Earning dynamics and selection in health insurance market

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Motivation

- Improve welfare analysis for policies to combat Adverse selection can save a lot of money
  - Adverse selection: sicker individuals have higher incentive to purchase health insurance and healthier people drop out of the market, leading to higher premium, low take-up and welfare loss.
  - An enormous amount of money is spent every year to reduce adverse selection

- Limited consideration of earning dynamics in welfare analysis
  - Consumption risk also consists of earning risks
  - Data limitation in estimating relationship between earning and medical spending
  - Earning dynamics might affect WTP for health insurance

- **This paper**: investigate the impact of introducing consideration of earning dynamics on adverse selection in Health insurance market

What's new

1. Utilize new data
   - Literature: usually ignores heterogeneity in earning dynamic in welfare analysis for health insurance policies—Data limitation
   - Combines Utah UI records and All-payer Claims Data in Utah
     - estimate the joint distribution of earning and medical spending
2. First to investigate the impact of earning volatility and correlation between earning and medical risk on adverse selection
3. Combine the discussion of health-related policy and non-health related policy (in progress)
   - Literature: usually separate discussion of two types of policies
   - This paper: examine the impact of non-health related policy, e.g. unemployment insurance, on health insurance market
4. Main finding: ignoring heterogeneity in earning dynamics tend to overestimate the adverse selection

Earning distribution prediction

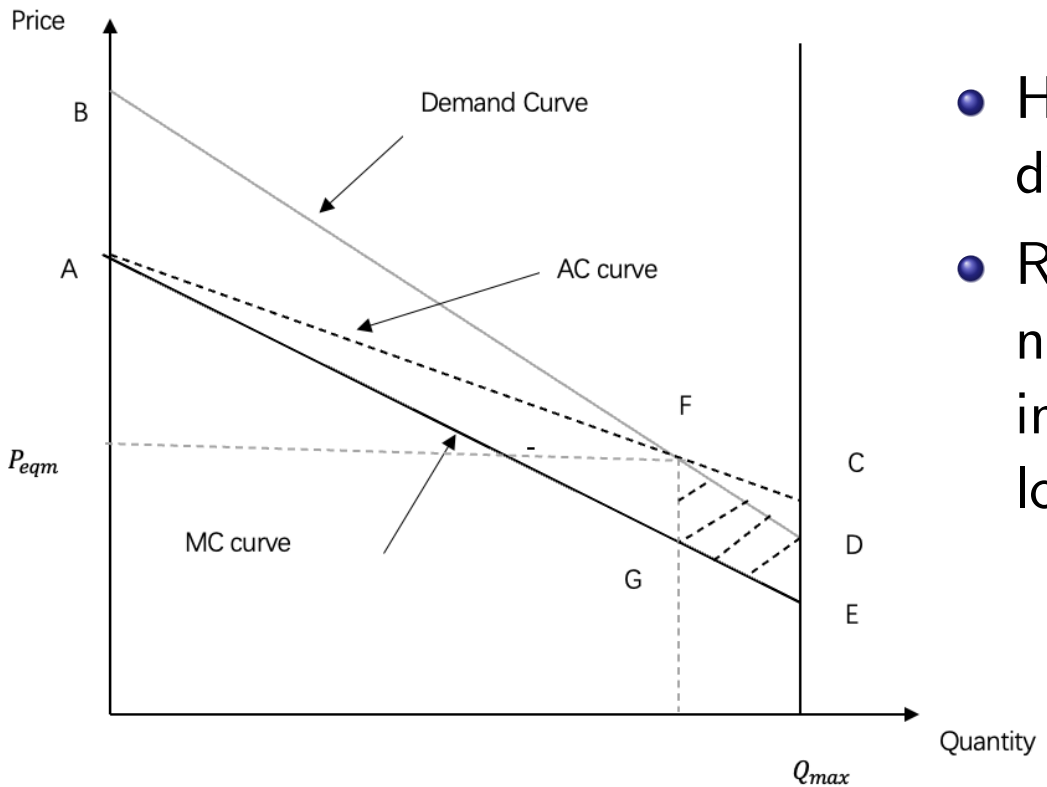
$$w(\theta_{it}) = exp(\underbrace{f_W(\theta_{it})}_{\text{mean log earning}} + \underbrace{\epsilon(\theta_{it})}_{\text{log earning error}})$$

- Earning distribution prediction
  - "Persistent shock": Type realization in t: $Pr(\theta_{it})$
  - "Transitory shock": Log earning errors $\epsilon(\theta_{it})$
- Heterogeneity and WTP
  - John vs. Tom: Medical risk
  - Tom vs. Jerry: Earning volatility
  - Jerry vs. Alice: correlation between earning and medical spending
  - Tom vs. Anna: Earning mean

Name	E(W)	SD(W)	E(M)	ρ
John	40,000	0	3000	0
Tom	40,000	0	5000	0
Jerry	40,000	2,000	5000	0
Alice	40,000	2,000	5000	negative
Anna	400,000	0	5000	0

Deviation from textbook Akerlof model

Textbook Akerlof model



- Heterogeneity in earning dynamic change WTP
- Resorting: the expected cost of next person to buy the insurance is no longer always lower than the previous buyer

Overview of the talk

1. Earning's impact on WTP
2. Model: prediction of earning and medical spending
3. Decomposition
4. Counterfactuals: subsidy and mandate
5. Conclusion
6. Future studies

Earning impact intuition

Decision Problem

- Setting
  - Homogenous concave utility function $u(.)$
  - Saving is not allowed for now

- Uninsured vs. Fully insured

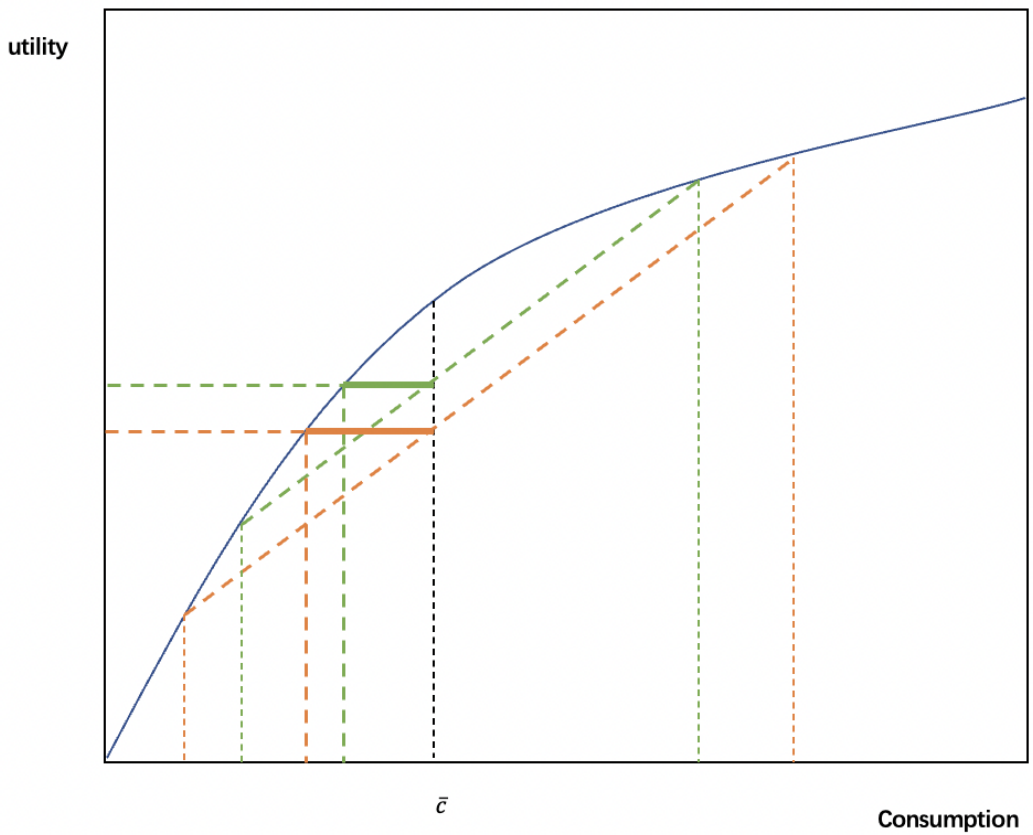
Impact of earning on WTP is ambiguous

- **We might think**: People with higher earning volatility are willing to pay more for health insurance because they face more consumption risks.

- However, the impact of earning volatility on WTP is **ambiguous** because of another force:
  - "More expensive plan": Have to give up more utility to pay for premium when earning volatility is higher.

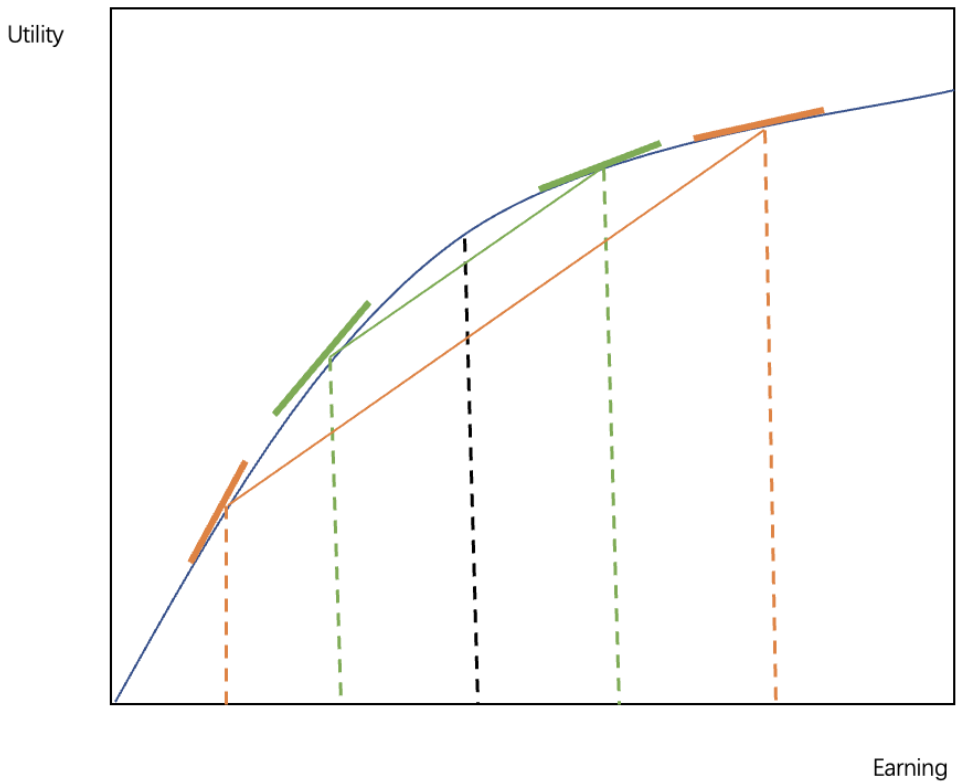
Earning volatility: force 1

- Same consumption mean.
- Orange: higher consumption volatility
- More consumption volatility, worse off if being uninsured: WTP $\uparrow$



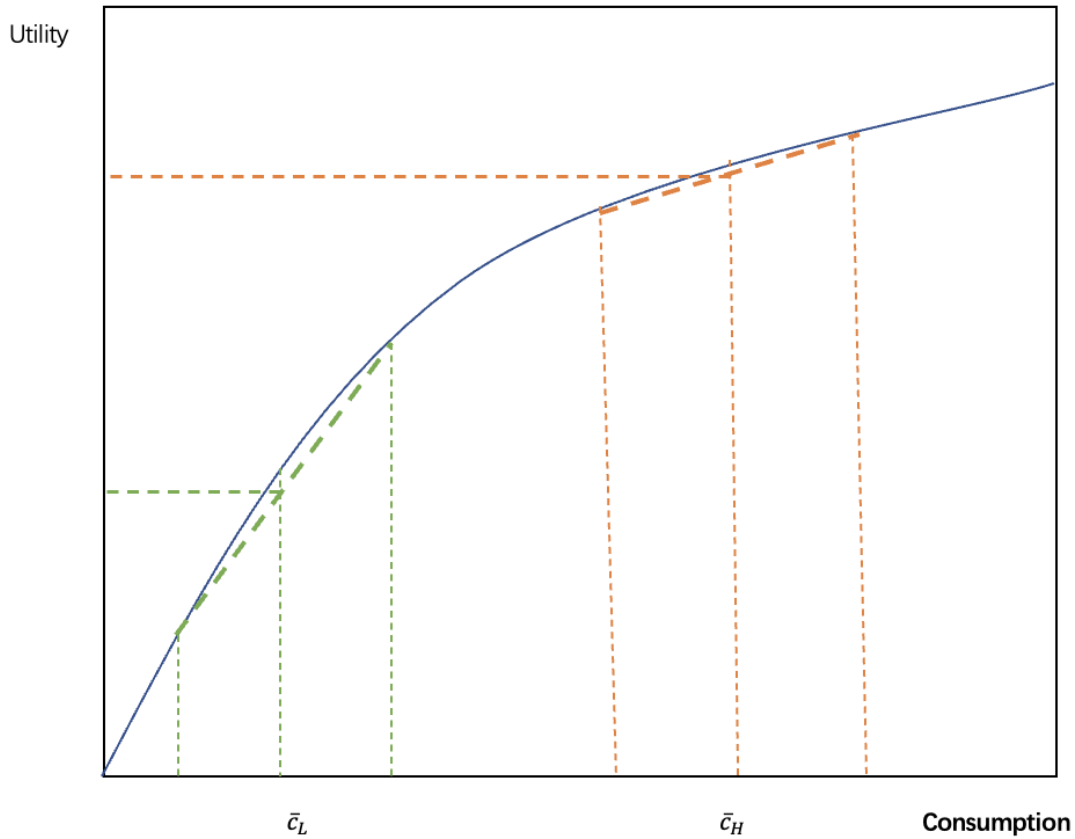
Earning volatility: force 2

- Orange: Higher earning volatility case
- Higher earning volatility, higher utility to give up for premium: WTP $\downarrow$



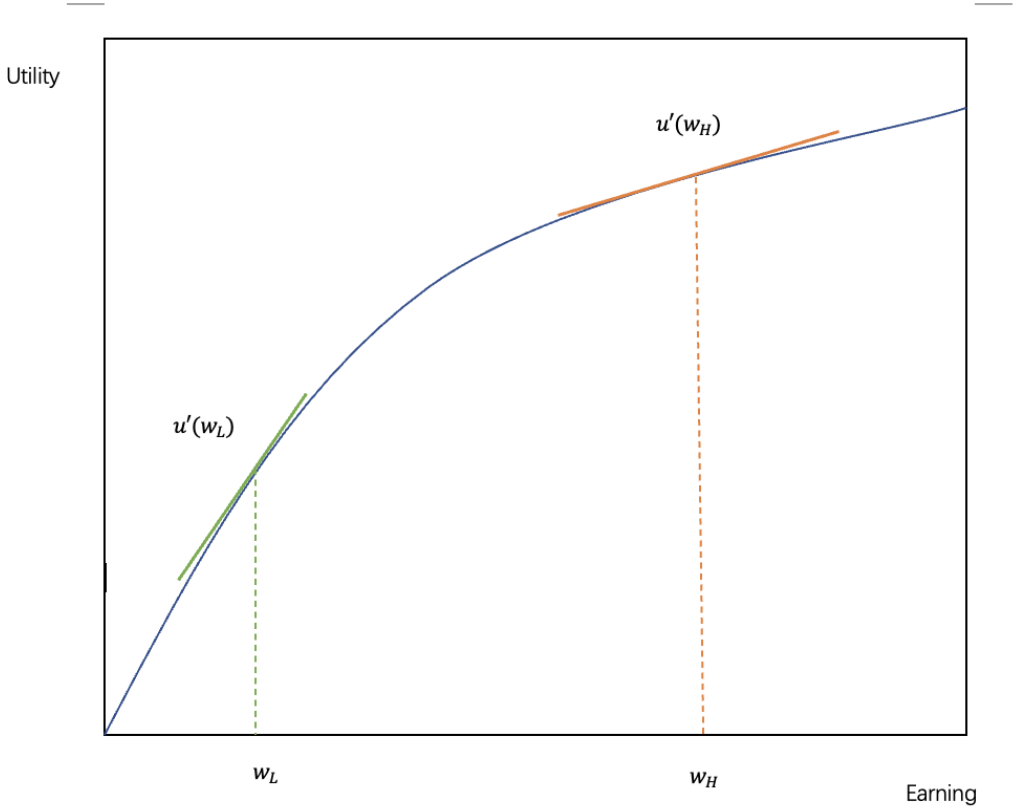
Earning mean: force 1

- Lower mean predicted earning, worse off if being uninsured: WTP ↑



Earning mean: force 2

- Lower earning mean, higher utility to give up to pay for premium: WTP $\downarrow$



Impact of correlation

Compare with the case that earning and medical spending are independent,

- **Negative**: Lower earning when higher medical spending, WTP $\uparrow$
  - Reallocating consumption from bad state to good state, making bad state worse, good state better
  - **More likely case**: bad health leads to lower earnings

- **Positive**: Higher earning when higher medical spending, WTP $\downarrow$
  - **Implicit insurance**: reallocating consumption from good state to bad state, making bad state better, good state worse

Is it possible to design a policy to utilize the correlation between w and m?

Consumption floor

- Abstract welfare policies that protect consumption risk
  - Definition: People's consumption in bad state is guaranteed to be above consumption floor because government will transfer wealth to the them in bad state
  - e.g. bankruptcy, unemployment insurance

- What does consumption floor do?
  - Wealth transfer
  - Reduction in consumption volatility

- **Heterogenous protection**: Earning dynamic affects the amount of protection from consumption floor

Precautionary saving

- We discussed **contemporary** consumption risk — uncertainty over which state of world would realize in current period

- People also have the need to smooth consumption between today and **future**
  - Risk can be persistent
  - People will build up asset to help protect their consumption risk over time
  - Large medical bill or unemployment may reduce asset holding $\Rightarrow$ protecting asset is one motive to buy Health insurance
  - Earning dynamic heterogeneity $\Rightarrow$ **Heterogeneous Asset holding**

Data

Data

- 2013-2015 All-payer Claims Data
  - insurance coverage of most people in Utah, and medical utilization records for inpatient, outpatient, physician office visits and prescription drug consumptions
- Utah UI records
  - Earning and employment status
  - employer-employee matches
- Linkage between the two data

Sample selection

- Age: 25-64
- Always insured from 2013-2015
  - medical spending unobserved for uninsured people
- Earn positive amount for at least one quarter from 2014-2015
  - Reduce the probability of including people who left labor force

Summary Statistics by health type

- People with higher spending are more likely to earn less, and more likely to be not employed, some evidence for negative correlation

	(1) All mean	(2) Health type = 1 (Lowest spending) mean	(3) Health type = 2 mean	(4) Health type = 3 mean	(5) Health type = 4(Highest spending) mean
Age	43.5	41.2	47.2	47.4	47.7
Male	0.5	0.6	0.4	0.4	0.4
Quarterly Earning	15875	16188	15940	15465	14282
Quarterly Earning(Imputed)	14762	15124	14840	14304	12960
Not employed	7.0	6.6	6.9	7.5	9.3
Total medical spending	1063	162	751	1488	6536
Acg risk score	1.2	0.5	1.2	1.9	4.8
N	3776220	2382740	562828	440348	390304

Model

Overview

1. Goal: develop a prediction model of joint earning and medical spending distribution

2. Two steps
   - Prediction of earning and medical spending **conditional on type**
   - Type transitions
     - multinomial logit model

Prediction of earning

Prediction of earning in next period t (when type realized is θ_{it}):

$$w(\theta_{it}) = exp(\underbrace{f_W(\theta_{it})}_{\text{mean log earning}} + \underbrace{\epsilon(\theta_{it})}_{\text{log earning error}})$$

- Uncertainty over
  - "Persistent shock": Type realization in t: $Pr(\theta_{it})$
  - "Transitory shock": Log earning errors $\epsilon(\theta_{it})$
- Earning mean prediction:
  1. Expectation over log earning errors: $\bar{w}(\theta_{it}) = \int w(\theta_{it}) dF(\epsilon)$
  2. Expectation over both log earning errors and possible types: $E(\bar{w}(\theta_{it})) = \sum_{\theta_{it} \in \Theta} Pr(\theta_{it}) \bar{w}(\theta_{it})$
- Correlation: types θ_{it} determines both earning and medical spending

Earning equation

When earning positive amount at t,

$$lnW_{it} = a\alpha_i + bQ_{it} \times k_{it}^{\mu} + dk_{it}^{\sigma} + eH_{it} + fX_{it} + \epsilon_{it} \quad (1)$$

where,

- W_{it} is the earning at time t.
- α_i: person earning type
- Q_{it} is the job mobility transition type in period t from period $t-1$.
- k_{it}^{μ} represents the pay level type of destination firm, and k_{it}^{σ} stands for the volatility type of the destination firm
- H_{it} is the indicator of which health type transition happens from period $t-1$ to t
- X_{it} are the covariates, include age, gender and year-quarter dummies
- ϵ_{it} is the error term

Types

- Health types
  - 4 categories, based on annual ACG risk scores
- Person and firm earning level fixed type link
  - Two way fixed effects model
- Job mobility
  1. Stayers: staying in the same firm
  2. Movers to a different firm
  3. Newly zero earners: moving from earning positive amount to earning zero
  4. Newly positive earners: moving from earning zero to earning positive amount
- Firm earning volatility type link
  - Proxy for uncertainty about transitory error conditional on types

Medical spending equation

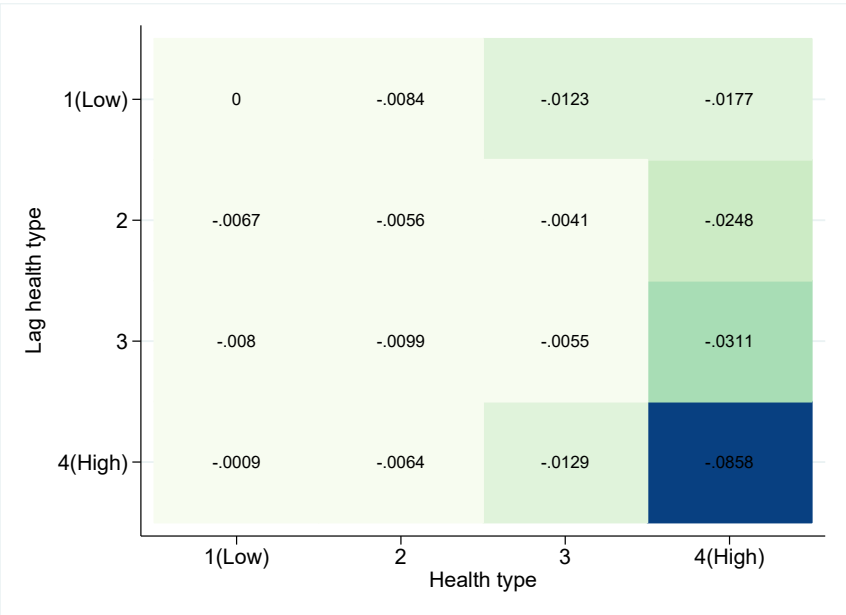
$$lnM_{it} = \rho lnM_{i,t-1} + AX_{it} + BH_{it} + C\alpha_i + D\phi_i + Gr_{it} + \nu_{it} \quad (2)$$

- M_{it} is the medical spending of last year.
- r_{it} is the average health insurance coverage of the year of prediction interest.
- X_{it} is time varying observables, here includes time dummies, age, gender
- ϕ_i is the time-invariant health conditions like diabetes and hypertension

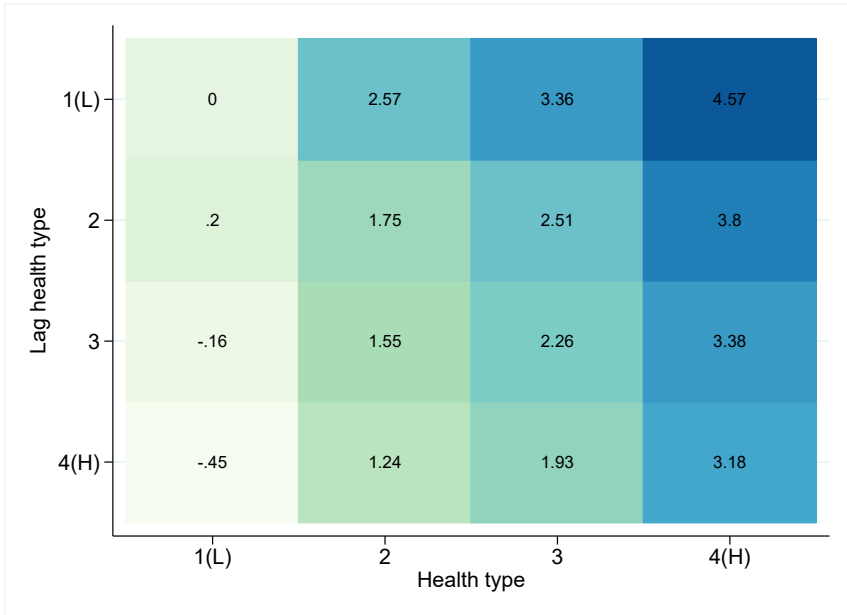
Quarterly prediction: divide the annual prediction by 4

Health type

- Negative correlation between earning and medical spending



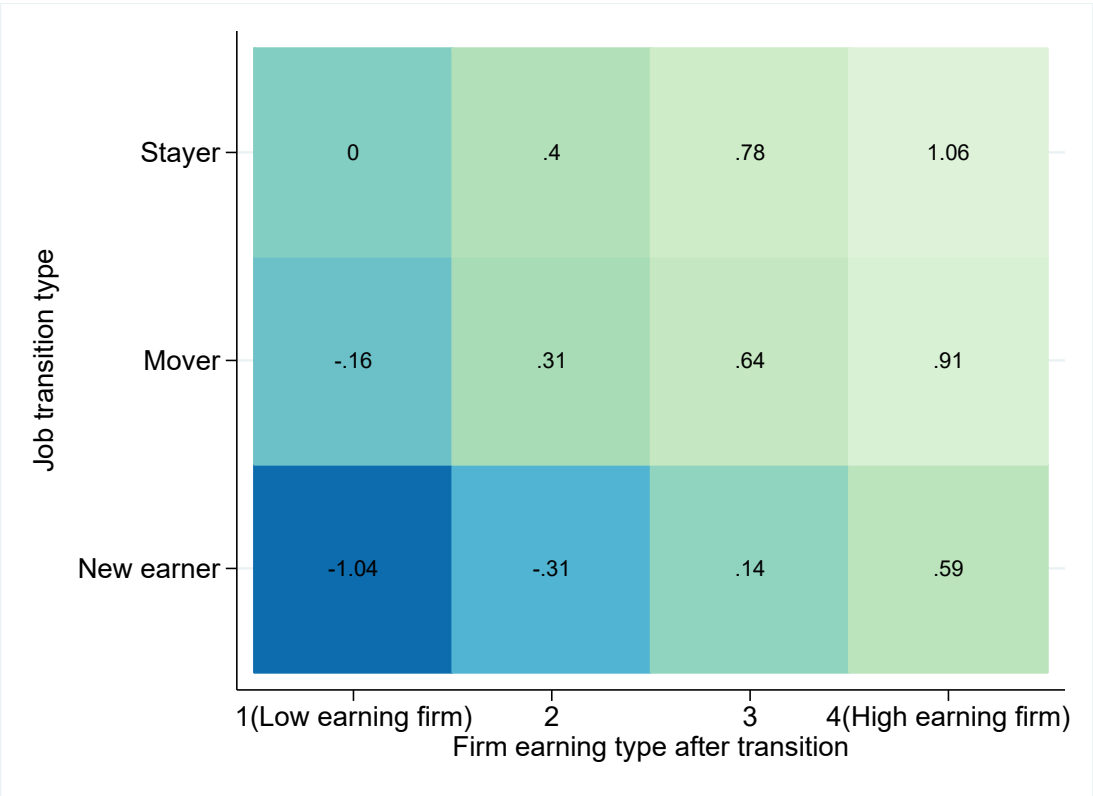
(a) Log quarterly earning



(b) Log annual medical spending

Job mobility

- Earning on average is higher if end up in a firm with higher pay type
- Conditional on the destination firm pay type, movers and new earners are on average earning less than stayers



Health impact on transitions of types

- Health type link
  - persistent
  - Older people are harder to transit out of bad health state

- Job mobility link
  - Zero earning state is persistent
  - Sicker people are harder to transit out of zero earning state

Decomposition

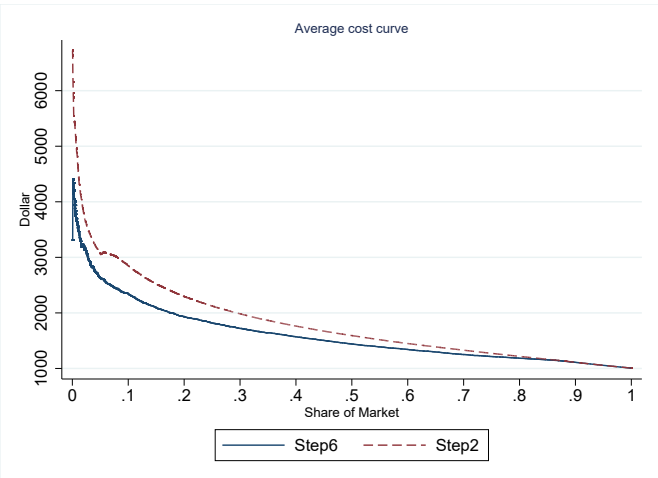
Decomposition

- Different earning measures
  - $w(\theta_{it})$: earning prediction with type uncertainty and transitory errors
  - $\bar{w}(\theta_{it})$: expectation over transitory errors
  - $E(\bar{w}(\theta_{it}))$: expectation over both type uncertainty and transitory errors
  - $E(\bar{w})$: population expectation over $E(\bar{w}(\theta_{it}))$

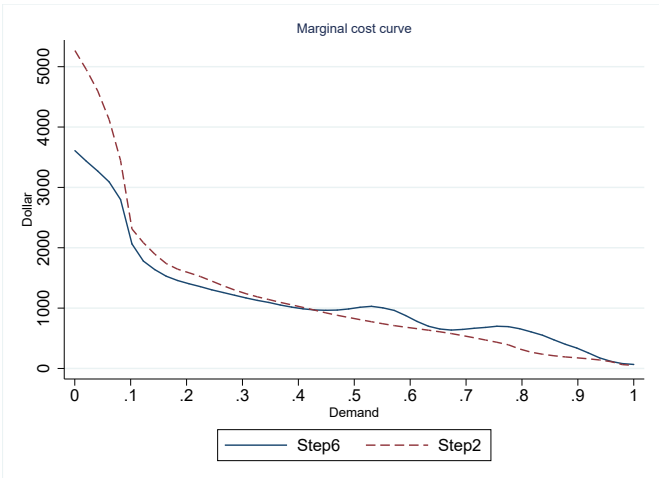
	Step	Take up	Equilibrium Premium	Consumer surplus per person	Transfer from consumption floor
1	Only heterogenous in Medical risk Earning: $E(\bar{w})$, Asset: 0	10.75%	2815	98.41	50.69
2	Add average asset holding consideration Earning: $E(\bar{w})$, Asset: $\bar{A}$	31.78%	1939	941.74	12.033
3	Add heterogeneity in asset holding Earning: $E(\bar{w})$, Asset: A_i	50.33%	1571	877.59	7.13
4	Add heterogeneity in earning mean Earning: $E(\bar{w}(\theta_{it}))$, Asset: A_i	40.63%	1580	710.00	63.25
5	Add heterogeneity in type uncertainty Earning: $\bar{w}(\theta_{it})$, Asset: A_i	39.98%	1589	697.00	68.18
6	Add heterogeneity in transitory errors Earning: $w(\theta_{it})$, Asset: A_i	37.09%	1614	629.59	76.42

Demand, MC and AC

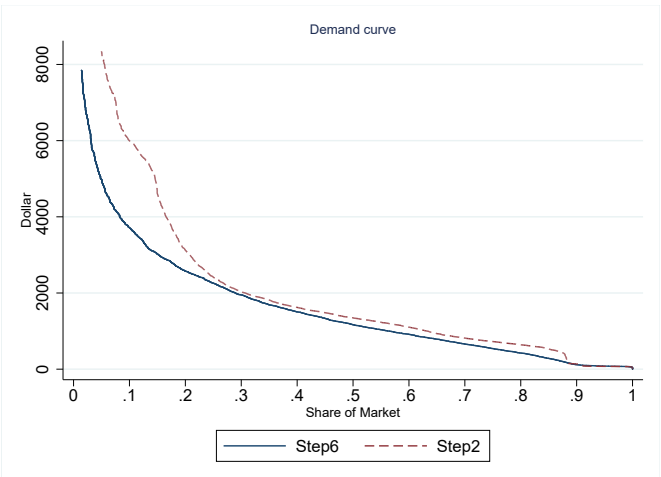
- "Resorting": MC is not monotonically decreasing; AC shifts down
- Demand shifts down



(a) AC



(b) MC(local polynomial fit)



Counterfactual

Counterfactual: subsidy and mandate

- Setting:
  - apply ACA policy and group everyone in the sample in one market
  - Allow heterogenous asset holding for all models in counterfactual analysis

- Theory behind policies
  - Subsidy: changes in utility cost of premium
  - Mandate: changes in expected utility of uninsured

Counterfactual: subsidy and mandate

- Take-aways:
  - the impact of subsidy and mandate changes when earning risk heterogeneity is not considered

Model		Equilibrium Premium	Take-up	Consumer Surplus per person	Cost of public funds
Status quo	Baseline	1571	50.33%	877.59	0
	$E(\bar{w})$	1580	40.67%	710.01	0
	$E(\bar{w}(\theta_{it}))$	1614	37.09%	629.60	0
Subsidy	Baseline	-240	+17.02%	+466.27	+117.89
	$E(\bar{w})$	-253	+24.17%	+348.06	+106.12
	$E(\bar{w}(\theta_{it}))$	-281	+29.64%	+364.82	+116.11
Mandate	Baseline	-166	+12.17%	+240.26	+0
	$E(\bar{w})$	-193.95	+13.29%	+233.24	+0
	$E(\bar{w}(\theta_{it}))$	-214	+14.29%	+229.23	+0

Conclusion

- Impact of earning on WTP for health insurance is ambiguous
  - Expected utility of being uninsured
  - Utility give up to pay for premium changes with earning mean and volatility
  - Consumption floor
  - Asset protection incentive

- Decomposition
  - Adverse selection is not only determined by medical risk, earning dynamics also matter
  - Ignoring heterogeneity in earning dynamics tend to overestimate the adverse selection

- Counterfactual
  - the impact of subsidy and mandate changes when earning risk heterogeneity is not considered

Next steps and future studies

- More counterfactual analysis
  - Government insurance on earning
  - Insurance that changes the correlation between earning and medical spending
- Allow choices among plans with different level of coverage
- Single agent to family
  - Marriage is also an implicit insurance
  - Changes the distribution of earning risk and medical risk
    - assortative mating is probably making inequality worse
- Reclassification risk and long-term insurance
  - Definition: changes in health status lead to changes in premiums over time if allow premium to depend on health status
  - Bad earning shock is persistent, reclassification risk is worse if we consider earning dynamics

Appendix

Person and firm earning fixed types

$$ln(W_{ijt}) = \underbrace{\gamma_i}_{\text{Person type}} + \underbrace{\Phi_{j(it)}}_{\text{Firm earning type}} + \beta X_{it} + \eta_{ijt} \quad (3)$$

where,

- γ_i is the person effects
- $\Phi_{j(it)}$ is the firm fixed effects, and $j(it)$ stands for the firm j that worker i matches to in period t.
- X_{it} is the year-quarter fixed effects

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Firm earning volatility type

- Proxy for the level of earning volatility an average employee faces inside each firm
- Divide firms into 4 categories based on $SD(F_j)$
  - Log earning difference between quarter $t-1$ and t: $ln(W_{i,t-1,t}) = ln(W_{it}) - ln(W_{i,t-1})$
  - standard deviation of the log earning difference for each firm j: $SD(F_j) = SD(\Delta ln(W_{i,t-1,t}))$

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Health type transition matrix

Table: Health type transition from $t-1$ to t for female

Age		1	2	3	4
26-30	1	0.81	0.09	0.06	0.03
	2	0.56	0.21	0.15	0.08
	3	0.44	0.17	0.25	0.14
	4	0.31	0.13	0.18	0.38
61-64	1	0.61	0.23	0.1	0.07
	2	0.45	0.26	0.21	0.08
	3	0.22	0.16	0.44	0.18
	4	0.14	0.09	0.29	0.48

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Currently Positive earners

Person type		Stayer	Mover	No earning
Lowest earning	Stayer	0.931	0.033	0.037
	Mover	0.792	0.154	0.054
	New earner	0.797	0.064	0.139
Highest earning	Stayer	0.984	0.01	0.006
	Mover	0.938	0.052	0.01
	New earner	0.953	0.022	0.025
Types: Healthiest, Male, 36-40				

Currently zero earners

	Lowest earning person(1)			Highest earning person (6)	
	Earning $= 0$	Earning>0		Earning $= 0$	Earning >0
Healthiest	0.755	0.245	Healthiest	0.726	0.274
Sickiest	0.784	0.216	Sickiest	0.758	0.242
Types: 36-40, Male					

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Currently zero earners

Panel A:	**Firm earning level type**			
Person earning type	1(Lowest earning)	2	3	4(Highest risk)
Lowest (1)	0.321	0.28	0.235	0.164
Highest(6)	0.171	0.267	0.227	0.335
Panel B:	**Firm earning risk type**			
Person earning type	1(Lowest risk)	2	3	4(Highest risk)
Lowest (1)	0.139	0.2	0.267	0.394
Highest(6)	0.196	0.274	0.278	0.252
Types: Male, 36-40				