :(
- Initial wealth w_0

WTP

- WTP for x the level of price $p = WPT(x, \theta)$ that equates expected utility with and without insurance:

$$\mathbb{E}_I \left[U \left(w_0 - I + G(I, x) - WPT(x, \theta), \theta \right) \mid \theta \right] = \mathbb{E}_I \left[U \left(w_0 - I, \theta \right) \mid \theta \right].$$

- Differentiating with respect to x yields

$$\mathbb{E}_I \left[U' \frac{\partial G}{\partial x} \mid \theta \right] - \mathbb{E}_I \left[U' \mid \theta \right] \frac{\partial WPT}{\partial x} = 0$$

$$\underbrace{\frac{\partial WPT}{\partial x}}_{\text{marginal WTP}} = \underbrace{\mathbb{E}_I \left[\frac{\partial G}{\partial x} \mid \theta \right]}_{\text{expected marginal cost}} + \underbrace{\frac{Cov_I \left[U', \frac{\partial G}{\partial x} \mid \theta \right]}{\mathbb{E}_I \left[U' \mid \theta \right]}}_{\text{marginal risk premium}}$$

- x is insurance if $Cov \left[U', \frac{\partial G}{\partial x} \mid \theta \right] > 0$: G larger when U' larger
- Insurance=redistribution (but across states, not people)
  - behind the veil of ignorance, states=people

Some useful specifications

- CARA preferences: $U(c) = -e^{-ac}$
  - a is the CARA parameter
- Gaussian wealth shocks $I \sim \mathcal{N}(\mu, \sigma^2)$
- Coinsurance: insurers absorbs a share $x \in (0, 1)$ of the shock
- $\Rightarrow$ mean-variance preferences: WTP is

$$WPT = \underbrace{x\mu}_{\text{expected cost}} + \underbrace{\frac{1}{2}\left(1 - (1-x)^2\right) a\sigma^2}_{\text{risk premium}}$$

- Also common, CRRA: $U(c) = \frac{c^{1-\gamma}}{1-\gamma}$
  - especially in empirical work

Outline

Motivation

- Takes Akerlof (1970)
  - Intuitive graphical illustration
  - generalization to advantageous selection
  - allows intuitive quantifying of distortions from selection (more about this in Howard Smith's lectures)
  - (simpler exposition in Einav and Finkelstein (2011))

Firms

- Symmetric insurers
- Perfectly competitive
  - free entry, zero profit
- Risk-neutral
- Big assumption: 1 fixed insurance contract
  - for instance: covers x% of medical bills, deductible is £x
  - fixed quality
  - firms compete in prices
- Later we will look at endogeneous quality (Rothschild and Stiglitz (1976); Veiga and Weyl (2014))
- Costs = expected payment to each individual

Individuals

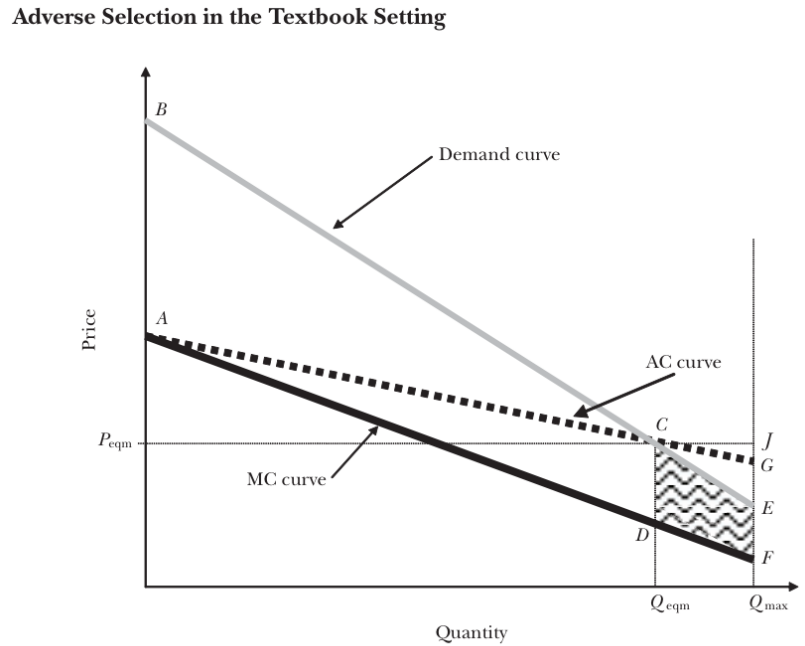
- Mass 1
- Binary choice: choose whether or not to purchase insurance
- Expected cost, which we will call MC, is privately known
- WTP increasing in MC
  - WTP = MC + risk premium

Outline

Textbook Setting

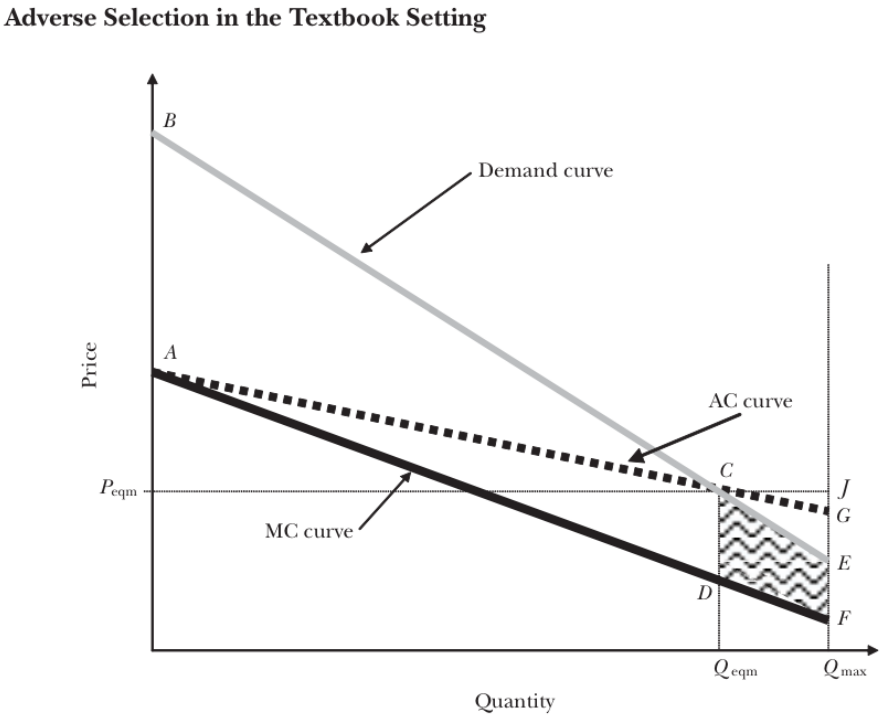
- Heterogeneous privately-known probability of loss
- Homogeneous in everything else, like risk aversion
- No other frictions
  - administrative
  - claim-processing
  - no moral hazard

Textbook Setting: Graphical Analysis



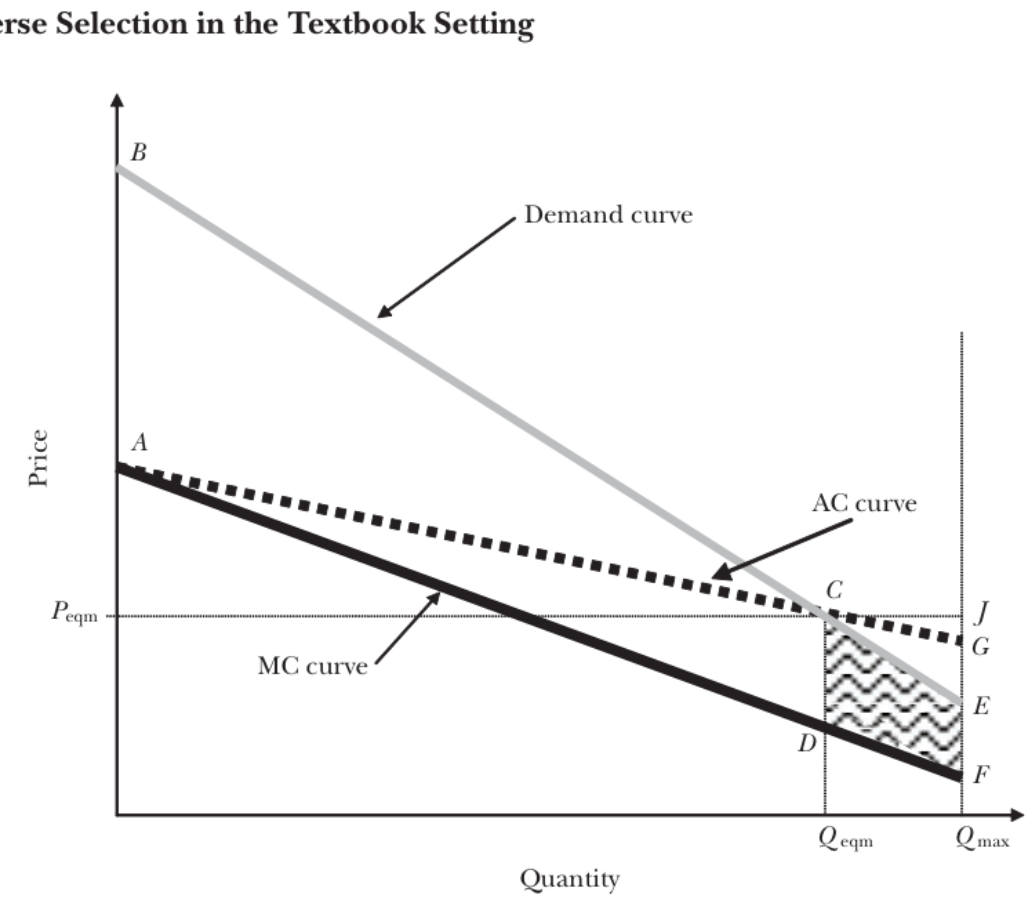
- (Inverse) demand $WTP(Q) = Q^{th}$ quantile of WTP
- $MC(Q)$ is expected loss of consumers in Q^{th} quantile of WTP
  - notice link between demand and cost
  - risk aversion+no frictions⇒WTP>MC (WTP=MC+risk premium)
  - $P(Q = 1) > MC(1) > 0$
- $AC(Q)$ average cost among those with WTP>$WTP(Q)$
  - $MC(0) = AC(0)$= cost of most eager individual

Adverse Selection = decreasing MC



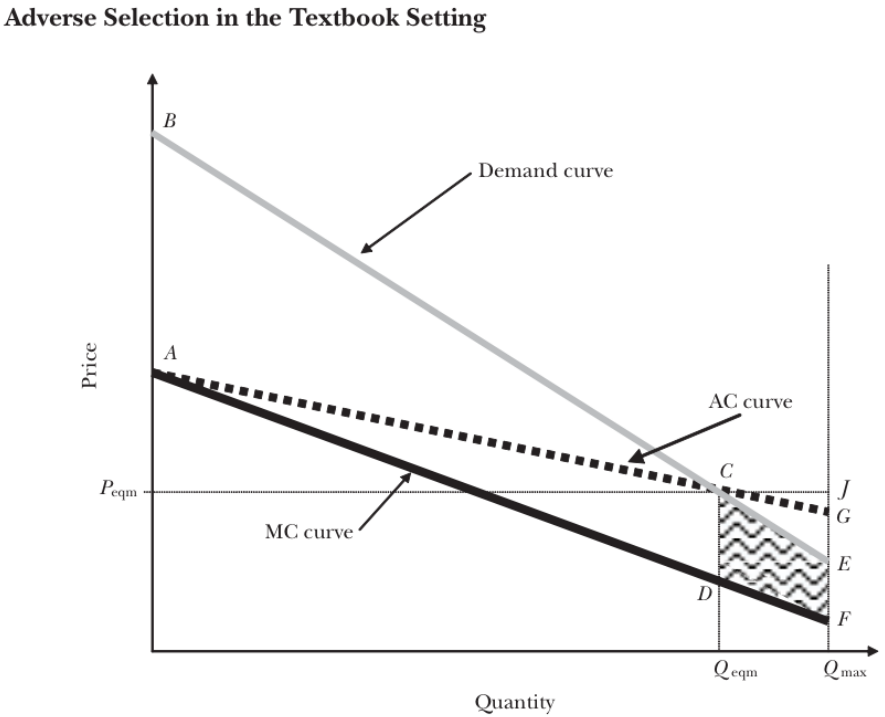
- $MC\,(Q)$ = expected loss of individuals in Q^{th} percentile of WTP
  - WTP = MC + risk premium
  - heterogeneity only in cost
  - high WTP $\Leftrightarrow$ high MC
  - $\Rightarrow$ MC downward sloping
  - AC $>$ MC

Equilibrium



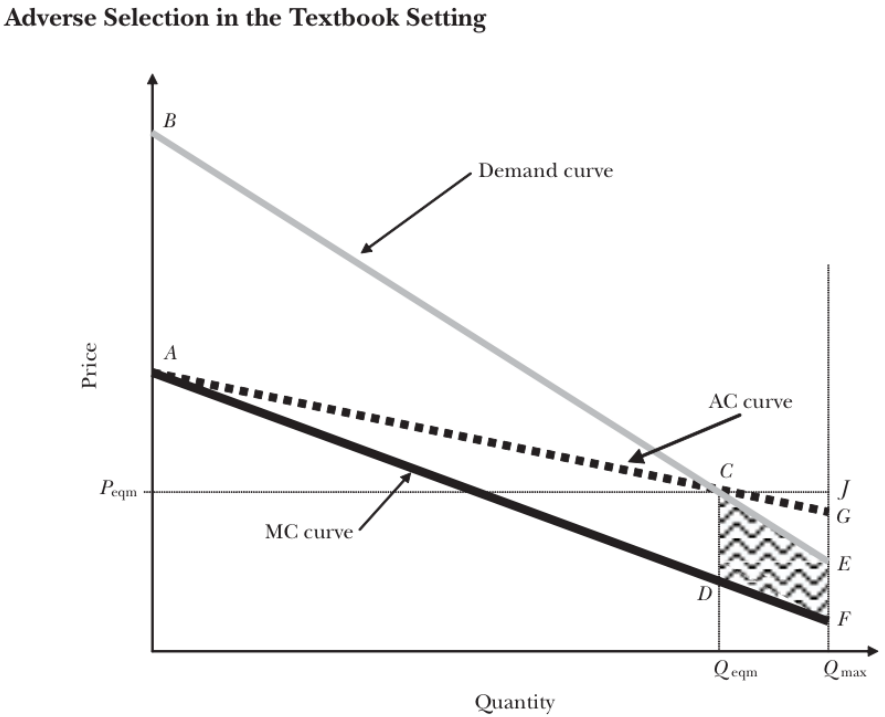
- Symmetric equilibrium
- Free entry $\Rightarrow$ profit $= Q(P - AC) = 0 \Rightarrow$ P = AC

Optimum



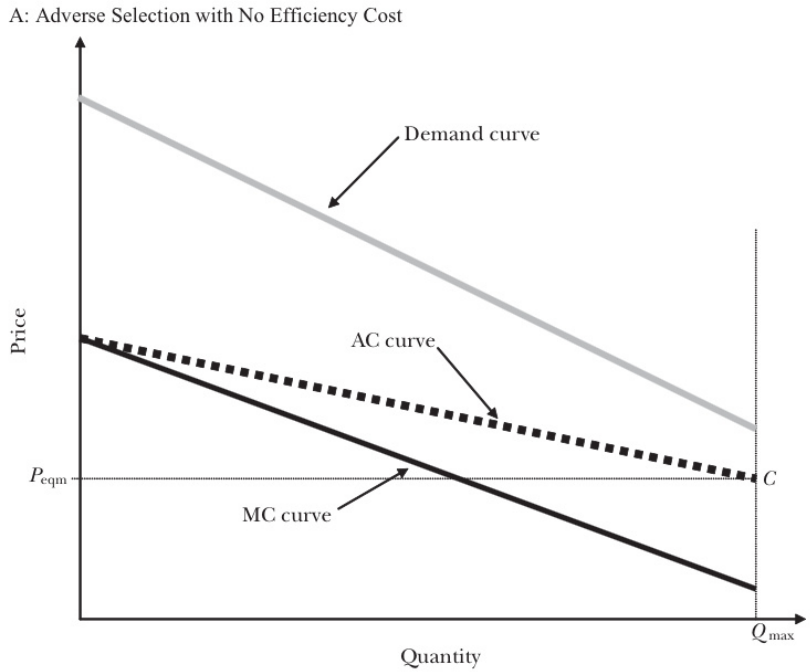
- Risk aversion + no other frictions$\Rightarrow$ $WTP - MC > 0$
- Optimum: $P = MC$ and $Q^\star = 1$
  - shift everyone's risk to the risk-neutral insurer

Welfare loss



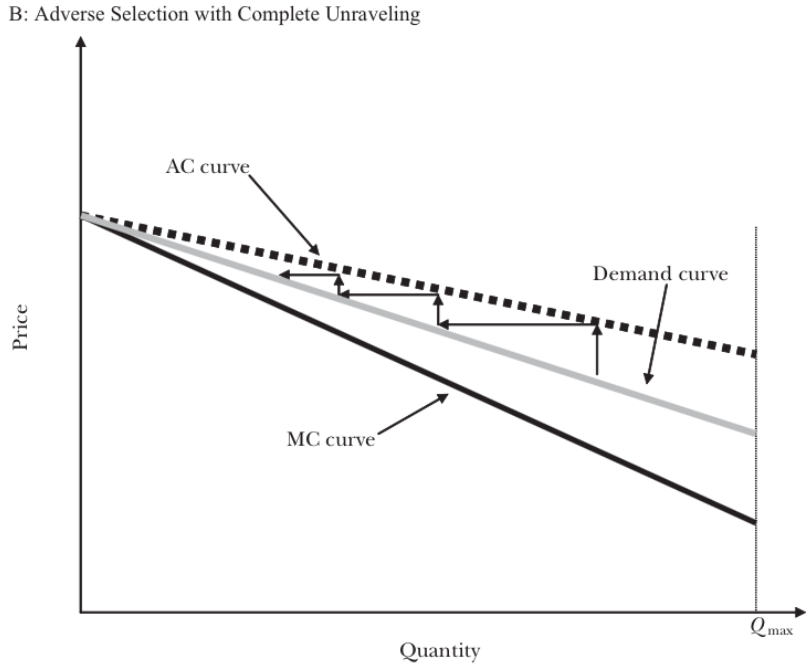
- Adverse Selection $\Rightarrow$ AC $>$ MC$\Rightarrow$ P is too high $\Rightarrow$ under-insurance
- The $1 - Q^{\star}$ individuals with lowest expected costs remain uninsured
  - they have C<WTP<AC=P
  - Adverse selection $\Rightarrow$ firms cannot insure these individuals & break even
  - welfare loss $= \int_{\{uncovered\}} (WTP - MC)$
  - negative externality from infra-marginals to marginals

Welfare loss can be small



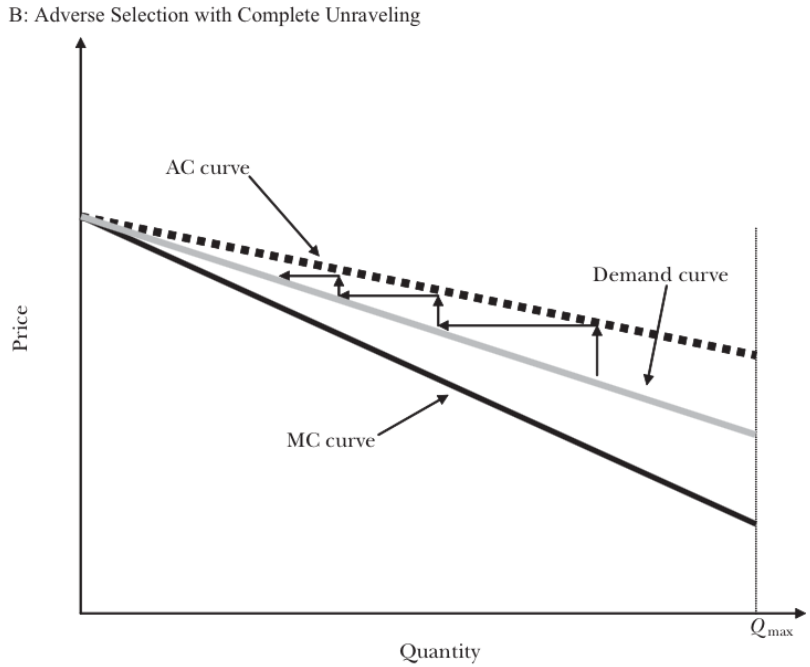
- Adverse selection & no welfare loss. For instance:
  - MC decreasing, equilibrium is P=AC>MC
  - But AC<WTP always, so $Q^\star = 1$
- When could this happen?
  - low heterogeneity in risk (MC and AC relatively flat)
  - high risk aversion (WTP >> MC)

Welfare loss can be large



- There can be complete market shutdown:
  - MC decreasing, but AC> WTP>MC
- When can this happen?
  - greatest have sure loss $\Rightarrow$ zero risk premium $\Rightarrow$ WTP=MC
- Massive welfare loss, as emphasized by Akerlof (1970)

Death Spiral

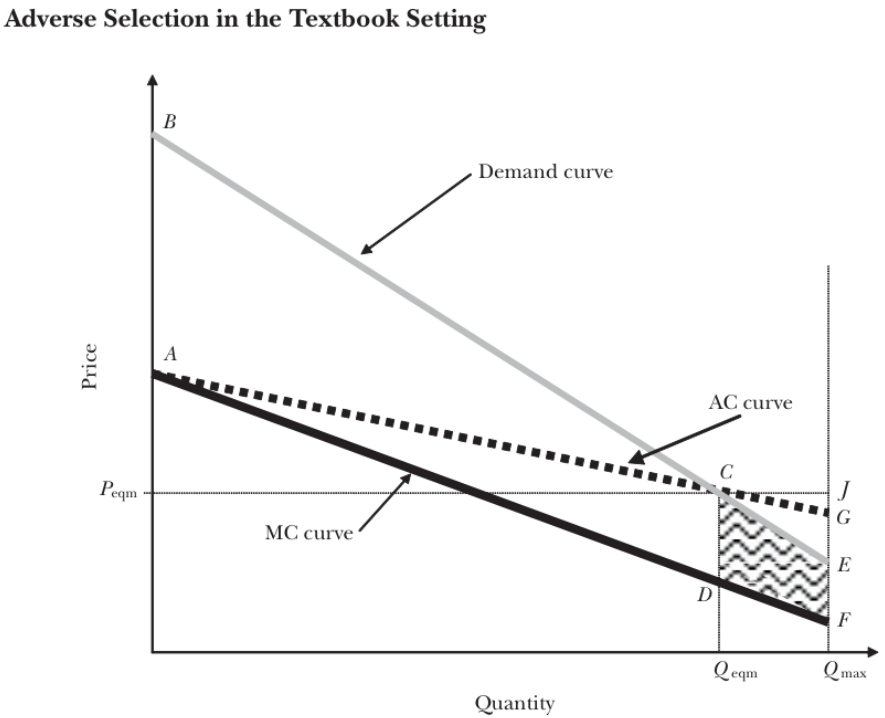


- Insurance prices often adjust dynamically
  - first set prices according to some estimate
  - dynamically adjust price to reflect AC from the previous period
  - can result if market collapse
- Described empirically by Cutler and Reber (1998) for health insurance of Harvard employees

Regulation?

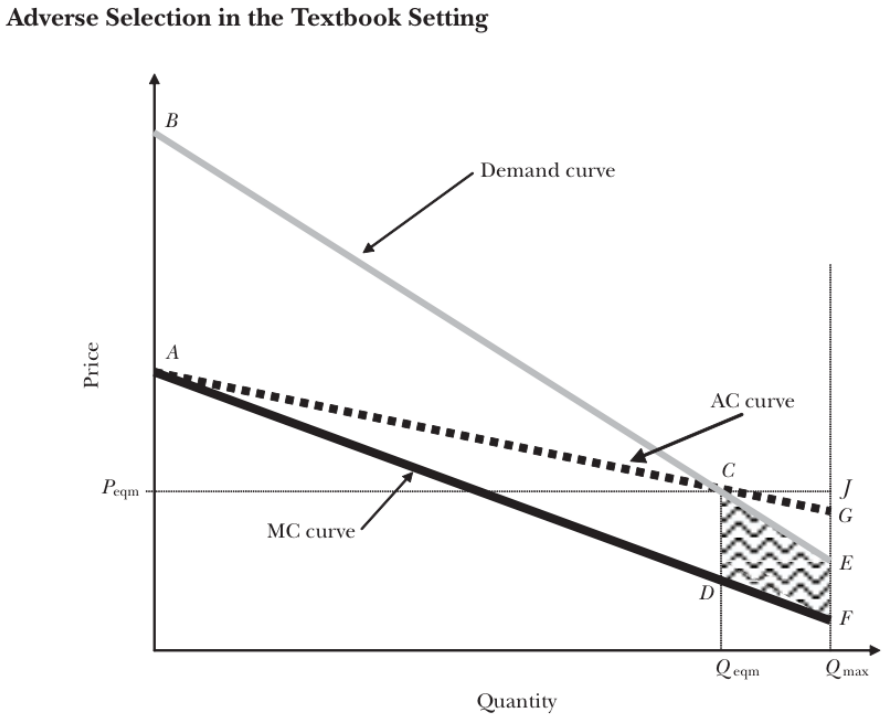
- Common forms of regulating health insurance markets
  - mandate
  - subsidies
  - community rating
  - risk adjustment

Regulation in the Textbook Case: mandate



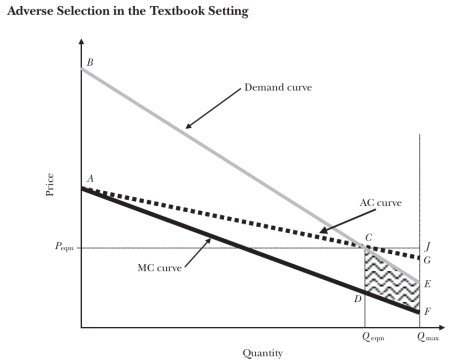
- Everyone must purchase insurance
  - like the Affordable Care Act (ACA) in the US
  - produces efficient outcome
- Welfare benefit can vary: depends on the extent of market failure ex ante

Regulation in the Textbook Case: subsidies



- Subsidize insurance purchase with lump sum transfer
  - also happens under the ACA for some people
  - shifts demand out
  - higher equilibrium quantity, less under-insurance, higher welfare
  - a large enough subsidy produces efficiency (Q=1)

Regulation in the Textbook Case: community rating



- What characteristics can firms price discriminate?
  - age, geography, gender, race, height, pre-existing conditions?
  - creates several markets
- What are the cost and demand curves in each resulting market?
  - perfect price discrimination $\Rightarrow$ all MC curves flat $\Rightarrow$ efficiency
  - Imperfect discrimination $\Rightarrow$ resulting setup can be better or worse than pooled market
    - more about this in Levin (2001)

Outline

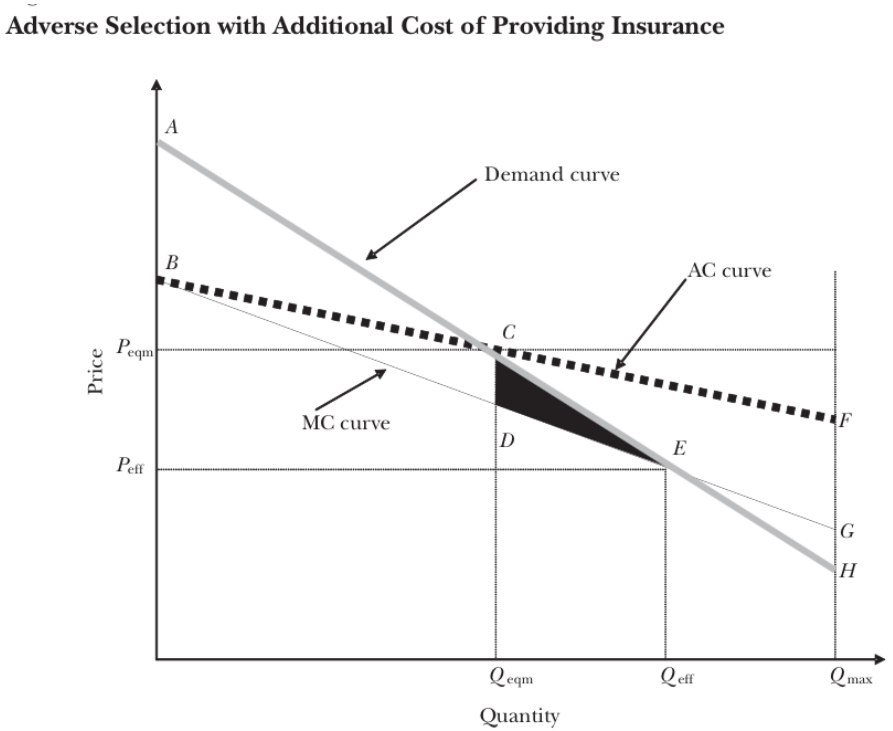
Departing from Textbook Setting

- So far we assumed:
  - private information only about risk
  - optimum is $Q = 1 \Rightarrow$ there is never over-insurance
  - mandatory insurance produces efficiency
- A little more realism challenges these results: we add
  - administrative costs of providing insurance ("loads")
  - richer preference heterogeneity (in risk aversion)

Loading factor

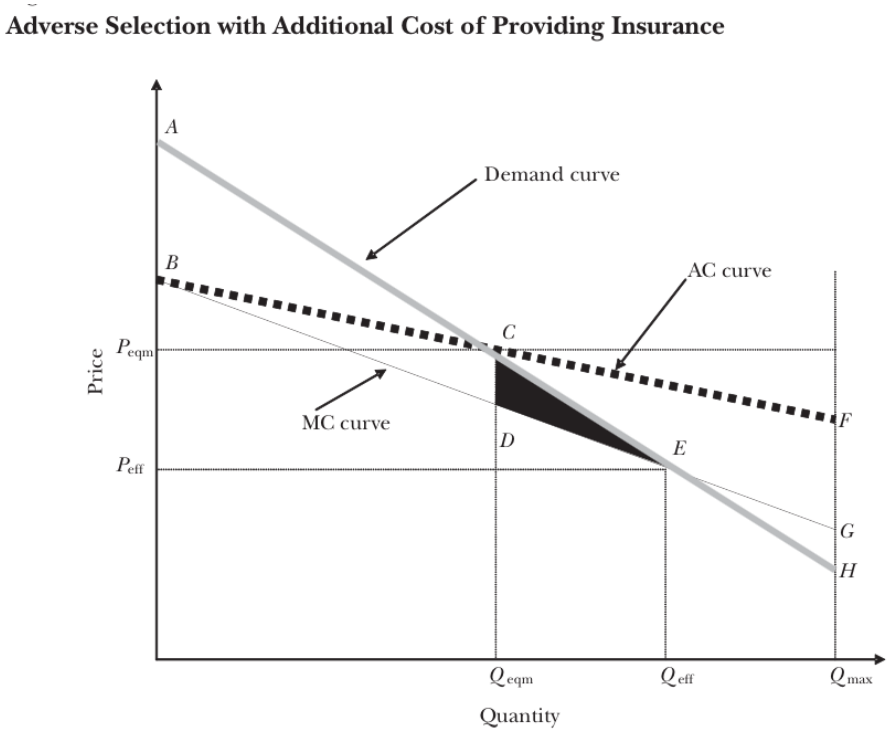
- Loading sources
  - administrative cost,
  - advertising and marketing
  - verifying and processing claims
- Implies an upward shift in MC and AC
- $Q = 1$ is not necessarily efficient
  - individuals are still risk averse
  - cost of providing insurance might be larger than WTP
    - WTP=MC+risk premium
    - total cost = MC + load
  - might be optimal to leave some individuals uninsured

Loading Factor



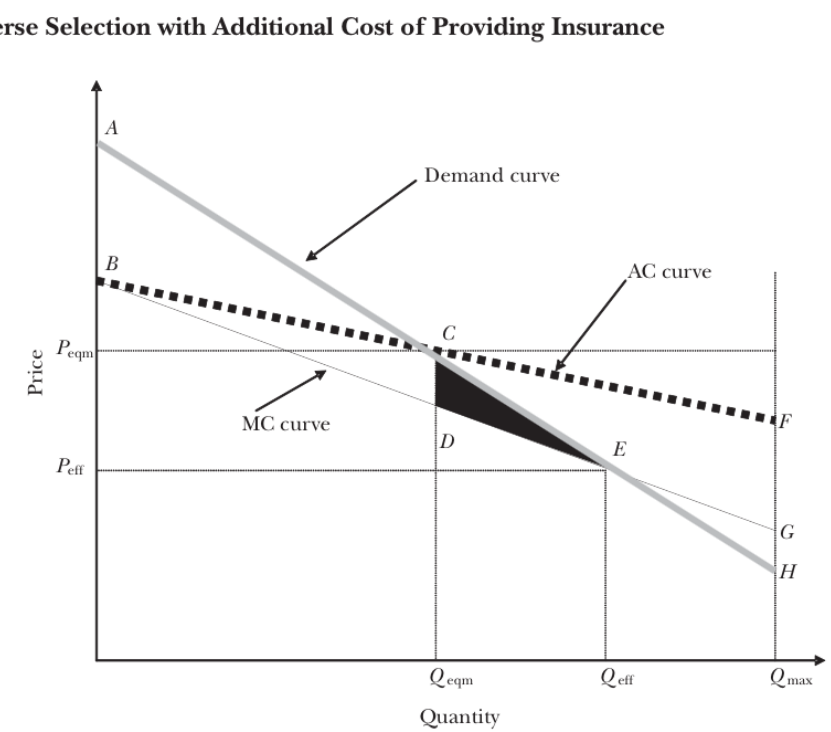
- MC crosses demand at Q<1
  - this intersection is the optimal allocation (P=MC)
  - on the left, WTP >MC; on the right, WTP < MC
  - equilibrium is still P=AC

Loading Factor & Welfare



- equilibrium P=AC; optimum P=MC
- decreasing MC $\Rightarrow$ under-insurance ($Q^{\star} < Q^{eff}$) as before
- How should we regulate?

Loading Factor & Welfare: mandate

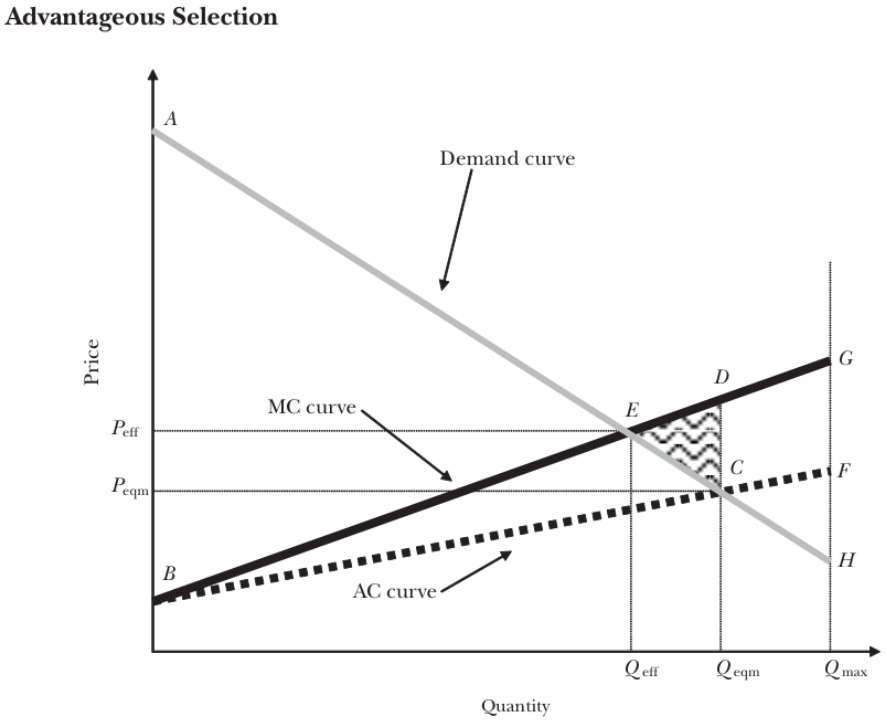


- Mandate no longer produces efficiency
  - Mandate can produce excessive insurance
  - fixes the welfare loss of under-insurance
  - can produce over-insurance by covering those with WTP<MC $\Rightarrow$ new welfare loss
  - final effect depends on the sizes of the two welfare losses
- What would happen with a subsidy?

Richer Types

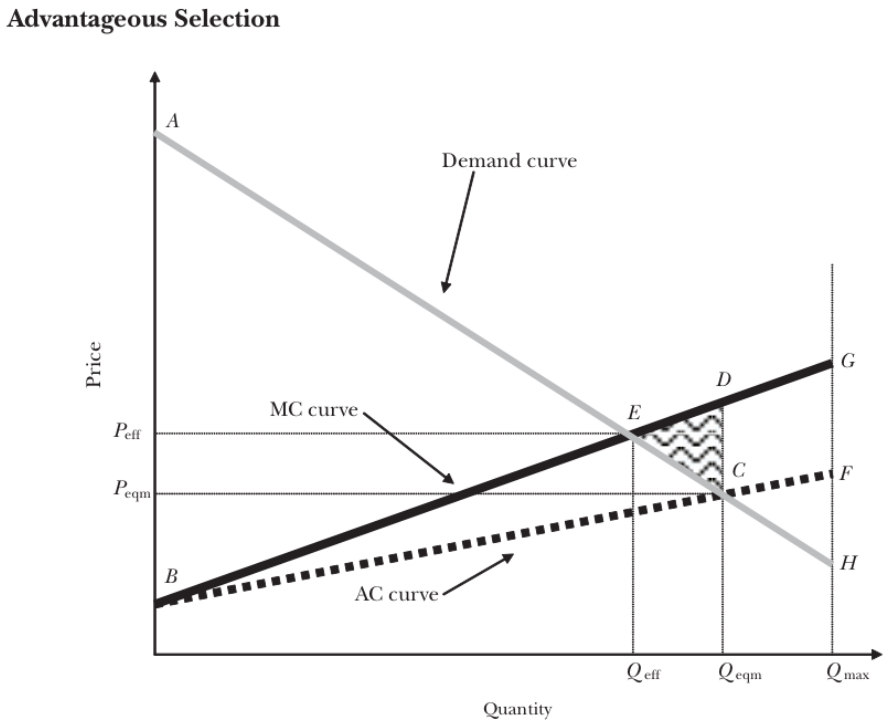
- So far we have assumed heterogeneity only in expected costs
- Empirical work has documented substantial preference heterogeneity as well
  - Finkelstein and McGarry (2006) (risk aversion)
  - Fang, Keane and Silverman (2008) (many, especially cognitive ability)
- Consider risk aversion:
  - WTP is increasing in risk and risk aversion
  - risk increases costs, but risk aversion does not
  - the most profitable consumers have low risk, high risk aversion
  - This opens the possibility of advantageous selection

Advantageous Selection



- Advantageous selection:
  - negative correlation between risk and risk aversion
  - low risk individuals have high risk aversion $\Rightarrow$ high WTP despite low risk
- We will look more at this correlation in Veiga and Weyl (2014)

Advantageous Selection = increasing MC

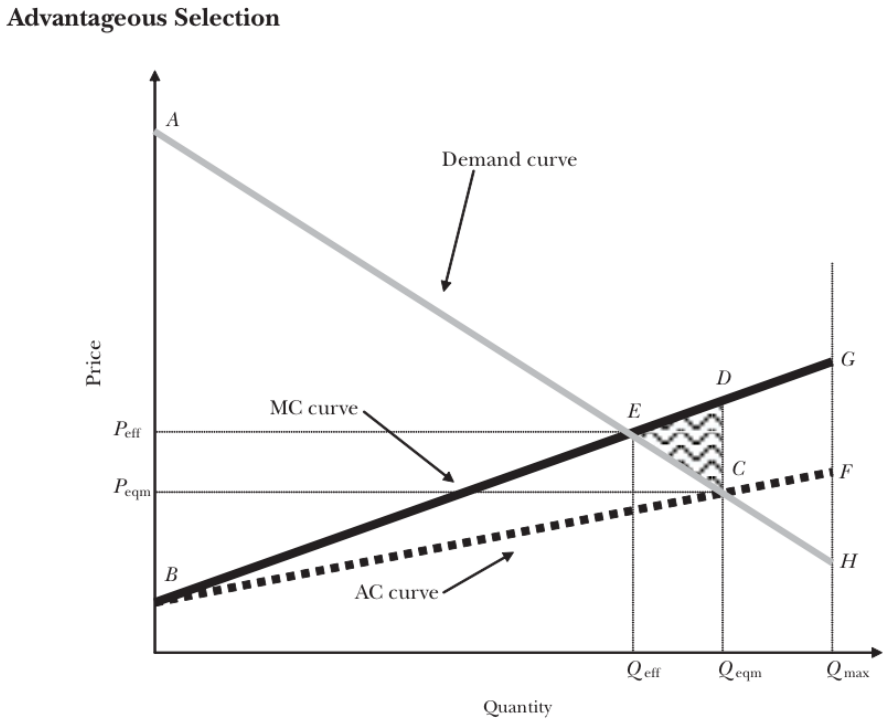


- Advantageous selection corresponds to increasing MC
  - marginal individual has higher MC than infra-marginals
  - AC<MC

Advantageous Selection + no loads: Welfare

- no loads + advantageous selection $\Rightarrow$ efficiency
  - we still have WTP=MC + risk premium
  - no loads $\Rightarrow$ MC<WTP
  - so equilibrium is P=AC<MC<WTP
  - market is covered
- The possible problem with advantageous selection:
  - infra-marginals are cheap $\Rightarrow$ firms make a profit on them
  - perfect competition pushes firms to dissipate these profits
  - firms serve marginal users with low WTP relative to cost
  - with loads, there might be excessive insurance

Advantageous Selection + loads: Welfare



- insurance loads + advantageous selection $\Rightarrow$ excessive insurance
  - the $Q^{\star} - Q^{eff}$ individuals are inefficiently covered in equilibrium
  - competition for profitable infra-marginals pushes firms to cover marginal high cost marginal consumers
- De Meza and Webb (1987): advantageous selection$\Rightarrow$ over-investment
  - more on this in Mahoney and Weyl (2013)

Advantageous selection & regulation

- Opposite solutions of those used with adverse selection
  - tax existing insurance policies
  - outlaw insurance coverage
- Of course, there is a chance of overshooting and ending up with too little insurance

Outline

Motivation

- So far: perfect competition
- Evidence of market power in health insurance
  - Starc (2014); Dafny (2010); Dafny, Duggan and Ramanarayanan (2012)
- What's the interaction of selection & market power?
- Given market power, do we want reduce selection?
  - should employers risk-adjust?
- Given selection, do we want to reduce market power?
  - should insurers merge?
  - should banks merge?

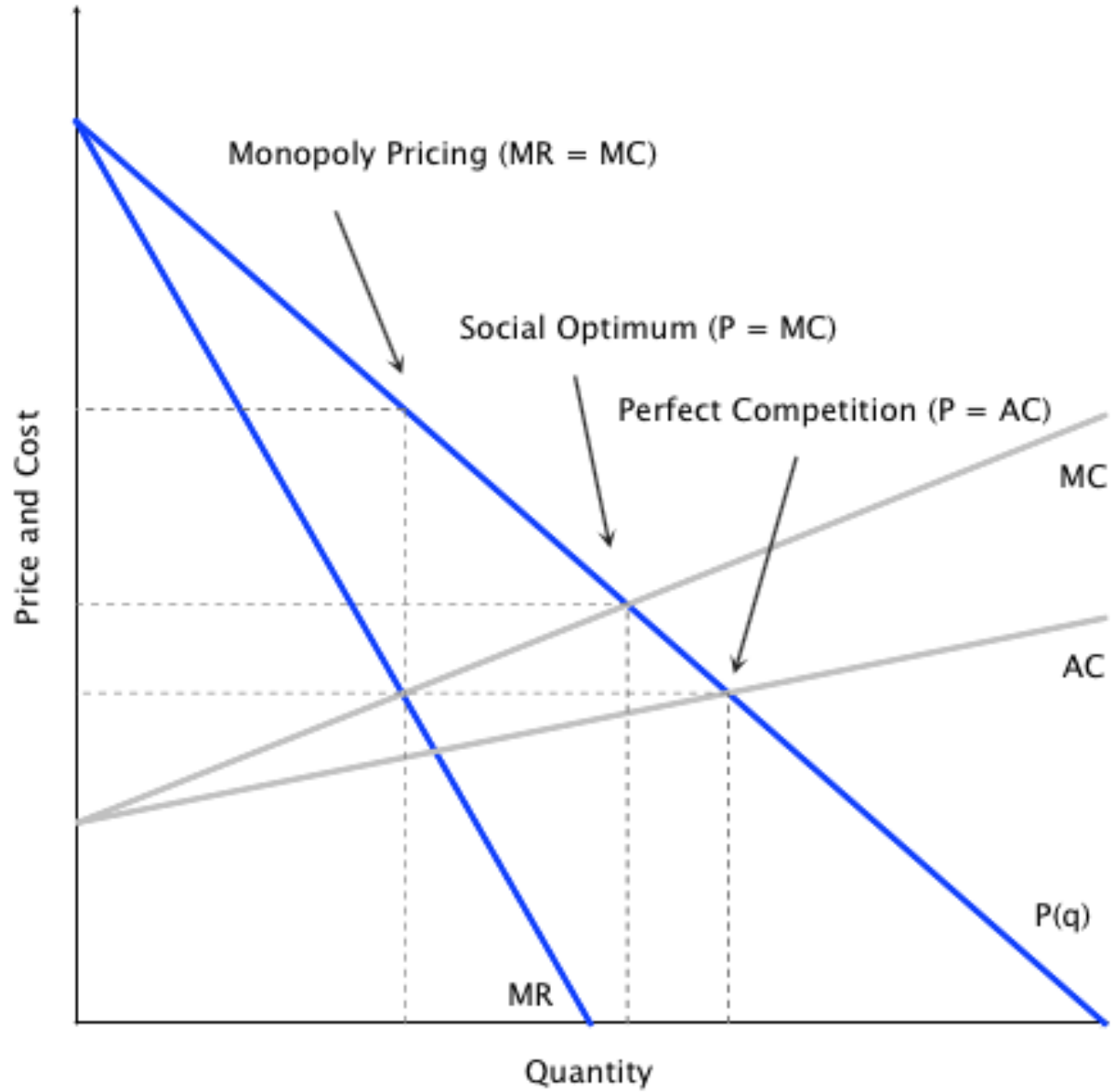
Basic Setup

- Imperfect competition in prices
  - quality is fixed
- Symmetric firms
  - health insurance (probable adverse selection)
  - auto loans (probable advantageous selection)
- $q \in [0, 1]$ consumers buy
- Inverse demand $P(q)$
- Marginal cost $MC(q)$
  - expected cost of consumer with q^{th} quantile of WTP
- Average cost $AC(q)$
  - average cost of consumers with WTP greater than q^{th} quantile
  - population average cost $AC(1)$ is a market primitive
- Selection is
  - adverse: $MC'(q) < 0$
  - advantageous: $MC'(q) > 0$

Pricing

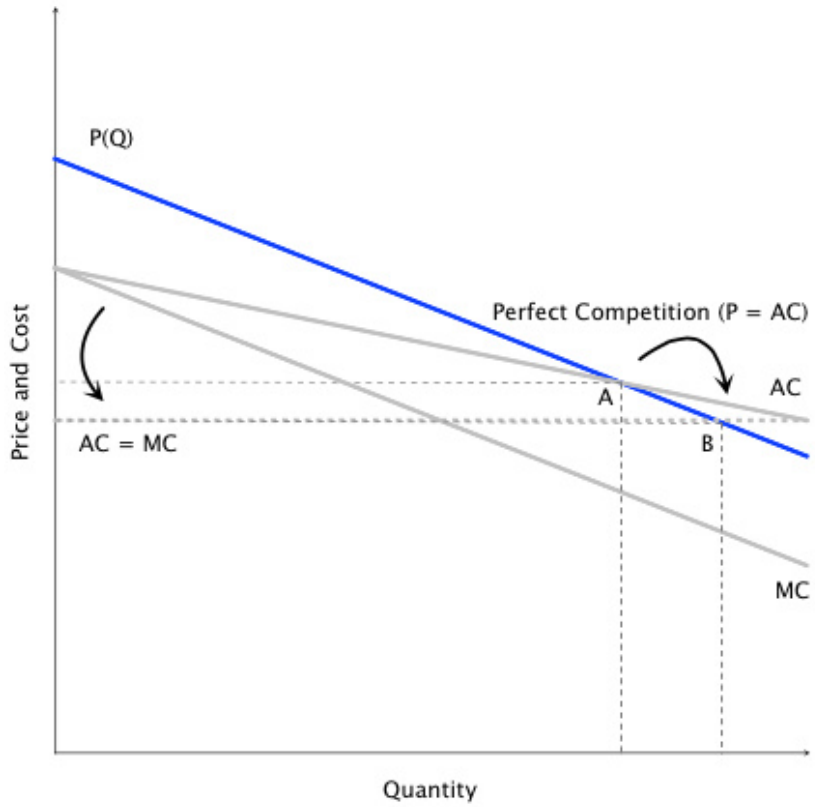
- Optimum:
$$P(q) = MC(q)$$
- Competitive:
$$P(q) = AC(q)$$
- Einav, Finkelstein and Cullen (2010): competitive price can be too high or too low
- Monopolist:
$$P(q) = MC(q) + MS(q)$$

Example of Pricing (advantageous selection)



Changing selection: cost rotations

- Less selection: AC(q) approaches $AC\,(1)$ at every q
  - makes everyone more similar to market average
- Adverse selection: AC rotates counter-clockwise



- Advantageous selection: AC rotates clockwise

Outline

Parameterizing market power: θ

- Conduct parameter $\theta \in (0, 1)$ captures market power
  - following Bresnahan (1989); Weyl and Fabinger (2013) (discussed last term in Howard Smith's class)

$$P = \theta \underbrace{(MC + MS)}_{\text{monopoly pricing}} + (1 - \theta) \underbrace{AC}_{\text{competitive pricing}}$$

- Accommodates several modes of competition
  - symmetric Cournot with n firms has $\theta = \frac{1}{n}$
  - symmetrically differentiated Bertrand
- Requires symmetry assumptions (see Weyl and Fabinger (2013))
  - symmetric distribution of types, symmetrically differentiated firms, switching margin representative of buyers

Parameterizing selection: σ

- Selection = AC, MC non-constant
- Less selection = AC, MC flatter and closer to $AC(1)$
- $\sigma = 0$ is zero selection; $\sigma = 1$ is full selection
  - $1 - \sigma$ captures the amount of risk adjustment in a market
  - σ multiplies the correlation between cost and WTP
- Firm's percieved costs become:

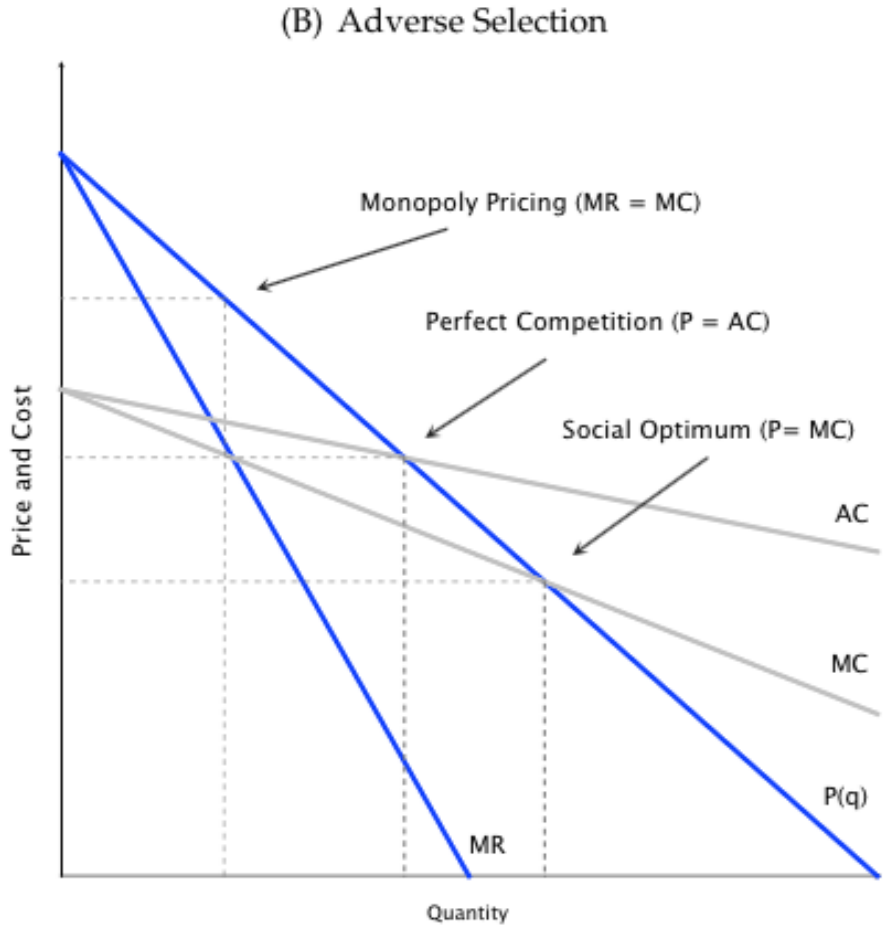
$$\text{average cost} = \sigma AC(q) + (1 - \sigma) AC(1)$$

$$\text{marginal cost} = \sigma MC(q) + (1 - \sigma) AC(1)$$

- Applies to both types of seleciton
- Requires symmetry: firms obtain a representative sample of buyers at equilibrium and in any deviation
- Results hold if: $\sigma \to 0$ means AC(q), MC(q)$\to AC(1)$ at every q

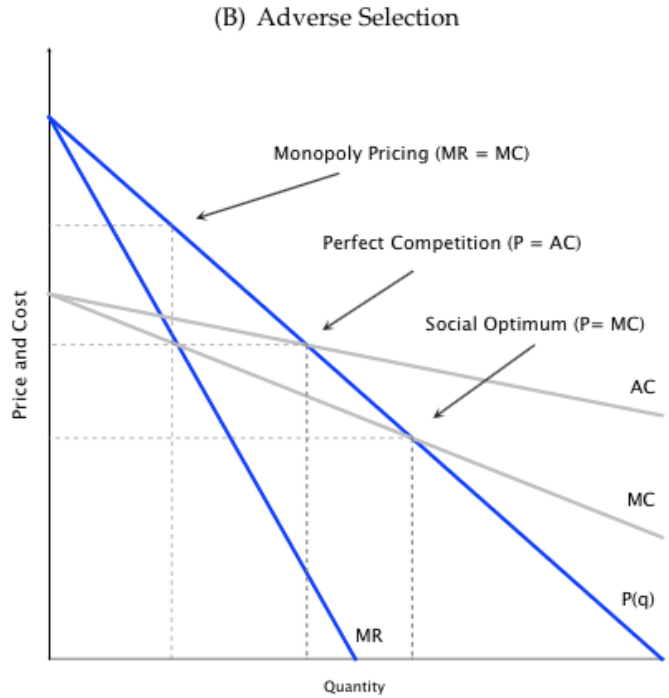
Outline

Optimal market power with adverse selection



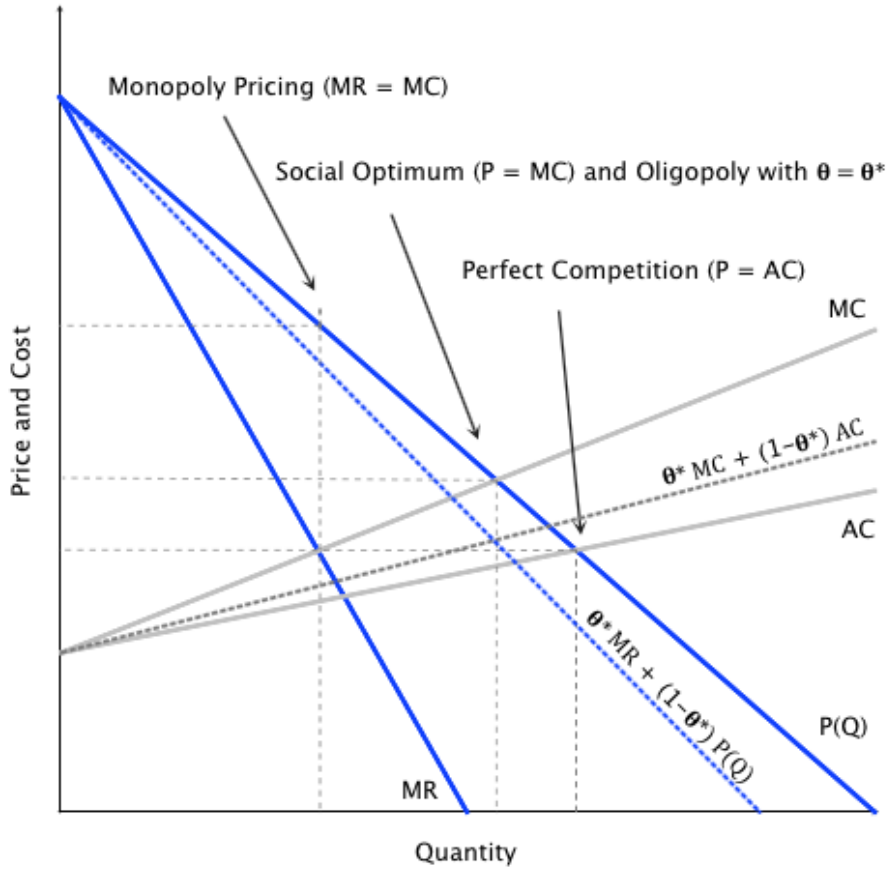
- Adverse selection (MC decreasing)
- Market power increases profit & decreases consumer surplus
  - same results as without selection
  - requires stability condition: $0 > AC' > P'$

Optimal market power with adverse selection



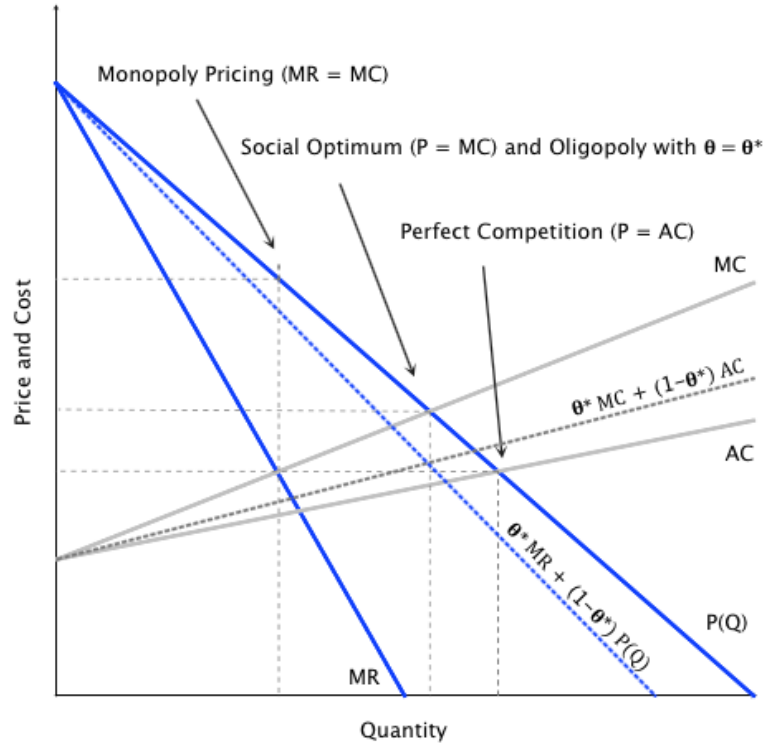
- Market power decreases welfare:
  - adverse selection + perfect competition $\Rightarrow$ under-provision of insurance
  - market power further reduces provision
- Market power cannot restore a collapsed market
  - not true in models with endogenous quality (Rothschild and Stiglitz (1976); Veiga and Weyl (2014))
- With adverse selection, market power is undesireable (as usual)

Optimal market power with advantageous selection



- Welfare is inverse-U-shaped in market power:
  - optimum is P=MC
  - monopoly $\Rightarrow$ under-provision (P=MC+MS)
  - perfect competition (+ loads) $\Rightarrow$ over-provision
  - there is an optimal θ between monopoly and perfect competition

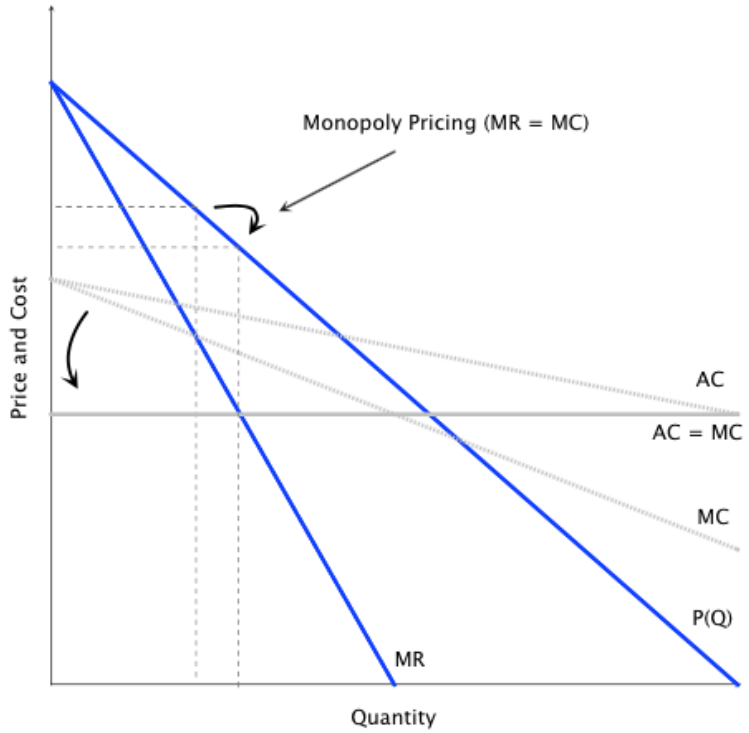
Optimal market power with advantageous selection



- Optimal θ increasing in degree of advantageous selection (σ)
  - excess production due to advantageous selection is increasing in σ
  - market power offsets this incentive
  - market power required to restore efficient q increases with σ

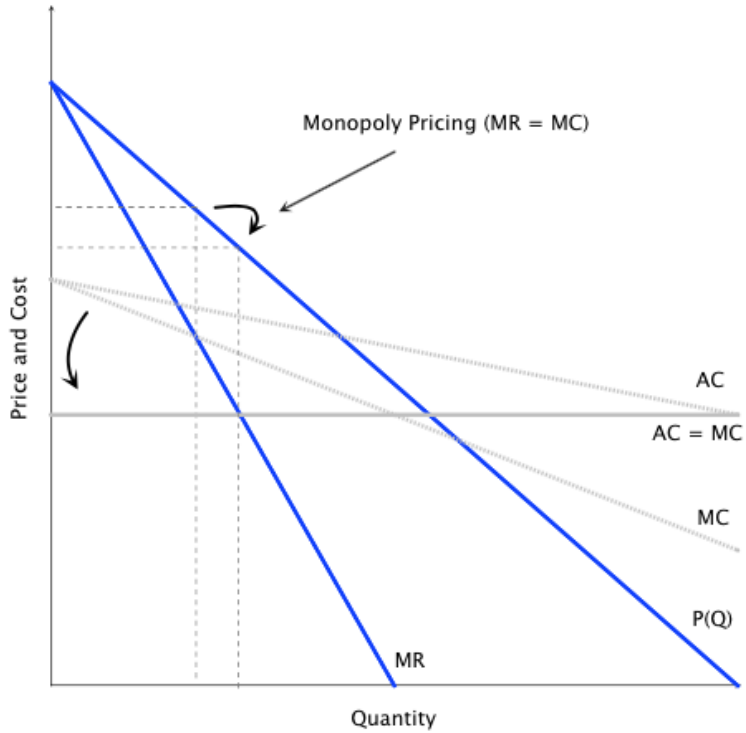
Outline

Reducing adverse selection under monopoly



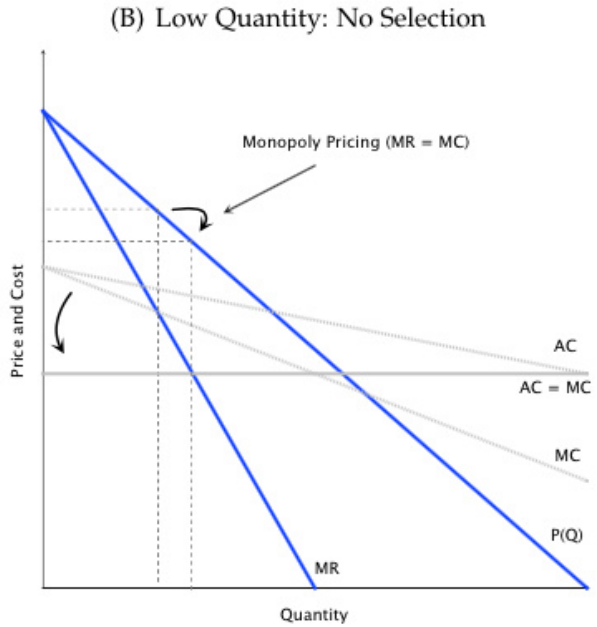
- Monopoly
- Reducing σ = less selection = counter-clockwise rotation of AC
- Corresponding shift in MC:
  - MC gets flater $MC(1) \to AC(1)$
  - always $MC(0) = AC(0)$
  - $\sigma = 0 \Rightarrow$ no selection $\Rightarrow$ AC(q)=MC(1)=AC(1)

Reducing adverse selection under monopoly



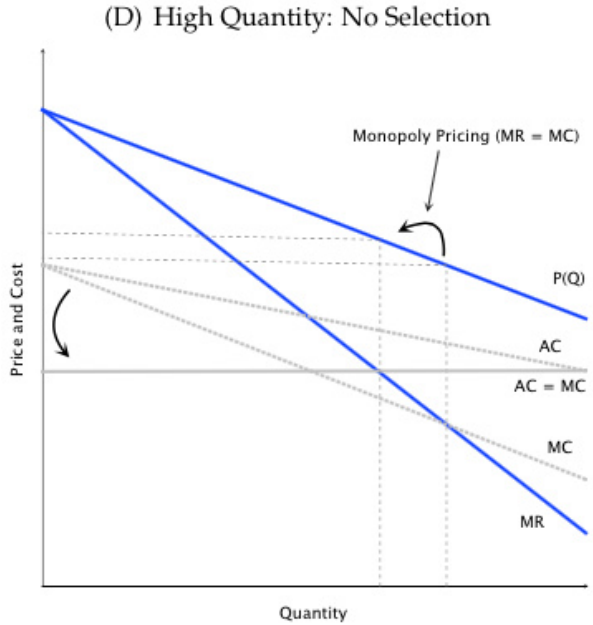
- Reducing adverse selection raises profits
  - envelope theorem: monopoly's optimal quantity is fixed
  - infra-marginals more costly than marginals
  - reducing selection$\Rightarrow$ lowers infra-marginal costs $\Rightarrow$ higher profit
- Effect on consumer surplus depends on q

Reducing adverse selection under monopoly - low q



- Equilibrium quantity low
  - MC decreasing: q low means $AC(1) < MC(q)$
  - market is working poorly
- Reducing selection (σ):
  - low $q \Rightarrow$ lowers MC
  - monopoly's price determined by MC $\Rightarrow$ lowers price
  - might reduce under-provision

Reducing adverse selection under monopoly - high q

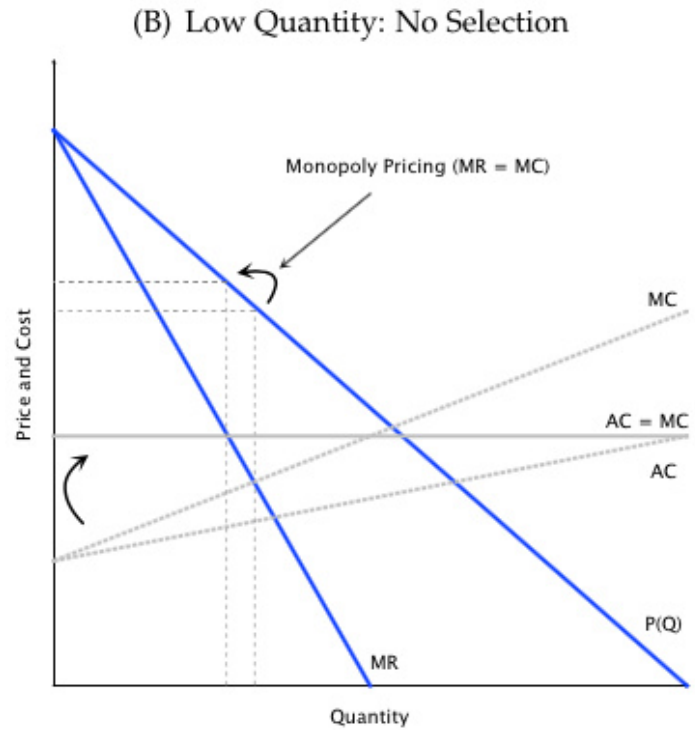


- Equilibrium quantity high: $AC(1) > MC(q)$
- high q + reducing selection $\Rightarrow$ raises MC $\Rightarrow$raises price
- Reducing adverse selection can even lower welfare if q is very high
  - buyers are nearly representative of the entire population
  - less selection $\Rightarrow$ large increase in MC $\Rightarrow$ large reduction in CS
  - less selection $\Rightarrow$ small change in AC $\Rightarrow$ small increase in profit
  - (requires regularity conditions on the demand)

Reducing advantageous selection under monopoly

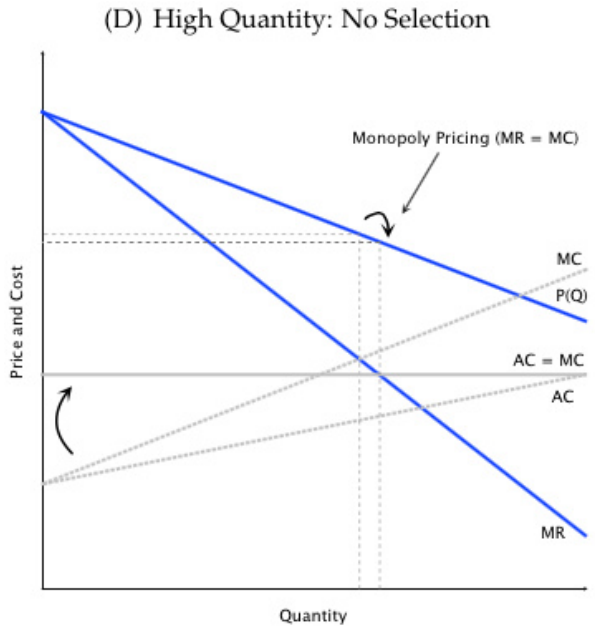
- Reducing advantageous selection: clockwise rotation of AC
- Lowers monopoly profit
  - envelope theorem: optimal quantity fixed
  - reducing $\sigma \Rightarrow$ higher average cost$\Rightarrow$ lower profits
- Effect on CS is ambiguous: depends on q

Reducing advantageous selection under monopoly - low q



- Advantageous selection: low quantity means $MC\,(q) < AC\,(1)$
  - reducing selection $\Rightarrow$ increasing MC(q) $\Rightarrow$ price increases
  - might reduce over-provision

Reducing advantageous selection under monopoly - high q



- Advantageous selection: high quantity means $MC\,(q) > AC\,(1)$
  - reducing selection $\Rightarrow$ decrease MC(q) $\Rightarrow$ lower price

Optimal selection under monopoly

- Reducing selection
  - lowers the correlation between cost and WTP
  - makes AC and MC flat at AC(1)
- Monopolist internalizes the costs of the marginal consumer: P=MC+MS
- Effect of selection on P determined by its effect on MC
- Adverse selection: MC decreasing
  - low q $\Rightarrow$ MC(q)>AC(1) $\Rightarrow$ MC decreases $\Rightarrow$ price decreases
  - high q $\Rightarrow$ MC(q)<AC(1) $\Rightarrow$ MC increases $\Rightarrow$ price increases
- Advantageous selection: MC increasing
  - low q $\Rightarrow$ MC(q)<AC(1) $\Rightarrow$ MC increases $\Rightarrow$ price increases
  - high q $\Rightarrow$ MC(q)>AC(1) $\Rightarrow$ MC decreases $\Rightarrow$ price decreases

Optimal selection under competition

- Perfect competition $\Rightarrow$ zero profit $\Rightarrow$ P=AC
  - only consumer surplus matters
- Adverse selection: MC, AC decreasing
  - AC(q) > AC(1)
  - reducing selection $\Rightarrow$ lower AC(q) $\Rightarrow$ lowers prices
  - higher CS, higher welfare
- Advantageous selection: MC, AC increasing
  - AC(q)<AC(1)
  - reducing selection $\Rightarrow$ higher AC(q) $\Rightarrow$ higher prices
  - lower CS, lower welfare
  - with pure risk adjustment, welfare increases here. However, only changing σ affects the underlying market so total surplus possible decreases.

Summary

1. Adverse selection: under-supply
   - 1.1 market power worsens this problem
2. Advantageous selection: excessive supply
   - 2.1 market power is beneficial while it offsets this incentive
   - 2.2 monopoly still under-provides
   - 2.3 welfare is inverse-U-shaped in market power
3. Increasing adverse selection may increase welfare by offsetting market power
   - 3.1 if q low enough
4. Increasing advantageous selection may increase welfare by offsetting market power
   - 4.1 if q is very high

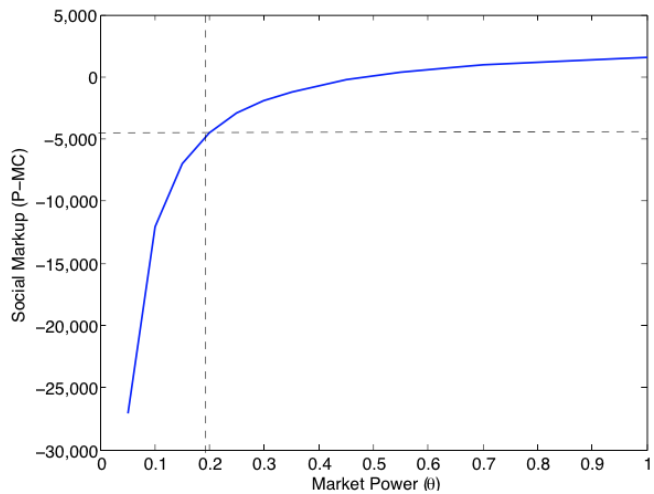
Outline

Risk Adjustment in Health Insurance

- Employers may choose risk-adjustment
  - recommended by Cutler and Reber (1998), assuming perfect competition
  - adverse selection (MC decreasing) + market power
- Risk adjustment:
  - MC low at equilibrium $\Rightarrow$ downward pressure on prices
    - firms compete for marginal "young invincibles"
  - Risk adjustment $\Rightarrow$ increases MC(q) $\Rightarrow$ higher prices
- If there was perfect competition?
  - P=AC(q)>AC(1)
  - risk adjustment: lowers AC(q)$\Rightarrow$ lower prices $\Rightarrow$ higher welfare
- Calibration:
  - distr. of market power: Dafny, Duggan and Ramanarayanan (2012)
  - coverage rates from the EHBS
  - in many markets: risk adjustment would reduce welfare

Advantageous selection in consumer lending

- Pre-crisis: very generous loan terms even to subprime borrowers
  - firms compete for infra-marginal good risks
  - end up serving marginal bad risks
- A monopoly would internalize these "cream-skimming" externalities
  - AC and MC are upward-slopping $\Rightarrow$ credit is oversupplied
  - monopolist (P=MC+markup) under-supplies credit
  - optimal level of market power is somewhere in between
- Calibration to Einav, Jenkins and Levin (2012):
  - strong advantageous selection
  - distortion P $-$ MC: negative $\theta < \frac{1}{2}$ (symmetric Cournot duopoly) $\Rightarrow$ low competition seems desirable



Outline

Motivation

- Until now, insurance quality was fixed
- In fact, firms choose combinations of price and quality
  - what is the optimal insurance quality?
  - what is the equilibrium?
- This paper will covered in a very simplified and brief way
  - you have seen it/will see it more in Advanced Micro

Consumers

- CARA utility
- Gaussian wealth shocks with mean μ
- $x \in [0, 1]$ is % of loss covered (= quality)
- WTP is:

$$u = \underbrace{x\mu}_{\text{mean risk}} + \underbrace{\gamma(x)\, v}_{\text{risk premium}}$$

- Rothschild and Stiglitz (1976): general utility, 2 states of world
- $v = a\sigma^2$: a is CARA parameter, σ^2 variance of shocks
- $\gamma(x)\, v = \frac{1}{2}\left(1 - (1-x)^2\right) v$ = risk premim = social surplus = $\gamma(x)\, v$
  - increasing concave and maximized at full insurance ($x = 1$)
- no moral hazard
- Covered market (everyone purchases)

Firms

- Symmetric
- Risk neutral
- Choose quality: x
- $c = x\mu$ is cost to insurer
- Perfect competition $\Rightarrow p = x\mu$

Homogeneous market

- Everyone had the same μ
  - no private information
- Price of coverage is $P(x) = x\mu$
- Individuals choose x at competitive price
- WTP is

$$argmax_x \left[x\mu + \gamma(x)\, v - P(x)\right] = argmax_x \gamma(x)$$

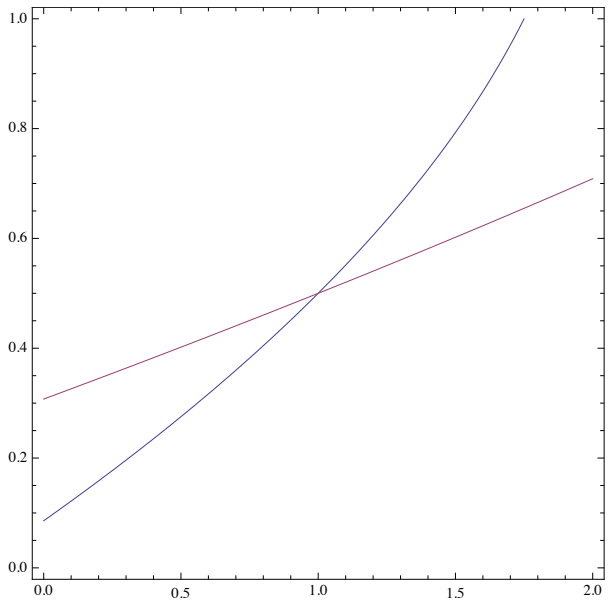
- Individuals fully insure: $x = 1$
  - everyone pays $p = \mu$

Heterogeneous market - first best

- Observable heterogeneity: $\mu_l < \mu_h$
- Pricing can be made conditional on type
  - effectively there are two different markets
  - each market homogeneous
  - revert back to previous case:
    - full insurance: $x_h = x_l = 1$
    - $p_h = \mu_h > p_l = \mu_l$

Heterogeneous market - No pooling equilibrium

- Now μ is private information
- No pooling equilibrium! (1 contracted accepted by both types)
- Price would have to be $p = x\mathbb{E}[\mu]$
- Graph: indifference curves at a candidate pooling eql ($\hat{x} = \frac{1}{2}, \hat{p} = 1$)
  - $v = 1, \mu_h = 4 > \mu_l = 1$; $x \in [0, 1]$ on vertical axis



- Red is μ_h: willing to pay more for an increase in x
- local deviation ($p < \hat{p}, x < \hat{x}$) between the curves attracts μ_l types
  - $\Rightarrow$profitable

Separating equilibrium

- To solve this, insurer offers 2 contracts:
  - insurer converts x into p/profit
    - wants x as large as possible, subject to separation (IC)
  - μ_h's full info contract is not envied
    - $\Rightarrow$ no need to change $x_h = 1$ ("no distortion at the top")
  - μ_l's full info contract is envied by μ_h
    - $\Rightarrow$ reduce x_l to eliminate adverse selection
    - hits envier type (μ_h) here it hurts him most, x
- Separating equilibrium:
  - unhealthy get full insurance ($x_h = 1$) at a high price
  - The healthy get imperfect insurance ($x_l < 1$)
    - x_l is the highest possible conditional on IC_h
  - No separating equilibrium with continuum of types (Riley (1979))
    - mixed strategy equilibrium: Luz (2012)
- Externality between types: Pareto improvement to separate markets
  - mediated by market
- Glazer and McGuire (2000): optimal risk adjustment restores first-best

Outline

Motivation

- In Rothschild and Stiglitz (1976)
  - quality endogenous
  - perfect competition
  - heterogeneity in risk (μ) only
  - no pooling equilibrium
  - no separating equilibrium with continuum of types
  - market covered $\Rightarrow$ no quantity inefficiency
  - insufficient quality
- Empirical evidence that individuals differ in many dimensions
  - risk aversion: Finkelstein and McGarry (2006)
  - cognitive ability: Fang, Keane and Silverman (2008)
- How would these multidimensional types interact with
  - quality choices?
  - market power?

Setup

- WTP as before:

$$u = x\mu + \gamma(x)\, v$$

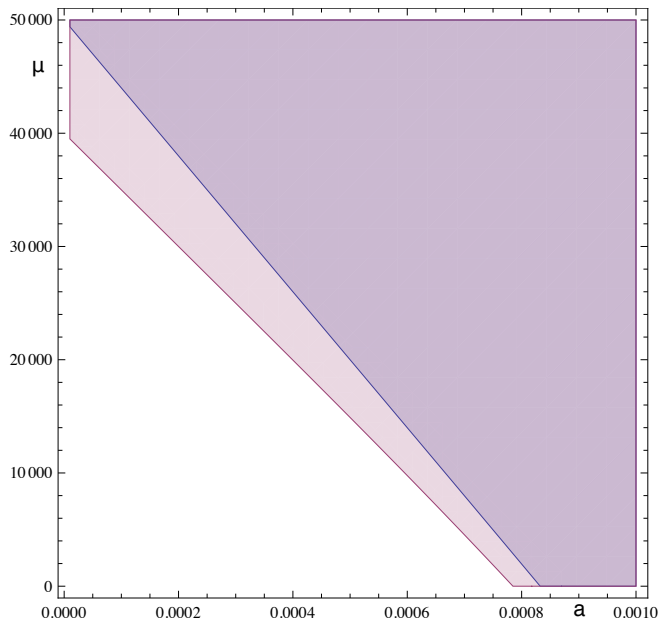
- Now, both μ and v are heterogeneous
  - there is a continuum of both
  - smooth joint density $f(\mu, v)$
- Insurer chooses (p, x)
- cost is $c = x\mu$
  - μ = health/risk, increases WTP and cost
  - v = risk aversion, increases WTP but not cost

Outline

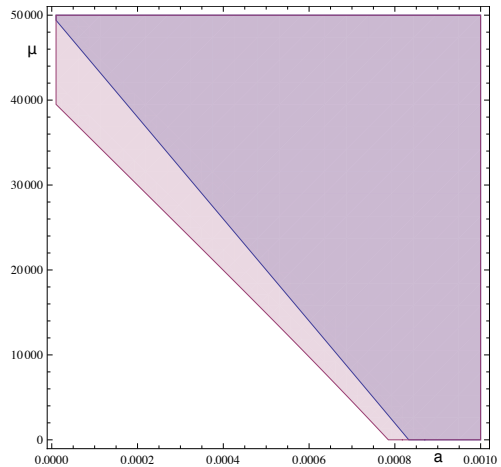
Monopoly: set of buyers

$$u > p \Leftrightarrow \mu > \frac{1}{x}\left[p - \gamma\left(x\right)v\right] = \mu^{\star}$$

- Buyers: $\mu > \mu^{\star}$; marginals: $\mu = \mu^{\star}$
  - margin: high risk $\Leftrightarrow$ low risk aversion
- Visually: p fixed, $x = 0.8$ (purple), $x = 1$ (pink+purple)



Demand



$$Q \equiv \int_{\underline{v}}^{\overline{v}} \int_{\mu^\star}^{\overline{\mu}} f(\mu, v)\, d\mu dv$$

$$\frac{\partial Q}{\partial p} = \int_{\underline{v}}^{\overline{v}} \left[-\frac{\partial \mu^\star}{\partial p} \right] f(\mu^\star, v)\, dv$$

$$\frac{\partial Q}{\partial p} = -\int_{\underline{v}}^{\overline{v}} \frac{1}{x} f(\mu^\star, v)\, dv = -M$$

- M is (proportional to) the density of marginal people

Price

$$\Pi \equiv \int_{\underline{v}}^{\overline{v}} \int_{\mu^\star}^{\overline{\mu}} [p - x\mu] f(\mu, v) \, d\mu dv$$

$$p = \underbrace{\mathbb{E}[x\mu \mid \mu = \mu^\star]}_{\text{marginal cost}} + \underbrace{\frac{Q}{M}}_{\text{markup}}$$

- But the really interesting part is the incentives to choose x...

Choice of quality (x)

$$\Pi \equiv \int_{\underline{v}}^{\overline{v}} \int_{\mu^\star}^{\overline{\mu}} [p - x\mu] f(\mu, v) \, d\mu dv$$

$$\frac{\partial \Pi}{\partial x} \equiv \int_{\underline{v}}^{\overline{v}} \int_{\mu^\star}^{\overline{\mu}} [-\mu] f(\mu, v) \, d\mu dv + \int_{\underline{v}}^{\overline{v}} \left[-\frac{\partial \mu^\star}{\partial x} \right] [p - x\mu^\star] f(\mu^\star, v) \, dv = 0$$

$$-Q\mathbb{E}[\mu \mid \text{buyers}] + \int_{\underline{v}}^{\overline{v}} \frac{1}{x} \frac{\partial u}{\partial x} [p - x\mu^\star] f(\mu^\star, v) \, dv = 0$$

$$-Q\mathbb{E}[\mu \mid \text{buyers}] + M \frac{1/x}{1/x} \frac{\int_{\underline{v}}^{\overline{v}} \frac{\partial u}{\partial x} [p - x\mu^\star] f(\mu^\star, v) \, dv}{\int_{\underline{v}}^{\overline{v}} f(\mu^\star, v) \, dv} = 0$$

$$-Q\mathbb{E}[\mu \mid \text{buyers}] + M\mathbb{E}\left[\frac{\partial u}{\partial x} (p - x\mu) \mid \text{margin} \right] = 0$$

Choice of quality (x)

$$-Q\mathbb{E}\left[\mu \mid \text{buyers}\right] + M\mathbb{E}\left[\frac{\partial u}{\partial x}\left(p - x\mu\right) \mid \text{margin}\right] = 0$$

$$-Q\mathbb{E}\left[\mu \mid \text{buyers}\right] + M\mathbb{E}\left[\frac{\partial u}{\partial x} \mid \text{margin}\right]\mathbb{E}\left[\left(p - x\mu\right) \mid \text{margin}\right] + MCov\left[\frac{\partial u}{\partial x}, p - x\mu \mid \text{margin}\right] = 0$$

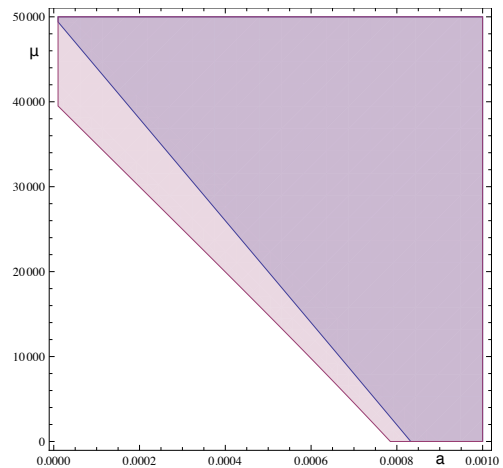
$$-Q\mathbb{E}\left[\mu \mid \text{buyers}\right] + M\mathbb{E}\left[\frac{\partial u}{\partial x} \mid \text{margin}\right]\frac{Q}{M} - MCov\left[\frac{\partial u}{\partial x}, x\mu \mid \text{margin}\right] = 0$$

$$\underbrace{-Q\mathbb{E}\left[\mu \mid \text{buyers}\right]}_{\text{cost}} + \underbrace{Q\mathbb{E}\left[\frac{\partial u}{\partial x} \mid \text{margin}\right]}_{\text{Spence}} - \underbrace{MCov\left[\frac{\partial u}{\partial x}, x\mu \mid \text{margin}\right]}_{\text{Sorting}} = 0$$

Sorting

$$\underbrace{-Q\mathbb{E}\left[\mu \mid \text{buyers}\right]}_{\text{cost}} + \underbrace{Q\mathbb{E}\left[\frac{\partial u}{\partial x} \mid \text{margin}\right]}_{\text{Spence}} - \underbrace{MCov\left[\frac{\partial u}{\partial x}, x\mu \mid \text{margin}\right]}_{\text{Sorting}} = 0$$

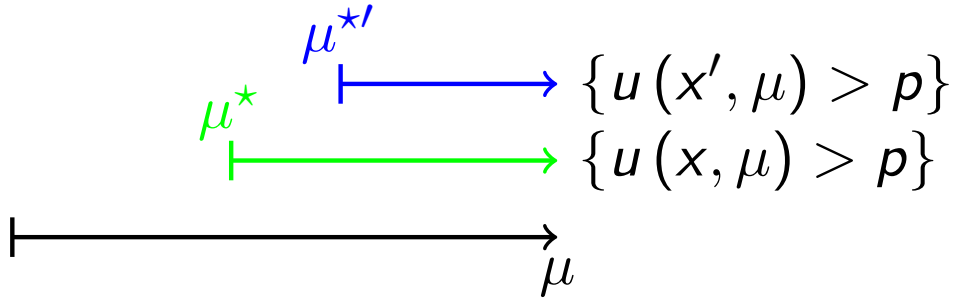
- The Spence (1975) captures shift in the set of marginal consumers
- The sorting term captures rotations of this line



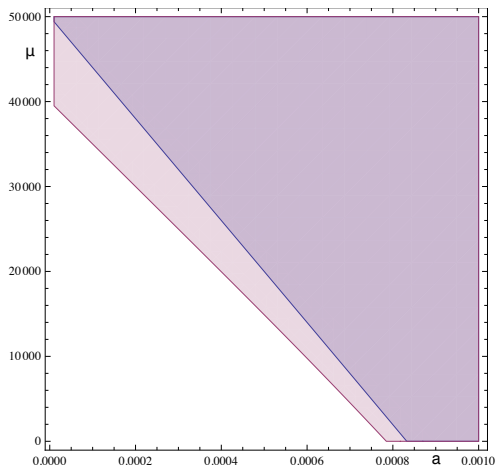
- Monopoly's sorting incentive is the same as welfare maximizer
  - not true of an oligopolist

Sorting requires multidimensional types

- 1D types:
  - Margin is a singleton $\Rightarrow Cov = 0$
  - Number of buyers Q determines composition



- 2D types:



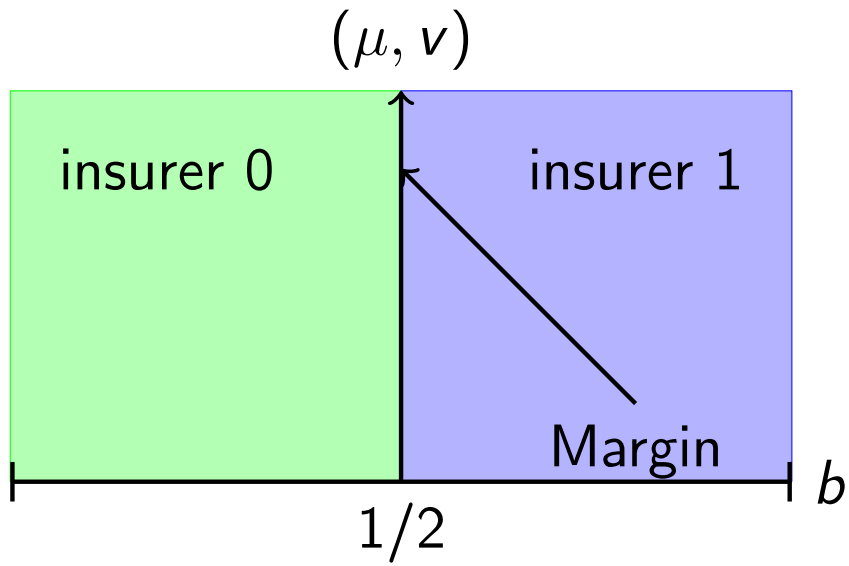
Sorting vs Selection

- Adverse selection:
  - fix quality x
  - increasing Q decreases MC: $MC'(Q) < 0$
  - depends on overall correlation between WTP and cost
- Adverse sorting:
  - fix Q
  - increasing x moves the MC curve
  - increasing x increases MC at Q: $Cov\left(\frac{\partial u}{\partial x}, c \mid \text{margin}\right) > 0$
  - depends on correlation between marginal WTP and cost, conditional on marginal buyers

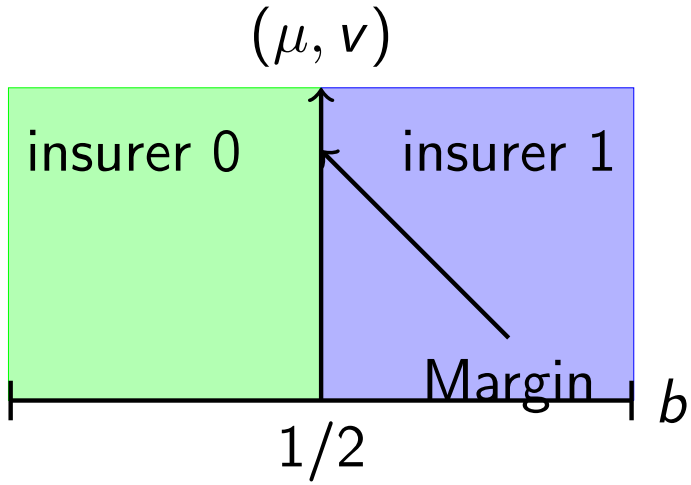
Outline

Setup

- two insurers, $i \in \{0, 1\}$ on the Hotelling unit interval
  - each chooses x_i and p_i, otherwise symmetric
- Consumers location is $b \in [0, 1]$
  - travel cost $\begin{cases} tb & \text{, insurer 0} \\ t(1-b) & \text{, insurer 1} \end{cases}$
  - t is market power
  - travel cost fungible with price
- b distributed uniformly on $[0, 1] \Rightarrow$ independent of (μ, v)
- market is covered (often true by law)



Equilibrium



- Equilibrium: marginal set is $\left\{b = \frac{1}{2}\right\}$, $Q_i^\star = \frac{1}{2}$ and $M^\star = \frac{1}{2t}$
- Marginal consumers representative of all consumers:
  - $\mathbb{E}$'s and *Cov* are unconditional
  - no Spence distortion
  - there will be a sorting distortion
- Pooling equilibria can exist here:
  - there is always a local deviation in Rothschild and Stiglitz (1976)

Imperfect competition (t>0)

- Welfare maximization prescribes full insurance:

$$\mathbb{E}\left[\gamma'(x)\, v\right] = 0.$$

- For $t > 0$, a unique $x^\star \in (0,1)$ satisfies the profit maximization FOC

$$\mathbb{E}\left[\gamma'(x)\, v\right] = \frac{1}{t} Cov\left[u', c\right].$$

- No Spence distortion: the term $\mathbb{E}\left[\gamma'(x)\, v\right]$ is the same
- Social optimum is full insurance (no moral hazard)
  - full insurance is never an equilibrium: $\frac{\partial \Pi}{\partial x}\,|_{x=1} < 0$
  - distortion captured by sorting term
- Monopolist internalizes cream-skimming externalities to other insurers
  - oligopolist does not
- Sorting is adverse at LDPE: $0 \leq \mathbb{E}\left[\gamma'(x)\, v\right] = \frac{1}{t} Cov\left[u', c\right]$
  - insurers increase x until sorting becomes adverse
- Results independent of $f(\cdot)$

Perfect Competition (t=0)

- In the limit as $t \to 0$, LDPE requires

$$Cov\left[u', c\right] = 0.$$

- As $t \to 0$, $M = \frac{1}{2t} \to \infty$, so Cov must vanish for FOC to hold
- $x = 0 \Rightarrow c = 0$ always satisfies this
- With 2D types, there is a second candidate is $x^\star = 1 + \frac{\mathbb{V}[\mu]}{Cov[v,\mu]}$
  - requires $\frac{Cov[v,\mu]}{\mathbb{V}[\mu]} < -1$
  - sorting must be sufficiently advantageous at zero insurance
    - otherwise, no incentives to raise x above $x = 0$
  - unlike Rothschild and Stiglitz (1976): if $\frac{Cov[v,\mu]}{\mathbb{V}[\mu]} < -1$, attracting the high$\mu$ also attract those with high $v \Rightarrow$ advantageous selection $\Rightarrow$ profitable to provide insurance

Market power raises quality

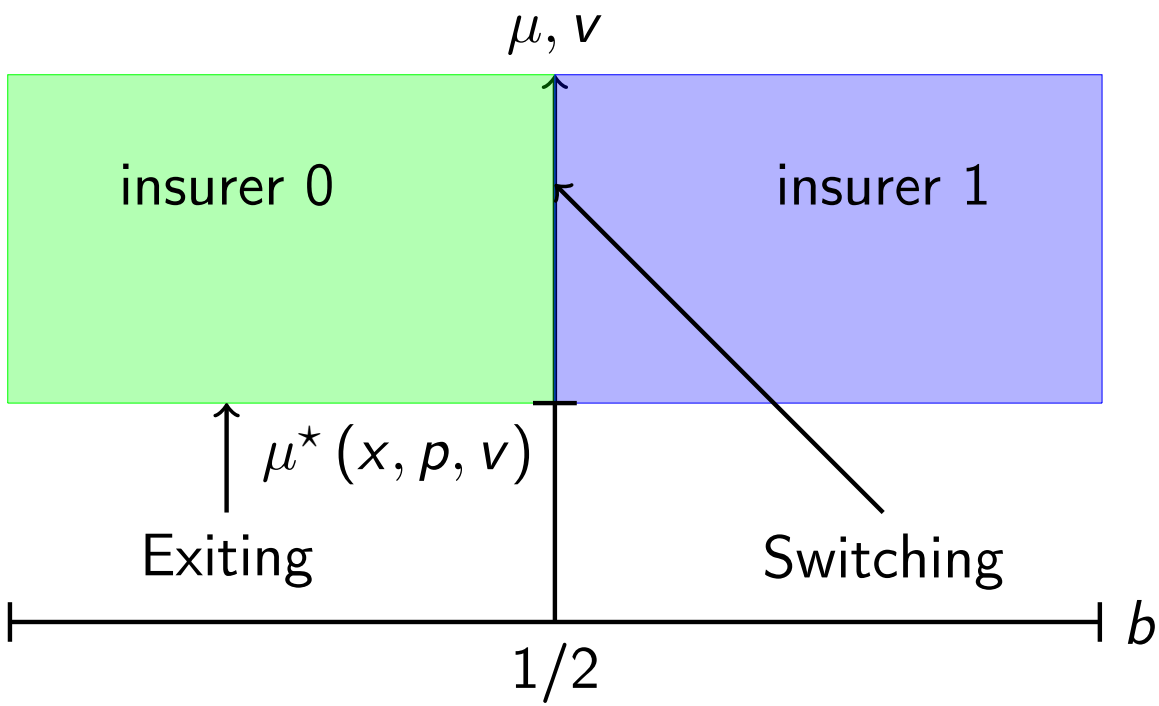
- Market power increases coverage:

$$\frac{dx^\star}{dt} \geq 0.$$

- Intuition:
  - sorting is adverse at LDPE $\Rightarrow$ downward pressure on x
  - $\mathbb{E}\left[\gamma'\left(x\right)v\right] = \frac{1}{t}Cov\left[u', c\right]$: t reduces the importance of sorting
- Here, t increases welfare
  - no moral hazard
  - no Spence distortion
  - market covered (market power does not reduce quantity and increases quality)

Quantity-quality trade-off

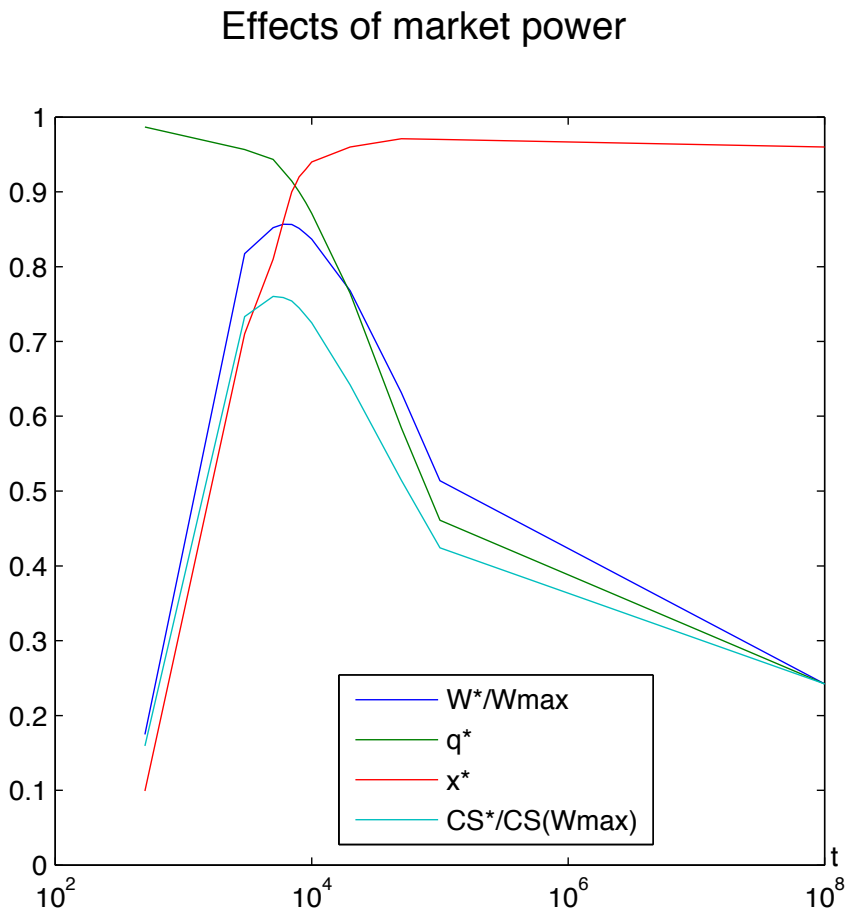
- Partly covered market
  - exiting margin (like monopoly)
  - switching margin (like covered market competition)



- Full insurance still optimal
- Increasing t: increases x, but reduces Q

Quantity-quality trade-off

- $f(\mu, v)$ calibrated from Handel, Hendel and Whinston (2013)
- optimal markup is 182% of cost $\Rightarrow x^\star$ =92%, $Q = 92\%$
  - welfare is 98% of first best, CS is 79% of first best



Highlights

- New sorting effect: $M \times Cov\left[u', c \mid \text{margin}\right]$
  - requires multidimensional types
  - quantifies quality-setting incentives in selection markets
  - quantities distortion from competition
- Pooling equilibria are possible if $Cov\left[\mu, v\right] < 0$
- Market power
  - reduces quantity
  - improves quality

Outline

Motivation

- How does the information structure affect the amount of trade?
  - better private information?
  - better public information?

Model

- 1 good with quality w
- 1 buyer with valuation $b(w)$
- 1 seller with valuation $s(w)$
- 3 equally likely states w: Lemon, Mellon, Huckleberry

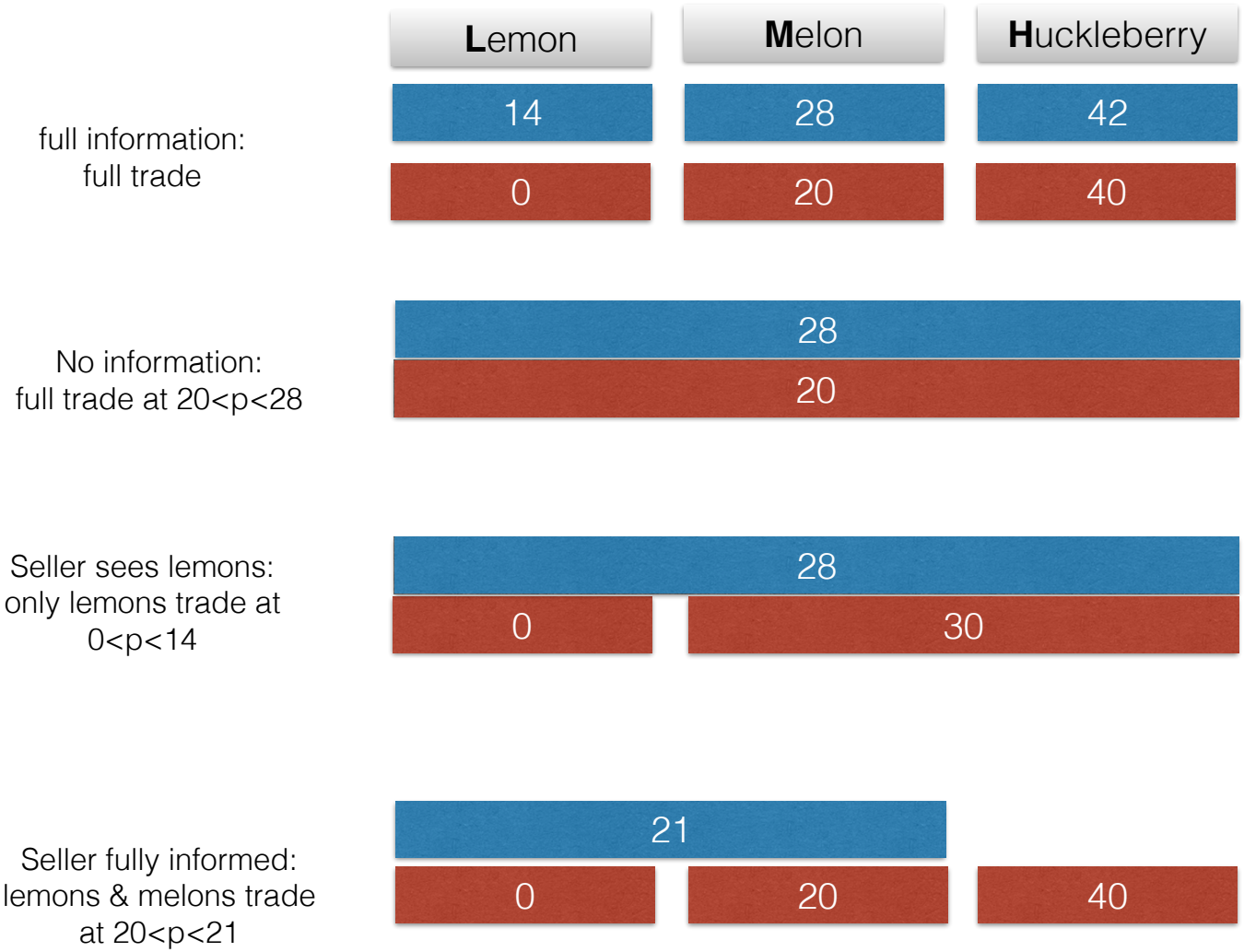
- Trade is always efficient: $b(w) > s(w)$
  - as in the insurance case

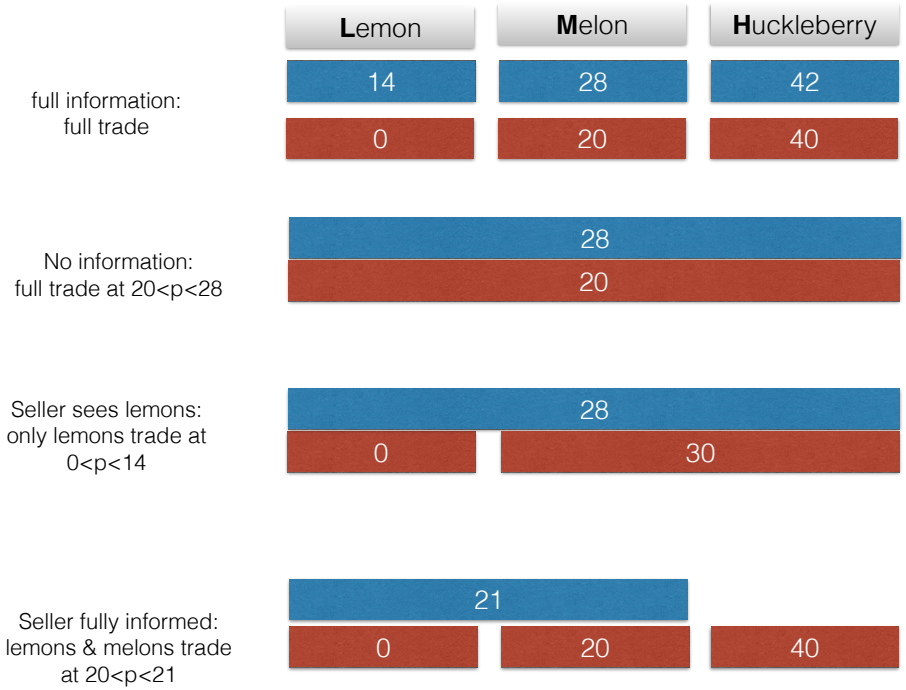
Information structure

- State of the world w might be unknown
  - possibly to both players
- posted price p
- trade/welfare: ex ante, how many states of the world there is trade in at a price p

Outline

Private information: can make things better or worse





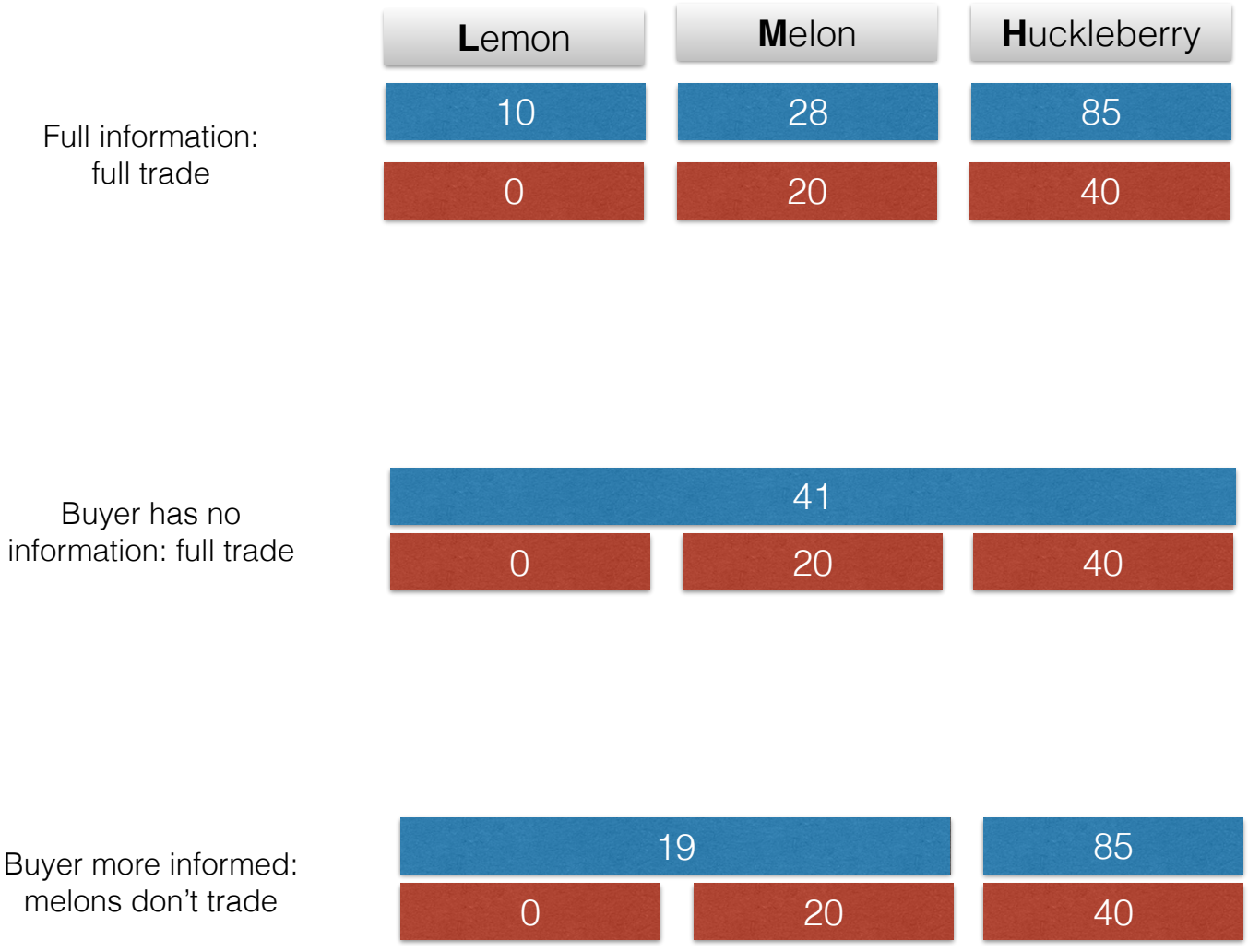
- First extra private info: seller in the market
  - more info tells her when RP is above the market price $\Rightarrow$ reduces trade
- Second extra private info: seller out of the market
  - lowers RP when melon (previous not traded) $\Rightarrow$ increases trade

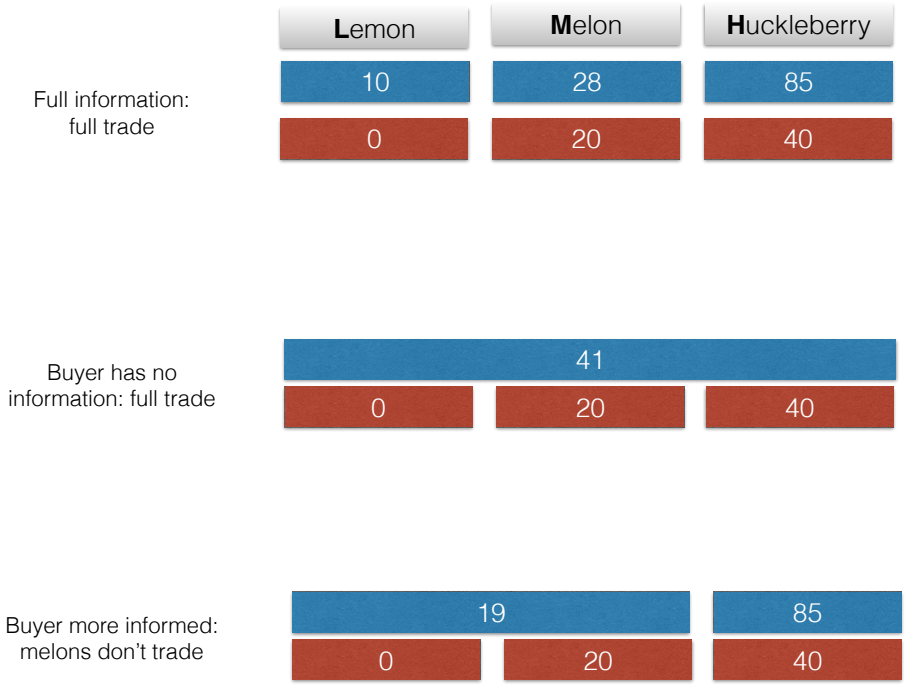
Outline

Public information

- Maybe the point isn't how much information there
- Is more common knowledge better?
- It depends

Public information: can make things better or worse





- First extra public info: buyer in the market
  - can decrease trade
- Move to full information: buyer out of the market
  - increases trade
- the possibility of H was facilitating trade when buyer was uninformed
  - making it certain collapses trade in other states of the world

More thoughts

- Suppose there are 3 variants of a disease
  - similar symptoms: cannot be distinguished a priori
  - different costs of treatment
- A hospital sets a price to treat people with those symptoms
  - should we allow for a test that identifies the illness prior to admission?
  - what if it distinguishes only certain kinds of the illness from others?
- Grossman and Stiglitz (1980): stock market
  - common values + private information $\Rightarrow$ no trade

Thank you!

For questions, please email

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(slides & audio at www.andreveiga.com & Weblearn)

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