Thanks to Raj Chetty and Amy Finkelstein for generously providing their lecture notes, some of which are reproduced here.
Welfare Analysis of Health Insurance

- Significant evidence of adverse selection in health insurance markets

- How does this affect welfare analysis?
  - What are the optimal subsidies or mandates (if any)?

- Begin with static model of Einav, Finkelstein, and Cullen (2010)

- Extend to ex-ante welfare analysis (Hendren, 2018)

- Extend to dynamic models of insurance (Cochrane (1996); Hendel and Lizzeri (2003); Handel, Hendel, and Whinston (2015)

- Key issue: Realization of information over time $\implies$ Conceptual question of how to define welfare
1. Static Revealed Preference Welfare

2. Static Ex-Ante Welfare

3. Dynamic Insurance Model

4. Market Power and Networks
Setup

- Individuals experience utility given by

\[ u(c, m; \theta) \]

where \( c \) is consumption, \( m \) is medical expenditure, and \( \theta \) is a health shock.

- After learning \( \theta \), individuals choose \( c \) and \( m \) subject to a budget constraint:
  - Budget constraint depends on whether they are insured.
  - Insured budget constraint:
    \[ c^I(\theta) + x(m^I(\theta); \theta) + p_I \leq y(\theta) \]
  - Uninsured budget constraint:
    \[ c^U(\theta) + m^U(\theta) + p_U \leq y(\theta) \]

- \( p_U \) and \( p_I \) are the price of being uninsured and insured respectively.
- \( y(\theta) \) is income (which might be affected by the shock).
- \( x \) is out-of-pocket medical expenses.
Insurance Demand

- Individuals choose whether or not to purchase insurance after learning a signal, $s \in [0, 1]$, about their risk
  - WLOG $s$ orders demand so that $s = 0$ is the highest WTP type

- Demand given by $D(s)$, which solves

$$E \left[ u \left( y(\theta) - x \left( m^l(\theta); \theta \right) - D(\tilde{s}) - p_U, m^l(\theta); \theta \right) | \tilde{s} \right] = E \left[ u \left( y(\theta) - m^U(\theta) - p_U, m^U(\theta); \theta \right) \right]$$

- Assume does not vary with $p_U$ (only relative price matters)
  - True if CARA utility (exercise to show this!)
- Fraction of the market purchasing insurance, $s$, solves $D(s) = p_I - p_U$
Following Einav, Finkelstein, and Cullen (2010), define marginal and average cost curves:

- **Average cost of enrollees when fraction** \( s \) of the market is enrolled:
  
  \[
  AC (s) = E \left[ m^I (\theta) - x \left( m^I (\theta) ; \theta \right) \right] \mid \tilde{s} \leq s
  \]

- **Marginal cost of additional enrollees brought in by lowering prices.** Note that total cost is \( sAC (s) \), so that marginal cost is given by:
  
  \[
  MC (s) = \frac{d}{ds} [sAC (s)]
  \]
  
  \[
  = \frac{d}{ds} \int_{\tilde{s} \leq s} E \left[ m^I (\theta) - x \left( m^I (\theta) ; \theta \right) \mid \tilde{s} \leq s \right] d\tilde{s}
  \]
  
  \[
  = E \left[ m^I (\theta) - x \left( m^I (\theta) ; \theta \right) \mid \tilde{s} = s \right]
  \]

where the last line assumes \( m^I \) is not affected by insurance purchase

- e.g. no Becker and Ehrlich (1972) effects
Competitive Equilibrium

- Suppose there are at least two firms that compete over relative price for $H$ versus $L$ plan
  - Weyl and Viega (2016) discuss issues with multiple plan prices
- Competitive equilibrium from 2-stage game
  - Insurers post prices
  - Individuals choose insurance contracts
- Competitive equilibrium characterized by
  \[ s^{CE} = \max \{ s \mid D(s) = AC(s) \} \]

with price $p^{CE} = D(s^{CE})$
  - Why the maximum market size?
- Smetters and Scheuer (2016): minimum price not reached (ACA website?)
Competitive Equilibrium with Adverse Selection

Figure 2 (continued)

B: Adverse Selection with Complete Unraveling

- AC curve
- Demand curve
- MC curve

Price vs. Quantity

$Q_{\text{max}}$
Welfare Loss in Competitive Equilibrium

- If prices must reflect average costs, EFC2010 and Akerlof (1970) note that this can lead to some efficient trades not taking place
  - Those with \( D(s) \in (MC(s), AC(s)) \) are willing to pay their marginal cost of insurance but remain uninsured in a competitive equilibrium
  - “Efficient” for all those with \( D(s) \geq MC(s) \) to purchase insurance

\[
D\left(s^{\text{eff}}\right) = MC\left(s^{\text{eff}}\right)
\]

- Can quantify the size of this “deadweight loss” from foregone trades

\[
DWL = \int_{s \in [s^{CE}, s^{eff}]} [D(s) - MC(s)] \, ds
\]

- What is the aggregate willingness to pay above costs for trades that go unmet in a competitive equilibrium?
Competitive Equilibrium with Adverse Selection

How does the modeling approach deal with moral hazard?
- Impact of insurance on $m$: $m^I > m^U$
- Can define cost of $s$ type as if they are insured and uninsured
- Cost relevant for the insurer is the cost they pay, $E[m^I - x(m^I) | s]$
- But, this could be higher than the costs they would pay if the individual consumed care as if she were uninsured, $E[m^U - x(m^U) | s]$
- Moral hazard of $s$ type is given by $E[m^I - x(m^I) | s] - E[m^U - x(m^U) | s]$
  - Requires identifying $E[m^U - x(m^U) | s]$
  - Tough if $x$ is nonlinear, but if linear (or full insurance) just need to identify cost curve of the uninsured, $E[m^U | s]$
Figure 5
The “Positive Correlation” Test for Selection
Einav, Finkelstein, and Cullen (2010 QJE) note that one can estimate these costs using exogenous variation in prices. Can estimate BOTH demand and cost curve:

- Demand = fraction that buy at posted price
- Cost = added cost on policy $H$ versus $L$ for those who purchase at posted price
- Rarely does price variation identify both supply + demand!

But need some institutional structure that randomly varies prices...

- Alcoa! (they make aluminum)
- Business unit heads choose price charged for high versus low coverage plans
Results suggest welfare loss is “small”
  - $9.55/employee (~2% of the average price)

Beautiful paper - starts with theoretical graph and maps empirical objects directly onto this graph

But a few limitations:
  - Paper takes contracts as given
    - Perhaps the contracts were inefficient? (Rothschild and Stiglitz 1976)
    - Multiple insurance contracts: Equilibrium existence problems (Azavedo and Gottlieb, 2016; Weyl and Viega, 2016)
  - Would competition on other dimensions unravel the market in practice?

Main question: does the welfare cost of foregone trades correspond to maximizing utilitarian welfare?
1 Static Revealed Preference Welfare

2 Static Ex-Ante Welfare

3 Dynamic Insurance Model

4 Market Power and Networks
Insurance demand depends on knowledge/beliefs of risk

Individuals often have some knowledge about risk when measuring demand, generating adverse selection

Value of foregone trades is unstable measure of welfare (Hirshleifer, 1971)

Hendren (2017): Can be misleading for optimal policy analysis
Motivating Example (Hendren, 2017)

- Begin with simple example to illustrate issue and a solution

- Individuals have $30

- Face a risk of losing $m, uniformly distributed between 0 and 10

- Willing to pay $0.50 markup for full insurance if CRRA is 3
  - Indifferent between roughly $24.50 versus uniformly distributed consumption on $[20, 30]$
  - Would be “efficient” for everyone to have $25 with certainty
    - Value of insurance market is $0.50

- How does this map to demand and cost curves?
Ex-Ante Demand and Cost

Fraction Insured (s)

Demand

Cost
Ex-Ante Demand and Cost

\[ s^{CE} = 1 \]
Ex-Ante Demand and Cost

\[ W^{Ex-Ante} = \$0.50 \]

\[ s^{CE} = 1 \]
Motivating Example

• What if people have information about their risk when we measure demand?

• Begin with extreme case: suppose individuals learn their loss
  - Willingness to pay equals cost, \( D(s) = m(s) \)
Observe Demand and Cost

\[ s^{CE} = 0 \]

Fraction Insured (s)

Observed Demand

Marginal Cost

Average Cost

Observed Demand and Cost
What are the welfare implications of this unraveling?

Fraction Insured (s)

Observed Demand
Marginal Cost
Average Cost

\[ s^{CE} = 0 \]
Observe Demand and Cost

\[ DWL = 0 \]

No lost surplus from foregone trades

\[ s^{CE} = 0 \]
Timeline of Information Revelation and Insurance Purchase

Ex-Ante

Expected Utility / WTP

Choice

Knowledge

Event Occurs

E[u(c)]

u(c)
If choices are made prior to info revelation, revealed preference measures ex-ante utility, $E[u(c)]$. 

**Expected Utility / WTP**
Timeline of Information Revelation and Insurance Purchase

Ex-Ante

Expected Utility / WTP

Knowledge

Event Occurs

Choice

Observed WTP

Ex-Ante

$E[u(c)]$

$u(c)$
Timeline of Information Revelation and Insurance Purchase

Knowledge

Observed	WTP

Choice

Event Occurs

E[u(c)]

Ex-Ante

Expected Utility / WTP

Choice

Observed WTP

Ex-Ante
If choices are made after info revelation, revealed preference does **not** measure ex-ante utility, $E[u(c)]$.
Timeline of Information Revelation and Insurance Purchase

Knowledge

Event Occurs

Ex-Ante

E[u(c)]

Ex-Ante

Expected

Utility / WTP

Choice

Revealed preference measures WTP for insurance against *remaining risk*

E[u(c)]

u(c)

Observed

WTP
Timeline of Information Revelation and Insurance Purchase

Expected Utility / WTP

Knowledge

Event Occurs

Does not capture value of insurance against risk known at time of making choice
Timeline of Information Revelation and Insurance Purchase

Knowledge

- Observed
- WTP
- Choice

> Avg

Event	Occurs

Ex-Ante

E[u(c)]

Expected Utility / WTP

Ex-Ante

u(c)

Event Occurs

Choice

Avg[ Observed WTP ]
Market Surplus is Unstable Measure of Welfare

Ex-Ante $E[u(c)]$ → Knowledge $u(c)$

Choice 0 $WTP_{Ex-Ante}$
Market Surplus is Unstable Measure of Welfare

\begin{align*}
E[u(c)] & \quad \rightarrow \quad u(c) \\
\text{Ex-Ante} & \quad \rightarrow \quad \text{Knowledge} \quad \rightarrow \quad \text{Event Occurs} \\
\text{Choice 0} & \quad \uparrow \quad \text{Choice 1} \\
\text{WTP}_{\text{Ex-Ante}} & \quad \geq \quad E[\text{WTP}_1]
\end{align*}
Market Surplus is Unstable Measure of Welfare

\[ \text{WTP}_{\text{Ex-Ante}} \geq \mathbb{E}[\text{WTP}_1] \geq \mathbb{E}[\text{WTP}_2] \]
Market Surplus is Unstable Measure of Welfare

\[ E[u(c)] \]

Ex-Ante

Knowledge

Event Occurs

\[ u(c) \]

\[ WTP_{\text{Ex-Ante}} \geq E[WTP_1] \geq E[WTP_2] \geq E[WTP_3] = \text{Cost} \]
**Problem:** Revealed preference does not deliver a stable welfare metric corresponding to expected utility

- Depends on amount of information that happens to be revealed when insurance choices are made
- Same insurance policies (e.g. value of a mandate) may have different welfare properties simply because of when the econometrician chooses to measure WTP!
**Goal of Paper:** Evaluate policies in markets where information has been revealed when measuring WTP (i.e. adverse selection)

- Use stable welfare criteria corresponding to ex-ante expected utility
  
  - Condition on observables (e.g. income) to isolate redistribution
Timeline of Information Revelation and Insurance Purchase

E[u(c)]

Ex-Ante

Knowledge

Goal of Paper

Ex-Ante

Expected Utility / WTP

Event Occurs

u(c)

Choice

Observed WTP
Timeline of Information Revelation and Insurance Purchase

Goal of Paper
Evaluate policies in this market

Ex-Ante
Expected Utility / WTP

Knowledge

Event Occurs

Ex-Ante
E[u(c)]

u(c)

Choice

Observed WTP
Timeline of Information Revelation and Insurance Purchase

**Ex-Ante**

- **E[u(c)]**: Expected Utility / WTP
- **Knowledge**: From ex-ante welfare perspective *before learning WTP*
- **Event Occurs**

**Choice**

- **u(c)**: Observed WTP

**Goal of Paper**

- Evaluate policies in this market

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Timeline of Information Revelation and Insurance Purchase
Approach: Combine Market Surplus with Sufficient Statistics

Knowledge

Ex-Ante

Event Occurs

Expected Utility / WTP

Observed WTP
Approach: Combine Market Surplus with Sufficient Statistics

Knowledge

Observed WTP

Choice

Event Occurs

Ex-Ante

Expected Utility / WTP

Revealed Preference

WTP-Cost (EFC2010)
Approach: Combine Market Surplus with Sufficient Statistics

- $E[u(c)]$ (Ex-Ante Expected Utility/WTP)
- Observed WTP
- Difference in marginal utilities between insured and uninsured ("Sufficient Statistics")
- Revealed Preference WTP-Cost (EFC2010)
- $u(c)$ (Event Occurs)
Approach: Combine Market Surplus with Sufficient Statistics

- **Ex-Ante** Expected Utility / WTP
- Benchmark implementation using:
  1. Market WTP + Cost Curves
  2. Measure of risk aversion
- **Observed** WTP
- **Event Occurs**
- **Choice**
  - Revealed Preference WTP-Cost (EFC2010)

Difference in marginal utilities between insured and uninsured ("Sufficient Statistics")
Approach: Combine Market Surplus with Sufficient Statistics

- **Expected Utility / WTP (Ex-Ante)**
  - $E[u(c)]$
  - Revealed Preference $WTP - Cost (EFC2010)$

- **Knowledge**
  - Difference in marginal utilities between insured and uninsured ("Sufficient Statistics")

- **Event Occurs**
  - $u(c)$

**Benchmark implementation using:**
1. Market WTP + Cost Curves
2. Measure of risk aversion

**Choice**
- Observed $WTP$
Motivating Example

- Observed demand does not capture the value of insurance against learning about your risk prior to demand measurement.
  - Adverse selection implies a divergence between DWL and Ex-Ante Welfare.
Motivating Example

- Observed demand does not capture the value of insurance against learning about your risk prior to demand measurement
  - Adverse selection implies a divergence between DWL and Ex-Ante Welfare

- Hendren (2017) derives an “ex-ante” demand curve to facilitate welfare analysis from behind the veil of ignorance
  - Combine Einav, Finkelstein, and Cullen (2010) with Baily-Chetty
Deriving the Ex-Ante Demand Curve

- Return to example in which \( D(s) = m(s) \)

- Suppose \( s = 50\% \) of the population has insurance

- Obtained by setting prices subject to a resource constraint:
  - Price of insurance, \( p_I \)
  - Price/penalty of being uninsured, \( p_U \)
  - Set so that \( sp_I + (1 - s)p_U = sAC(s) \)
From Observed Demand to Ex-Ante Demand

\[ p_I - p_U = $5 \]
From Observed Demand to Ex-Ante Demand

Fraction Insured ($s$)
Demand Marginal Cost

Marginal Price

From Observed Demand to Ex-Ante Demand

\( ds \)
From Observed Demand to Ex-Ante Demand

\[ D'(s) \, ds \]

Lowers \( p_I - p_U \) by \( D'(s) \, ds \)
From Observed Demand to Ex-Ante Demand

\[ dp_U = -sD'(s) ds \]

1-s pay higher prices

Fraction Insured (s)

Demand

Marginal Cost
From Observed Demand to Ex-Ante Demand

\[ dp_U = -sD'(s)ds \]

\[ dp_I = (1-s)D'(s)ds \]

\( s \) pay lower prices

\( 1-s \) pay higher prices

\( dp_U = -sD'(s)ds \)

\( dp_I = (1-s)D'(s)ds \)
From Observed Demand to Ex-Ante Demand

\[ dp_I = (1 - s)D'(s)ds \]

\[ dp_U = -sD'(s)ds \]

\[ dW = s(1 - s)D'(s)ds \cdot E[u' | Insured] \]

\[ dW = -(1 - s)sD'(s)ds \cdot E[u' | Unins] \]
From Observed Demand to Ex-Ante Demand

$EA(s) = \left( \frac{(1 - s) SD'(s)}{s} \right) \frac{E[u'|Insured] - E[u'|Unins]}{E[u'|Insured]}$

-Marginal Utility Difference

Size of Transfer

$s$ pay lower prices

$dp_I = (1 - s) D'(s) ds$

-1-s pay higher prices

$dp_U = -s D'(s) ds$

$dW = s(1 - s) D'(s) ds \cdot E[u'|Insured]$ $dW = -(1 - s) sD'(s) ds \cdot E[u'|Unins]$
From Observed Demand to Ex-Ante Demand

\[ EA(s) = \left((1 - s) sD'(s)\right) \frac{E[u'|\text{Insured}] - E[u'|\text{Unins}]}{E[u'|\text{Insured}]} \]

\[ u(s) = u(y - p_I) \]

\[ u(s) = u(y - m(s) - p_U) \]

Fraction Insured (s)

Demand

Marginal Cost

Insured

Uninsured
From Observed Demand to Ex-Ante Demand

\[ EA(s) = \left( (1 - s) sD'(s) \right) \frac{E[u'|\text{Insured}] - E[u'|\text{Unins}]}{E[u'|\text{Insured}]} \]

Size of Transfer

Marginal Utility Difference

Utility ‘as if’ type s is insured

\[ u(s) = u(y - p_I) \]

\[ u(s) = u(y - D(s) - p_U) \]

Fraction Insured (s)

Demand

Marginal Cost
From Observed Demand to Ex-Ante Demand

\[ EA(s) = \left( (1 - s) sD'(s) \right) \frac{E[u' | Insured] - E[u' | Unins]}{E[u' | Insured]} \]

Size of Transfer
Marginal Utility Difference

\[ u_c(s) = u_c(y - p_I) \]

\[ u_c(s) = u_c(y - D(s) - p_U) \]

Insured
Uninsured
From Observed Demand to Ex-Ante Demand

\[ EA(s) = \left( (1-s)sD'(s) \right) \frac{E[u'|\text{Insured}]-E[u'|\text{Unins}]}{E[u'|\text{Insured}]} \]

Assumptions:
1. State independence
2. Common risk aversion

\[ u_c(s) = u_c(y-p_I) \]

\[ u_c(s) = u_c(y-D(s)-p_U) \]
From Observed Demand to Ex-Ante Demand

\[
EA(s) = \left( (1-s) sD'(s) \right) \frac{E[u'|\text{Insured}] - E[u'|\text{Unins}]}{E[u'|\text{Insured}]}
\]

Size of Transfer
Marginal Utility Difference

\[
u_c(s) = u_c(y - p_1)
\]

\[
u_c(s) \approx u_c(s') + u_{cc}(s')(D(s) - D(s'))
\]

Demand
Marginal Cost
From Observed Demand to Ex-Ante Demand

\[ EA(s) = \left( (1 - s) s D'(s) \right) \frac{u_{cc}}{u_c} E \left[ D(s) - D(s') \mid s' > s \right] \]

Size of Transfer

Marginal Utility Difference

\[ u_c(s) = u_c(y - p_I) \]

\[ u_c(s) \approx u_c(s') + u_{cc}(s')(D(s) - D(s')) \]

Insured

Uninsured

Fraction Insured (s)
From Observed Demand to Ex-Ante Demand

\[ EA(s) = \left( (1 - s) s D'(s) \right) \frac{u_{cc}}{u_c} E \left[ D(s) - D(s') \mid s' > s \right] \]

Size of Transfer

Marginal Utility Difference

\[ EA(0.5) = \frac{1}{2} \cdot 0.5 \cdot (-10) \cdot \left( -\frac{3}{25} \right) \cdot (-2.5) = 0.75 \]
From Observed Demand to Ex-Ante Demand

\[ EA(s) = \left( (1 - s) sD'(s) \right) \frac{u_{cc}}{u_c} E \left[ D(s) - D(s') | s' > s \right] \]

- Size of Transfer
- Marginal Utility Difference

$0.75$ Ex-ante surplus from larger insurance market
From Observed Demand to Ex-Ante Demand

- Fraction Insured (s)
- Demand
- Marginal Cost
- 'Ex-ante' Demand, D(s)+EA(s)

Graph showing the relationship between Fraction Insured (s) and Marginal Cost.
From Observed Demand to Ex-Ante Demand

EA(0.3) = $0.88

Fraction Insured (s)
Demand
Marginal Cost
'Ex-ante' Demand, D(s)+EA(s)
Marginal Price
From Observed Demand to Ex-Ante Demand
EA(0.3)=$0.88
From Observed Demand to Ex-Ante Demand

\[ EA(0.7) = \$0.38 \]
From Observed Demand to Ex-Ante Demand

\[ \int_0^1 EA(s) \, ds = \$0.50 \]
\[ \int_{0}^{1} EA(s) \, ds = 0.50 = W_{Ex-Ante} \]
DWL versus Ex-Ante WTP

- Ex-ante demand curve facilitates ex-ante/utilitarian welfare analysis
  - Even though demand is measured after information is revealed

- Ex-ante (ex-post utilitarian) surplus can lead to different conclusions about the value of insurance
  - Ex-ante efficient to have full insurance
  - No value to insurance market after info is revealed
    - (Strictly positive DWL if there was moral hazard)
General Model with Moral Hazard

- Ex-ante/Utilitarian welfare when fraction $s$ has insurance

$$W(s) = E[u(c(s;\theta),m(s;\theta);\theta)]$$

- Ex-ante WTP for larger insurance market:

$$\frac{W'(s)}{E[u'|\text{Insured}]} = \frac{D(s) - MC(s) + EA(s)}{\text{Ex-Post Surplus}}$$

where

$$EA(s) = (1 - s) \left( \frac{\text{MDWL}(s) - s}{\partial D/\partial s} \right) \left( \frac{E[u'(s)|\text{Insured}] - E[u'(s)|\text{Uninsured}]}{E[u'(s)|\text{Insured}]} \right)$$

- Adjust size of transfer for $\text{MDWL}=MC(s)-D(s)$
Implementation

- Use common assumptions to approximate difference in marginal utilities between insured and uninsured
  - State independence: \( u_c \) only depends on \( c \)
  - Income doesn’t vary with \( s \)
  - Common risk aversion (Andrews and Miller, 2013)

- Implies:
  \[
  EA(s) = (1 - s) \left( MDWL(s) - s \frac{\partial D}{\partial s} \right) \left( \frac{-u_{cc}}{u_c} \right) E\left[ D(s) - D(s') \mid s' > s \right]
  \]
  - Ex-ante component increasing with the square of demand/cost
    - \( D(s) \rightarrow aD(s) \) implies \( EA(s) \rightarrow a^2 EA(s) \)
Risk Aversion

- Measuring ex-ante demand requires risk aversion

- Can be assumed externally
  - CRRA = 3
  - CARA = 5x10^{-4}

- Or can be estimated internally

  \[
  \frac{-u_{cc}}{u_c} \approx 2 \frac{\text{Markup}}{\text{Variance Reduction}} \approx 2 \frac{D(s) - MC(s)}{\text{var}(m^U) - \text{var}(x^I)}
  \]

- WTP for insurance against remaining risk reveals can proxy for WTP for insurance against realized risk
1. Top-up market for more generous PPO coverage in Alcoa
   - Demand and Cost Curves from Einav, Finkelstein, and Cullen (2010)
   - Average annual cost: $500

2. “Medium risk”
   - 4x Demand and Cost curves from Einav, Finkelstein, and Cullen (2010)
   - Average annual cost: $2,000

3. “Large Risk”: Conservative approx. to insured vs. uninsured
   - 8x Demand and Cost curves from Einav, Finkelstein, and Cullen (2010)
   - Average annual cost: $4,000
   - Smaller than $5,922 (full vs. no insurance) or $5,270 in MA (Hackman, Kolstad, Kowalski, 2015)
Top-Up Health Insurance (EFC2010)

Fraction Insured

Demand

Marginal Cost

Average Cost
Top-Up Health Insurance (EFC2010)

- **MDWL** = $138

- **Demand**
- **Marginal Cost**
- **Average Cost**
Top-Up Health Insurance (EFC2010)
Top-Up Health Insurance (EFC2010)

What about ex-ante demand?

Fraction Insured

Demand

Marginal Cost

Fraction Insured

Demand

Marginal Cost
Top-Up Health Insurance (EFC2010)

\[ EA(s) = (1 - s) \left( MDWL(s) - s \frac{\partial D}{\partial s} \right) \frac{E[u'(s) \mid Insured] - E[u'(s) \mid Uninsured]}{E[u'(s) \mid Insured]} \]

Size of Transfer
Marginal Utility Difference

Demand
Marginal Cost

Fraction Insured
Top-Up Health Insurance (EFC2010)

\[ EA(s) = (1 - s) \left( MDWL(s) - s \frac{\partial D}{\partial s} \right) \left( \frac{-u_{cc}}{u_c} \right) E \left[ D(s) - D(\bar{s}) | \bar{s} > s \right] \]
Top-Up Health Insurance (EFC2010)

\[ EA(s) = (1 - s) \left( MDWL(s) - s \frac{\partial D}{\partial s} \right) \left( \frac{-u_{cc}}{u_c} \right) E \left[ D(s) - D(\bar{s}) \mid \bar{s} > s \right] \]

\[ \approx 5 \times 10^{-4} \text{ Handel, Hendel, Whinston (2015)} \]
Top-Up Health Insurance (EFC2010)

\[ EA(s) = (1 - s) \left( MDWL(s) - s \frac{\partial D}{\partial s} \right) \left( 5 \times 10^4 \right) E \left[ D(s) - D(\bar{s}) \mid \bar{s} > s \right] \]

- **Size of Transfer**
- **Marginal Utility Difference**

Demand and Marginal Cost graphs with points and lines indicating the relationship between the fraction insured and corresponding values.
Top-Up Health Insurance (EFC2010)

Fraction Insured

Demand

Marginal Cost

'Ex-ante' Demand

Fraction Insured

.5

.6

.7

.8

.9

500

400

300

200

100

Demand

Marginal Cost

'Ex-ante' Demand

S

CE

Ex-Ante
Ex-Ante Optimal Insurance Markets Generate DWL

- Ex-ante optimal size of the insurance market solves:

\[
\frac{W'(s^{\text{Ex-Ante}})}{E[u'\mid \text{Insured}]} = \frac{D(s^{\text{Ex-Ante}}) - MC(s^{\text{Ex-Ante}})}{\text{Ex-Post Surplus}} + EA(s^{\text{Ex-Ante}}) = 0
\]

- Yields a “Baily-Chetty” condition:

\[
EA(s^{\text{Ex-Ante}}) = MDWL(s^{\text{Ex-Ante}})
\]

- **Corollary:** The ex-ante optimal allocation generally involves (ex-post) deadweight loss
  - Easy to show that MDWL(s)=0 implies EA(s)>0 whenever marginal utilities are higher for the insured than uninsured
  - MDWL is a cost we’re willing to accept for ex-ante insurance
Top-Up Health Insurance (EFC2010)

\[ W^{\text{Ex-Ante}} = $14.25 \]

Fraction Insured

Demand

Marginal Cost

'Ex-ante' Demand
Top-Up Health Insurance (EFC2010)

$W^{\text{Ex-Ante}} = 14.25$

$\text{DWL} = 9.55$

Fraction Insured

Top-Up Health Insurance (EFC2010)
Demand
Marginal Cost
'Ex-ante' Demand

$W^{\text{Ex-Ante}} = 14.25$

$\text{DWL} = 9.55$

Fraction Insured
DWL captures 67% of ex-ante welfare cost of adverse selection.

\[ W^{Ex-Ante} = $14.25 \]

\[ DWL = $9.55 \]
Medium Risk (4x EFC2010)

Demand Marginal Cost

'Ex-ante' Demand
Medium Risk (4x EFC2010)

Fraction Insured

Demand Marginal Cost

'Ex-ante' Demand

Medium Risk (4x EFC2010)
Medium Risk (4x EFC2010)

\[ W^{\text{Ex-Ante}} = 120.62 \]

Fraction Insured

Demand Marginal Cost

'Ex-ante' Demand

Medium Risk (4x EFC2010)
Medium Risk (4x EFC2010)

DWL captures 32% of ex-ante welfare cost of adverse selection.

$W_{\text{Ex-Ante}} = $120.62$

$DWL = $38.26$

Fraction Insured

Demand Marginal Cost

Medium Risk (4x EFC2010)
Large Risk (8x EFC2010)

DWL captures 18% of ex-ante welfare cost of adverse selection

\[ W^{\text{Ex-Ante}} = $427 \]

\[ \text{DWL} = $77 \]

Fraction Insured: 0.5 to 0.9

Demand and Marginal Cost Curves

Ex-Ante Demand

CE

Observed

Ex-Ante

Fraction Insured: 0.5 to 0.9

4000

6000

8000

0

Demand

Marginal Cost

Ex-Ante Demand
Ex-ante Insurance Value Increasing in Premium

- Divergence between Observed and Ex-ante value of insurance is increasing in the size/importance of the risk
  - DWL captures 67% of the ex-ante welfare cost of adverse selection for baseline specification in Einav, Finkelstein, and Cullen (2010)
  - Only 18% if risks are 8x as large

- More important for risks where the premiums are a significant share of people’s incomes
  - Health, life, disability, unemployment insurance
  - Less important for iPhone insurance...
Competitive Markets vs. Mandates

- Are competitive markets better or worse than govt mandates?
  - Competitive markets suffer adverse selection
  - Mandates may require some to buy insurance that don’t want it
Markets vs. Mandates: Medium Risk (4x EFC2010)

DWL = $38.26

DWL = $117.84

Fraction Insured

Demand

Marginal Cost

Markets vs. Mandates: Medium Risk (4x EFC2010)
Markets vs. Mandates: Medium Risk (4x EFC2010)

DWL = $38.26

DWL = $117.84

DWL prefers markets

Fraction Insured

Demand Marginal Cost

Markets vs. Mandates: Medium Risk (4x EFC2010)
Markets vs. Mandates: Medium Risk (4x EFC2010)

Ex-Ante Welfare prefers mandate $W_{\text{Ex-Ante}} = $120.62

$W_{\text{Ex-Ante}} = $94.7

Fraction Insured

Demand

Marginal Cost

'Ex-ante' Demand
For the medium and large risk specifications, ex-ante and ex-post (DWL) welfare measures generate different conclusions.

- DWL perspective prefers markets
- Ex-ante/utilitarian perspective prefers mandates
Key Lessons

- Insurance insures against the realization of risk
  - Adverse selection implies a divergence between DWL and Ex-ante welfare

- Exploit Baily-Chetty logic to create ex-ante demand curve
  - Conduct utilitarian/ex-ante welfare analysis

- DWL and Ex-ante welfare can differ in conclusions about:
  - Optimal size of insurance market
  - Welfare cost of adverse selection
  - Competitive markets vs. mandates
  - Difference between DWL and Ex-ante welfare increasing in size of risk
1. Static Revealed Preference Welfare

2. Static Ex-Ante Welfare

3. Dynamic Insurance Model

4. Market Power and Networks
Suppose there are $T$ periods
  - No discounting for simplicity

Each period, medical spending shock $m_t$ is realized
  - Shocks can be persistent: future $m_{t+1}$ correlated with $m_t$
  - No choice in $m_t$ (can be extended)

Ex-Ante (time 0) budget constraint

$$E \left[ \sum_t c_t \right] = E \left[ \sum_t y \right] - E \left[ \sum_t m_t \right]$$

Equivalent to selling claims to $y_t$ and buying insurance in competitive ex-ante market to cover cost, $m_t$ (price in the market equals probability)

Utility given by

$$E \left[ \sum_t u (c_t) \right]$$
Reclassification Risk

- Ex-ante optimal allocation, \( \{ c_t \} \), solves

\[
u'(c_t) = \lambda \quad \forall t
\]

where \( \lambda \) is the lagrange multiplier on the budget constraint.

- Individuals are fully insured
  - State independent utility implies \( c_t = \bar{c} = E \left[ \sum_t y \right] - E \left[ \sum_t m_t \right] \)
Implementing the Optimal Allocation

- Are ex-ante contingent claims time-consistent?
  - No. Suppose you get a positive health shock – might want to withdraw and consume future endowment
    - Requires commitment to sell future income stream to cover health costs
    - But healthy people might want to leave!

- Cochrane (1996): Can implement with 1-period contracts

- Each period \( t \) buy insurance that pays \( t_t (m_{t+1}) \) if \( m_{t+1} \) occurs in period \( t + 1 \) at price \( q_t (m_{t+1}|m_t) = \Pr \{ m_{t+1}|m_t \} \)

\[
c_t (m_t) + m_t + \sum_{m_{t+1}|m_t} t_t (m_{t+1}) q_t (m_{t+1}|m_t) = y + t_{t-1} (m_t)
\]

- Lagrange multiplier \( \lambda_t (m_t) = \text{marginal utility of consumption if } m_t \text{ is realized} \)
Consider period $t$ optimization after $m_t$ has been realized

Can collapse period $t' > t$ budget constraints (recursively substitute out $t_t (m_{t+1})$)

\[ c_t + m_t = y - E \left[ \sum_{t' > t} m_{t'} | m_t \right] \]

or

\[ c_t = y - E \left[ \sum_{t' \geq t} m_{t'} | m_t \right] \]
The maximization becomes

$$\max \ E \left[ \sum_{t' \geq t} u(c_t) \mid m_t \right]$$

subject to

$$c_t = y - E \left[ \sum_{t' \geq t} m_{t'} \mid m_t \right]$$

Claim: can equate marginal utilities across all states/time periods:

$$u'(c_{t'}) = \lambda(m_t)$$

for all $t' \geq t$

WLOG, extend back to $t = 0$ and we can implement the first best!
What do the insurance products look like that implement the first best?

Each period:

$$\bar{c} + m_t + \sum_{m_{t+1}} t_t (m_{t+1}) q_t (m_{t+1} | m_t) = y + t_{t-1} (m_t)$$

or

$$\bar{c} + m_t + E \left[ t_t (m_{t+1}) | m_t \right] = y + t_{t-1} (m_t)$$

or

$$t_{t-1} (m_t) = m_t + \bar{c} - y + E \left[ t_t (m_{t+1}) | m_t \right]$$

Payments, $t_{t-1} (m_t)$, are increasing in $m_t$ for two reasons:

- Medical shock, $m_t$
- Impact of $m_t$ on future insurance costs, $E \left[ t_t (m_{t+1}) | m_t \right]$

“Reclassification Risk”
Reclassification Risk: Commitment

- But, we don’t see markets for “reclassification risk” insurance
  - Why?

- Private information about future realizations of $m_t$
  - Akerlof unraveling?
  - No evidence of this, but could be true...

- Lack of 1-period commitment (Hendel and Lizzeri, 2003)
  - Good realizations of $m_t$ may induce people to “run” from the contract
  - Can implement with zero profits in each period, but requires $t_t (m_{t+1}) < 0$ for some realizations of $m_{t+1}$
  - Incentive to leave the contract and not pay!
Front-Loading

Solution: Front-load the contract!
- Pay the insurer lump sum upfront
- Can sustain $t_t (m_{t+1}) \geq 0$ in all future periods so that consumers never wish to leave the contract
- Hendel and Lizzeri (2003) argue this explains why life insurance contracts are front-loaded

Many reasons to want to front-load insurance contracts
- Prevents ex-post healthy people from leaving the risk pool

But, if front-loading helps increase commitment, should people be allowed to re-sell their insurance contracts?
- “Life settlement” market (Fang and Kung, 2010)
WHAT IS A LIFE SETTLEMENT?

A life settlement is a cash settlement obtained through the sale of your existing life insurance policy.

When life insurance is no longer wanted or needed a life settlement can be a much more valuable financial option than surrendering or lapsing your insurance. The beauty of a life settlement is that you receive a cash settlement that is significantly more than what your insurance company will pay and you will be free from the obligation and financial burden of paying future premium payments.

GET A FREE, NON-BINDING APPRAISAL
Should people be allowed to re-sell their insurance contracts?

- "Life settlement" market

Downside: Prevents commitment

Upside: Increases flexibility / choice

- But choice not necessarily welfare improving with asymmetric information

In general, if first period insurance contracts were optimal but required commitment, then re-trading in life settlement markets ex-post will reduce welfare
Reclassification Risk

- In practice, most health insurance contracts do not look like optimal contracts in Cochrane (1996)
  - Repeated static contracts
  - Perhaps because of both commitment and private information problems?

- Opens up important questions in optimal insurance designs
  - Community rating versus adverse selection

Simulate model of health insurance with repeated static insurance contracts

- Community rating: everyone pays same price
- Risk-based pricing: prices of insurance is risk-rated

Community rating generates adverse selection within periods

- Healthy people don’t buy insurance
  - Wait until they’re sick to buy
- Leads prices for insurance to be too high

Risk-based pricing generates risk against the realization of health conditions

- Expose to reclassification risk: higher price of insurance if sick

Results: community rating generates significant adverse selection but 5x higher welfare than risk-based pricing

- Reduces reclassification risk!
Handel, Hendel, and Whinston (ECMA, 2015)

- Simulate model of health insurance with repeated static insurance contracts
  - Community rating: everyone pays same price
  - Risk-based pricing: prices of insurance is risk-rated
- Community rating generates adverse selection within periods
  - Healthy people don’t buy insurance
    - Wait until they’re sick to buy
  - Leads prices for insurance to be too high
- Risk-based pricing generates risk against the realization of health conditions
  - Expose to reclassification risk: higher price of insurance if sick
- Results: community rating generates significant adverse selection but 5x higher welfare than risk-based pricing
  - Reduces reclassification risk!

Studies Medigap Market
- Medicare pays 80% of bills; coinsurance of 20%
- Medigap reduces this 20% (several standardized/regulated policies available)

Two regulatory regimes that vary by states:
- Community rating for all ages
- Open enrollment period (6-months) at age 65
  - Followed by ability of insurers to underwrite post age 65
  - But, if purchased at age 65, policy is guaranteed renewable
Curto (2016)

- Incentives under community rating?
  - Wait until sick to buy Medigap...

- Curto (2016) provides evidence for this strategic behavior

- Empirical strategies:
  - Compare take-up across states with different policies
  - Robustness: explore differences only along border discontinuities
Figure 4: Age at First Purchase among Medigap Buyers

- Community Rating (CR)
- Guaranteed Renewal (GR)
- Community Rating with Rejections (CRR)

Notes: This figure shows a histogram of age at first Medigap purchase among Medigap buyers. The sample is restricted to individuals living in Community Rating areas.
Figure 12: Medigap Enrollment during Onset of Chronic Health Condition

Notes: This figure shows estimates of Medigap enrollment for each of the years prior to and after the onset of a chronic health condition. The chronic health conditions examined are severe cancers including those of the lung and upper digestive tract. The sample is all aged Medicare beneficiaries ever diagnosed with this health condition between 2006 and 2010. Year 0 is defined as the first year the health condition was diagnosed. Estimated coefficients are obtained from a regression of Medigap coverage on yearly indicators and individual fixed effects. The bars show 95 percent confidence intervals.
Considerable evidence of lack of competition in several dimensions:
- Health insurers
- Health providers

Additional reason for insurance: bargaining power with providers

Generates role of provider networks
- Ability to go to some but not all hospitals
Shepard (2016), “Hospital Network Competition and Adverse Selection: Evidence from the Massachusetts Health Insurance Exchange”

Star hospitals (e.g. MGH) attract sicker patients (adverse selection) and also cause an increase in costs (moral hazard)

But, people have strong demand for them!
- Adverse selection can lead to inefficiently low coverage of star hospitals
- But, adverse selection can reduce market power effects
  - higher prices $\rightarrow$ higher costs $\rightarrow$ less incentive to raise prices and exploit market power

[Aside: Thanks to Mark Shepard for sharing his presentation slides!]
### High-Price Star Hospitals: Partners Healthcare

- **Price**: Estimated with model of average amount paid per admission, adjusted for patient severity [Details](#).

<table>
<thead>
<tr>
<th>Hospital</th>
<th>System</th>
<th>Price</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Brigham &amp; Women's Partners</td>
<td>Partners</td>
<td>$20,474</td>
<td>1.12</td>
</tr>
<tr>
<td>2 Mass. General</td>
<td>Partners</td>
<td>$19,550</td>
<td>1.09</td>
</tr>
<tr>
<td>3 Boston Med. Ctr. BMC</td>
<td>BMC</td>
<td>$15,919</td>
<td>1.05</td>
</tr>
<tr>
<td>4 Tufts Med. Ctr. Tufts</td>
<td>Tufts</td>
<td>$14,038</td>
<td>1.10</td>
</tr>
<tr>
<td>5 UMass Med. Ctr. UMass</td>
<td>UMass</td>
<td>$14,111</td>
<td>1.07</td>
</tr>
<tr>
<td>6 Charlton Memorial Southcoast</td>
<td>Southcoast</td>
<td>$14,210</td>
<td>1.03</td>
</tr>
<tr>
<td>7 Baystate Med. Ctr. Baystate</td>
<td>Baystate</td>
<td>$12,223</td>
<td>1.11</td>
</tr>
<tr>
<td>8 Lahey Clinic</td>
<td>Lahey</td>
<td>$11,742</td>
<td>1.13</td>
</tr>
<tr>
<td>9 Beth Israel Deaconess CareGroup</td>
<td>CareGroup</td>
<td>$11,787</td>
<td>1.08</td>
</tr>
<tr>
<td>10 St. Vincent</td>
<td>Vanguard</td>
<td>$11,455</td>
<td>1.03</td>
</tr>
</tbody>
</table>

**All Other Hospitals**: --- $8,585 0.95
Evidence from Network Changes

- **Additional evidence**: How do selection patterns, costs respond to change in network coverage of Partners?

- **Biggest change**: Large plan (Network Health) drops Partners (+ several other hospitals) in 2012

How did network changes affect selection and costs?

- **Selection**: Look at plan switching
- **Cost changes (moral hazard)**: Analyze cost changes for non-switchers
Shepard (2016): Main Results

- Costs to policy decrease after Network Health plan drops Partners
- Is this moral hazard or adverse selection?
  - Study costs on those who don’t switch policies
  - Finds some reduction in costs
  - Indicates “moral hazard’
Evidence of Overall Cost Reductions for Stayers

Note: Points are group x time coeffs. from regression with individual fixed effects.
Shepard (2016): Main Results

- Paper sets up structural model to:
  - Study the welfare impact of covering a star hospital?
    - e.g. do too few or too many plans include MGH?
  - Studies counterfactual policies (e.g. increased risk adjustment)
    - Can prevent unraveling of coverage of star hospitals
    - But this doesn't increase welfare on net

- Main Lessons:
  - Adverse selection discourages covering star hospitals
    - Adverse selection may help explain rise in narrow network plans
  - Additional non-risk channel for thinking about adverse selection: selection on use of higher-cost option
    - Do people value this from an ex-ante perspective?
Einav, Finkelstein and Cullen (2010) provide baseline framework for welfare analysis of insurance

But, may not capture ex-ante welfare because information is realized over time (Hendren, 2017)

Suggests may be willing to trade off adverse selection for insurance against reclassification risk (Handel, Hendel, and Whinston, 2015)
  - But first-best would be to have dynamic re-classification contracts that insure against higher premiums in the future (Cochrane, 1996)
  - Alternatively, can front-load insurance contracts and have dynamic commitment (Hendel and Lizzeri, 2003; Curto, 2016)
    - e.g. Life insurance, LTC insurance, disability insurance, health?

Health insurance also provides access to providers
  - Additional adverse selection on preference for hospitals
  - Creates more complicated welfare/design questions