Proprietary Data, Competition, and Consumer Effort:
An Application to Telematics in Auto Insurance

Event

Location

Date

Proprietary Data Collection

THE WALL STREET JOURNAL.

BUSINESS

EU Asks: Does Control of 'Big Data' Kill Competition?

Regulators say the information could allow big businesses to exclude rivals from markets

European Competition Commissioner Margrethe Vestager is concerned about the amount of data companies store and its implications for rival businesses. PHOTO: CHARLES PLATIAU/REUTERS

By *Natalia Drozdiak*

Updated Jan. 2, 2018 9:34 a.m. ET

💬 37 COMMENTS

BRUSSELS—European Union antitrust regulators are taking a hard look at an increasingly important corporate currency: data.

The Economist

Regulating the internet giants

The world's most valuable resource is no longer oil, but data

The data economy demands a new approach to antitrust rules

The first is that antitrust authorities need to move from the industrial era into the 21st century. When considering a merger, for example, they have traditionally used size to determine when to intervene. They now need to take into account the extent of firms' data assets when assessing the impact of deals. The purchase price could also be a signal that an

identity system, Aadhaar. They could also mandate the sharing of certain kinds of data, with users' consent—an approach Europe is taking in financial services by requiring banks to make customers' data accessible to third parties.

COMPETITIVE STRATEGY

Data Monopolists Like Google Are Threatening the Economy

Harvard Business Review

by Kira Radinsky

big data holds many other risks.

. Chief among these, in my mind, is

the threat to free market competition.

New York Law Journal

WWW.NYLJ.COM
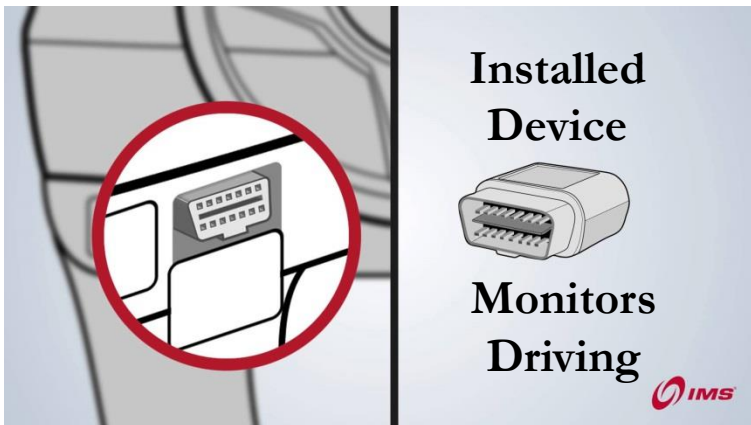
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ANTITRUST TRADE AND PRACTICE

Expert Analysis

Antitrust and 'Big Data': New Terrain for Inquiry?

Proprietary Data and Pricing

Installed Device

Monitors Driving

(Discounts for "good" behavior)
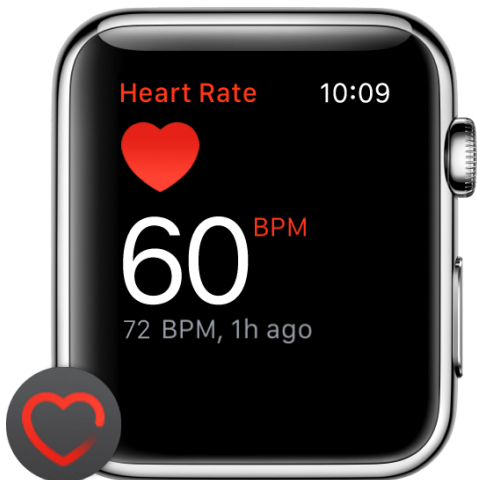
(Anti)competitive impacts

- **Monitoring for short periods generates switching costs**
  - Competitors cannot identify safer drivers to entice switching
  - Drivers would have to exert effort again
  - Monitoring costs incurred again

- **Proprietary monitoring allows price discrimination**
  - May itself be anticompetitive

- **Possible remedy: Force incumbents to share data with potential entrants**
  - … but that might reduce incentives to monitor

(Economic) benefits of monitoring

- **Inefficiencies from moral hazard**
  - Car accidents: $\approx$35,000 deaths and 2.35 million injuries yearly in U.S.[1]
  - Risky driving imposes externality on others and their insurers

- **Inexpensive monitoring may alleviate moral hazard problems**

[1] http://asirt.org/initiatives/informing-road-users/road-safety-facts/road-crash-statistics

Questions

- What is the impact of consumer monitoring on firm profits and consumer behavior?

- Do a firm's profits increase when it monitors its consumers? (And why?)

- Does competition erode profits when incumbents monitor their consumers?

- Does monitoring solve potential moral hazard problems?

- Specifically, investigate impacts of "Pay How You Drive" (PHYD) insurance products

- Background

Data use in insurance pricing

- Insurers try to tailor prices based on perceived risk

- In 1990s, used more variables for prediction
  - Credit scores, Education levels, GPAs

- Technological advances allowed proprietary data collection through monitoring
  - Cellular networks allow data transmission
  - By 2014, five companies introduced PHYD insurance

Pay-How-You-Drive insurance

- Drivers voluntarily install a monitoring device

- Insurers offer discounts up to 30% based on driving behavior
  - Hard Breaking
  - Late-night driving
  - Speeding
  - Mileage

- Monitoring periods vary between firms
  - Progressive: 30 days
  - Liberty Mutual: 90 days
  - The Hartford: 180 days
  - State Farm: permanently for some cars
  - Allstate: permanently

How can offering discounts increase profits?

$$Loss\ ratio = \frac{claims}{premiums}$$

- Get largest markup from safest drivers, even after accounting for discount

- Retention also highest for safest drivers (receiving largest discount)

PROGRESSIVE® snapshot

Loss Ratio vs. PHYD Group (Lower = Safer)

Legend: ○ Loss Ratio   □ Histogram of Earned Premiums
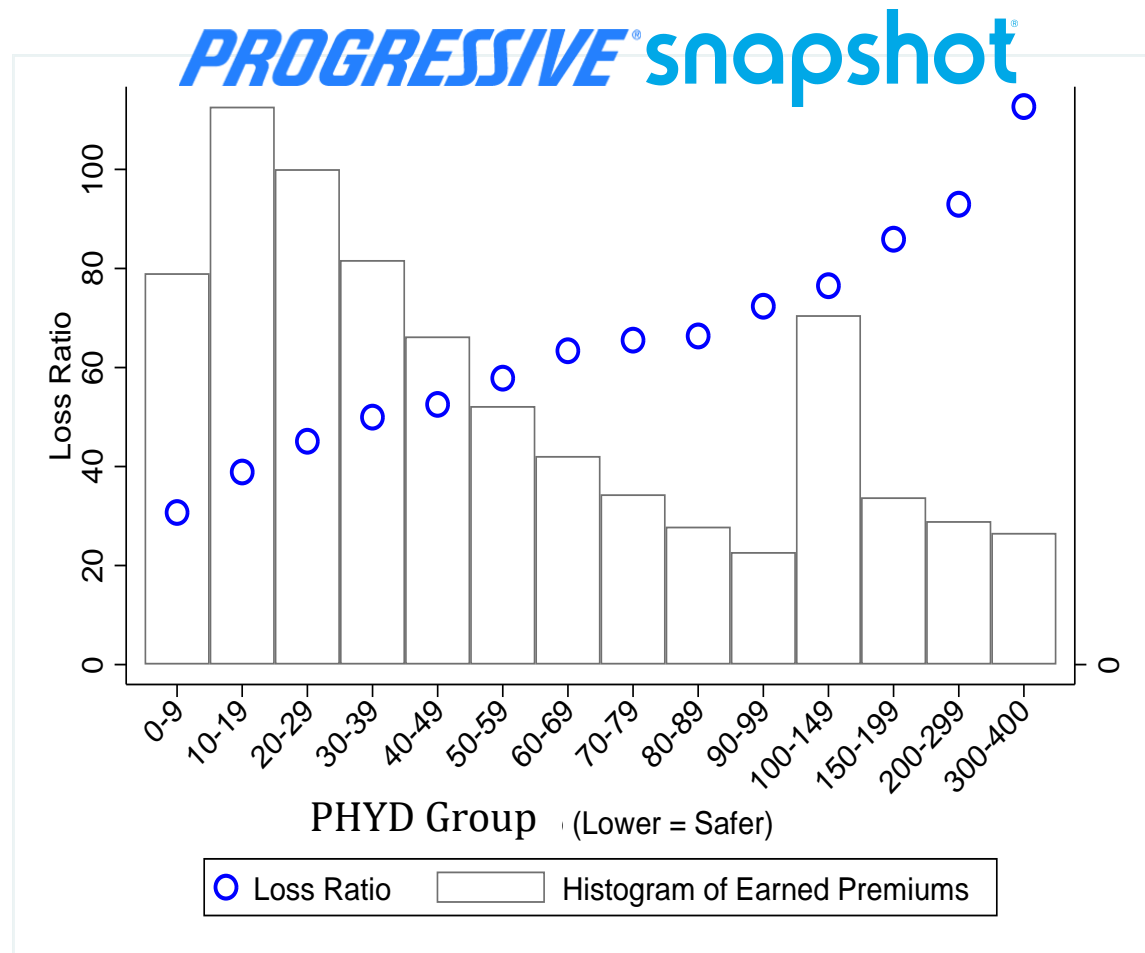
- Theoretical model

Intuition

- **If monitoring mainly alleviates moral hazard:**
  - Firms would want to monitor permanently
  - No advantage from previously collected data
  - Monitoring does not soften competition

- **If monitoring mainly helps segment consumers:**
  - Firms may want to monitor temporarily
  - If costs of monitoring are low, competition erodes profit
  - If costs of monitoring are high, the incumbent may retain supernormal profit

A simple model

- Consumers are rational and forward looking

- 2 consumer types: good and bad

- Cost to the firm (probability of an accident):
    - A_i if the consumer drives normally
    - 0 if a good driver is monitored

- Safe driving is costly (cost of effort r)
    - Firms can identify good drivers by monitoring

- Firms can choose to monitor perpetually or temporarily

Static Profits ($t > 1$)

When $r < A_G$:
- competition eliminates profits

When $r \geq A_G$:
- Incumbents may monitor to segment consumers

Facing competition, incumbent's static profits rise in r (monitoring effort costs)

permanent monitoring offered
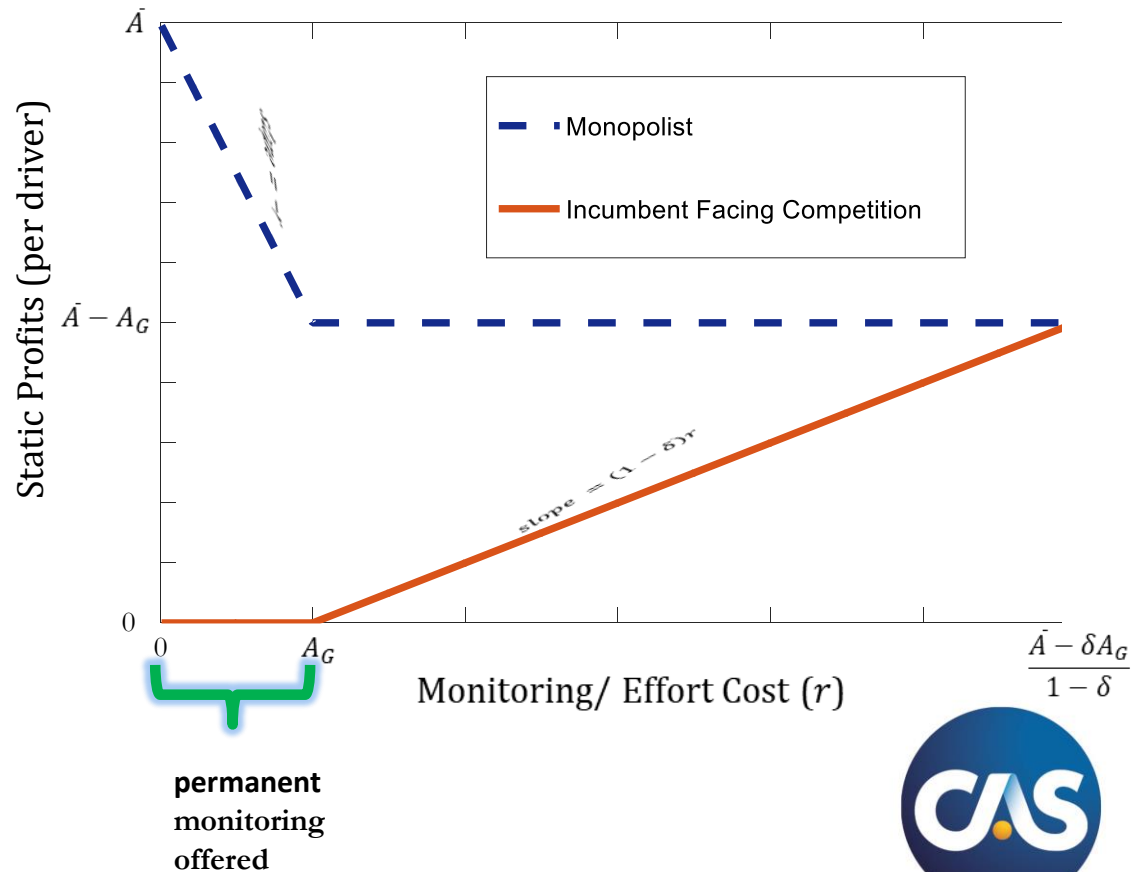
Take-Aways: competition

- The incumbent's static profits may lie anywhere between zero and monopoly profits
  - Depending on cost of effort

- If driver and insurer fully internalize cost of risky driving:
  - If effort cost $<$ risk reduction: firms permanently monitor
  - If effort cost $>$ risk reduction: incumbent monitors temporarily
    - Not monitoring would be efficient

- When costs of risky driving are not fully internalized:
  - Firms may monitor temporarily when permanent monitoring is efficient
  - Market failures may not be fully addressed

- Data

Data

- For each car insurer, state, and year from 2008 to 2014 (NAIC):
  - Profits, normalized by firm/state (derived from premiums, containment costs, and incurred losses)
  - Loss ratio $\left(= \frac{payouts\ to\ beneficiaries}{earned\ premiums}\right)$
  - Date of entry of PHYD program
    - (Including what the companies record)

- For each state and year (FARS):
  - Fatalities through car accidents
  - By accident location and registration state

PHYD Rollout Dates

- The 5 PHYD firms had a 42% market share in 2008

- Progressive began rollout years before other firms

Chart legend:
- **Progressive** (black)
- **StateFarm** (medium gray)
- **AllState** (dark gray)
- **Hartford** (light gray)
- **Lib. Mutual** (white)

Year	Progressive	AllState	StateFarm	Hartford	Lib. Mutual
2008	6				
2009	15				
2010	26		1		
2011	40	3	1		
2012	44	10	21	11	3
2013	46	28	45	15	10
2014	46	47	45	40	29
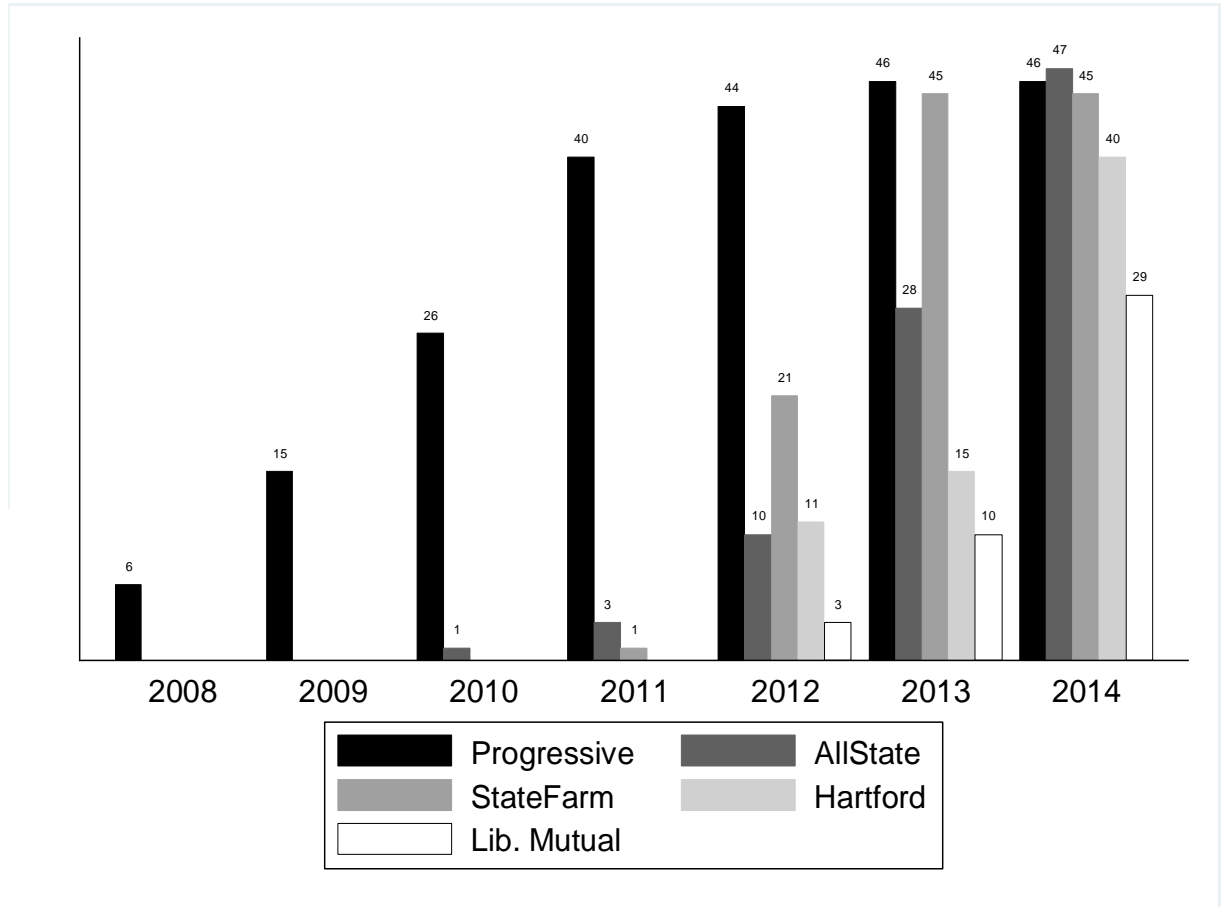
Entry order

Number States where Insurer was n^{th} To Introduce PHYD

Order of Entry	AllState	The Hartford	Liberty Mutual	Progressive	State Farm
1	1	0	0	41	4
2	10	5	1	1	15
3	11	7	3	5	17
4	14	15	8	1	6
5	2	15	23	0	2

Note: Any insurers entering the state in the same year were considered tied. In such cases, all tied insurers were assigned the highest entry order. For example, if AllState and Progressive each entered a state in the same year, and there were no preexisting UBI firms there, then both would be assigned an entry order of two, the second to arrive.

- Empirical Strategy and Results

Empirical Strategy

- Pseudo-random variation
- Each firm rolled out PHYD to most states very quickly
  - Speed of rollout appears primary concern of firms

- Entry timing impacted by regulations and number existing competitors

- Staggered entry
- Conditional on firm
  - PHYD is introduced in different states at different times
- Conditional on state
  - Different firms introduced PHYD at different times

Empirical Strategy (cont.)

- Estimation (Diff-in-Diff):
- Profits:

$$\pi_{jst} = \beta_0 + \beta_1 PHYD_{jst} + \beta_2 \times PHYD_{jst} \times NumComp_{st} + \mu_{jt} + \nu_{js} + \eta_{st} + \epsilon_{jst}$$

- Intuition:
  - Compare entrants changes in state-level profits
    - Relative to other firms in that state and that firm in other states

  - Compare changes incumbent's profits between states where competitors entered and where they have not

Profits

	Dependent variable is normalized profit (profit/avg. rev)		
	(1)	(2)	(3)
Entry order			
1st	0.0380**	0.0466**	0.0491***
	(0.0179)	(0.0186)	(0.0183)
2nd	0.0187		
	(0.0165)		
3rd	-0.0211		
	(0.0158)		
4th	-0.0089		
	(0.0158)		
I(Entered 1st) × I(n competitors)			
$n = 1$		-0.0120	-0.0224
		(0.0228)	(0.0254)
$n = 2$		-0.0145	-0.0272
		(0.0267)	(0.0264)
$n = 3$ or 4		-0.0438*	-0.0620**
		(0.0265)	(0.0289)
Years since entry			0.0075
			(0.0081)
Observations	6072	6072	6072

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Implies a 12-15% profit increase

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Observations	6072	6072	6072

Profits almost entirely eroded by competition

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Entry order			
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And it's not just about timing

Incumbent gain, Or competitors loss?

- Results imply change in profits relative to other firms

- Could be to entrant's gain or competitors loss.

- To investigate, add indicator for other firm's entry (dropping state/year fixed effects, which are no longer identified)

- $\pi_{jst} =$

$\beta_1 PHYD_{jst} + \beta_2 \times PHYD_{jst} \times NumComp_{st} + \beta_3 I(Oth. has\ entered_{st})\ \mu_{jt} + \nu_{js} + \epsilon_{jst}$

0.0261^* -0.0086 -0.0096

(0.0154) (0.0081) (0.0105)

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Statistical support for incumbent's profit increase

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0.0261^* -0.0086 -0.0096

(0.0154) (0.0081) (0.0105)

But not for other's loss

So what impacts PHYD entry?

	PHYD insurance entry			
	(1)	(2)	(3)	(4)
State allowed PHYD 2003	1.668***	1.657***		
	(0.237)	(0.236)		
Prior approval required		0.733*		
for rate changes		(0.117)		
Previous PHYD entrants			0.664**	
			(0.112)	
One PHYD entrant				0.519
				(0.224)
Two PHYD entrants				0.303**
				(0.165)
Three PHYD entrants				0.297**
				(0.178)
Four PHYD entrants				0.111***
				(0.087)
Observations	1453	1453	1453	1453

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Observations	1453	1453	1453	1453

Intensive vs. Extensive Margin

- Profit increases could be due to:
  - Increased revenue (more consumers)
- Decreased costs ("cheaper" consumers)

Impact of PHYD insurance on revenues and costs

	(1) Normalized revenue	(2) Cost ratio
Entered 1st	0.0354	-0.0380*
	(0.0314)	(0.0216)
I(Entered 1st) × I(n competitors)		
$n = 1$	-0.0112	0.0013
	(0.0228)	(0.0343)
$n = 2$	0.0312	0.0370
	(0.0344)	(0.0388)
$n = 3$ **or 4**	-0.0442	0.0354
	(0.0370)	(0.0374)
Observations	6071	6071

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Fatalities

Empirical Strategy

-
- Estimation (Diff-in-Diff):

$$\ln(Vehicles\ in\ Fatal\ Accidents)_{st} = \beta_1 PHYD_{st} + \beta_2 \ln(Vehicles)_{st} + \mu_s + \eta_t + \epsilon_{st}$$

- Intuition:
  - Compare vehicular fatalities between states where competitors entered and where they have not

Empirical Strategy

- **Robustness**
  - Worry: state safety initiatives might coincide with PHYD introduction
  - So divide vehicles by location state (s) and registration state (l), control for location accident trends

$$\ln(Vehicles\ in\ Fatal\ Accidents)_{lst} = \beta_1 PHYD_{lst} + \beta_2 \ln(Vehicles)_{st} + \mu_{ls} + \eta_{st} + \epsilon_{st}$$

- **Intuition:**
  - Safety initiatives depend on physical location
  - PHYD availability depends on where car registered
  - Can infer PHYD impact from impacts on accidents out of state

Monitoring and consumer behavior

PHYD insurance and moral hazard

	Log(cars in fatal accidents)		
	(1)	(2)	(3)
# firms with PHYD	-0.0162*		
	(0.0084)		
# firms entering this year		-0.0125	-0.0061
		(0.0105)	(0.0074)
# firms entering last year		-0.0210*	-0.0116
		(0.0111)	(0.0071)
# firms entering 2 years ago		-0.0157	-0.0225**
		(0.0121)	(0.0097)
# firms entering 3 years ago		-0.0067	-0.0059
		(0.0196)	(0.0147)
# firms entering 4 years ago		-0.0098	-0.0087
		(0.0233)	(0.0167)
Log registered vehicles	0.122**	0.123**	0.0396
	(0.0608)	(0.0611)	(0.0429)
Observations	1071	1071	55692

Monitoring and consumer behavior

PHYD insurance and moral hazard

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One additional PHYD insurer reduces accidents by ~1.6%

Monitoring and consumer behavior

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The effect is largest "early on"

An average monitored driver reduces their risk of being in a fatal accident by ≈50%

Conclusions

- In the context of auto insurance

- Proprietary data collection does not appear to soften effects of competition

- Monitoring saves lives

- Benefits fade over time

 – Likely due to temporary monitoring

- Subsidize monitoring programs?

Questions and Discussion

Identification

- Interacted fixed effects control for:
- firm-state presence, firm-level trends, state-level trends

- Firms might introduce PHYD in states where they expect unusual profit increases
- If so, hard to explain later entrants not profiting

- Google search volume didn't rise around PHYD introduction
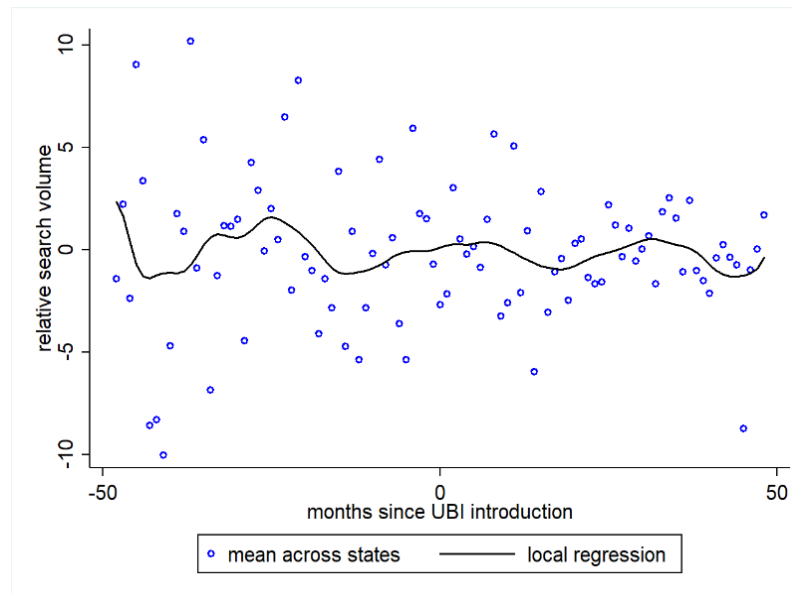
Relative Search Volume Around Progressive's PHYD insurance Entry

Robustness - Miles Driven

PHYD insurance and mortality (log cars in fatal accidents)				
	(1)	(2)	(3)	(4)
# firms with PHYD	-0.0162*		-0.0143*	
	(0.0084)		(0.0080)	
# firms entering this year		-0.0125		-0.01044
		(0.0105)		(0.0103)
# firms entering last year		-0.0210*		-0.0190*
		(0.0111)		(0.0108)
# firms entering 2 years ago		-0.0157		-0.0136
		(0.0121)		(0.0111)
# firms entering 3 years ago		-0.0067		-0.0063
		(0.0196)		(0.0197)
# firms entering 4 years ago		-0.0098		-0.0068
		(0.0233)		(0.0217)
Log registered vehicles	0.122**	0.123**	0.0792*	0.0801*
	(0.0608)	(0.0611)	(0.0470)	(0.0475)
Log miles driven			0.3709***	0.3708***
			(0.1330)	(0.1332)
Observations	1071	1071	1071	1071