Middlemen as Information Intermediaries: Evidence from Used Car Markets

Gary Biglaiser (UNC)   Fei Li (UNC)
Charlie Murry (Penn State)   Yiyi Zhou (Stony Brook)

Nov 2, 2017
Federal Trade Commission Micro Conference

Middlemen are everywhere...

Middlemen are everywhere...

What are their roles?

1. Facilitate search and matching

   - Theory: Rubinstein and Wolinsky (1987), Spulber (1996), Rust and Hall (2003), Wright and Wong (2014)
   - Empirical: Gavazza (2016), Hendel, Nevo, and Ortalo-Magne (2009) Salz (wp)

2. **Information certifier:** Biglaiser (1993) and Lizzeri (1999)

What are their roles?

1. Facilitate search and matching

   - Theory: Rubinstein and Wolinsky (1987), Spulber (1996), Rust and Hall (2003), Wright and Wong (2014)
   - Empirical: Gavazza (2016), Hendel, Nevo, and Ortalo-Magne (2009) Salz (wp)

2. **Information certifier:** Biglaiser (1993) and Lizzeri (1999)

What we do...

- Examine the the role of used car dealers in relieving asymmetric information.

- Present a model of dealer experts motivated by features of used car markets.

- Empirically test two key implications of the model:
  - Role/Value of Dealers: Dealer price premium is increasing in age.

  - Test of AI: Cars sold from private parties turn over more quickly.

Why do we car(e)?

Academic:

- Used cars classic example of market with AI.
- Dealers are "counteracting institution" in the parlance of Akerloff.

Practical:

- On-line peer-to-peer marketplaces typically have explicit certification/review mechanisms.
- Yet, significant amount of trade happens off-line.
- How do these market function with less developed certification mechanisms?

Why do we car(e)?

Academic:

- Used cars classic example of market with AI.
- Dealers are "counteracting institution" in the parlance of Akerloff.

Practical:

- On-line peer-to-peer marketplaces typically have explicit certification/review mechanisms.
- Yet, significant amount of trade happens off-line.
- How do these market function with less developed certification mechanisms?

Used Cars

- US total sales $\sim$ \$300 billion. Roughly 3-4 times the gross merchandise volume for eBay.
- Cars are complicated machines that require specialized care and maintenance – market ripe with information asymmetries.
- Two-thirds of used car transactions (in our sample) occur through a "dealer." Dealers are regulated, have reputation, and offer warranties and guarantees.

Model

Owners (Sellers)

- Used car with two potential quality states: $\{H, L\}$ (private information).
- Car state in private info of owner (seller).
- Quality shock arrives at some rate that changes the state. [Cont. time]
- Liquidity shock arrives at some rate that forces owner to sell.
- Seller can visit dealer with some exogenous probability.

Dealer

- Runs test to discover true quality of car.
- Makes a take-it-or-leave-it offer (potentially losing).
- Dealer sets selling price and earns price minus cost.
- Receives extra disutilty from selling an L.

Model

Buyers
- 2+ buyers, receive single unit of utility from car until it turns bad.
- Simultaneously bid for car – Bertrand competition.
- Observes the vintage, but does not observe quality or whether the car had been inspected by dealer.

Resales
- In a second "resale" stage, buyers receive liquidity shock with some probability and must sell.
- Buyer may also sell if they do not receive liquidity shock.
- Resale market observes vintage, but not the selling motive or previous seller.

Model – Important Assumptions

1. Exogenous Liquidity Shock + Dealer Visit
   - Induces exogenous mixing of High and Low cars in private market.
   - Ex: In Hedel & Lizerri (1999) – market tranches and distribution of valuations.
   - We can allow from some endogenous self selection.

2. Value of High and Low car
   - Assumption: Utility from H is greater than L.
   - Both types depreciate with vintage.
   - This difference decreases over time [goes to zero].

3. Dealer cost of selling "lemon"
   - Dealer less myopic than private sellers.
   - Stories: Damage to long run reputation, warranty costs, regulation.

Model – Results

Equilibrium

- Buyers bid expected quality in private market.
- Seller accepts dealers' offer it is greater than outside option.
- Dealers only trade in H type. Price equals buyer's utility.
- Resale market price is nonzero.

Model – Results

Equilibrium

- Buyers bid expected quality in private market.
- Seller accepts dealers' offer it is greater than outside option.
- Dealers only trade in H type. Price equals buyer's utility.
- Resale market price is nonzero.

Dealer Premium

1. Dealer's price premium in dollar terms is humped shaped in age.
2. Dealer's price premium in percentage terms is greater than one and increasing in age.

Intuition: Older cars more likely to be lemons – buyer values dealer certainty. But as cars get really old, depreciation wins out.

Model – Results

Equilibrium

- Buyers bid expected quality in private market.
- Seller accepts dealers' offer it is greater than outside option.
- Dealers only trade in H type. Price equals buyer's utility.
- Resale market price is nonzero.

Dealer Premium

1. Dealer's price premium in dollar terms is humped shaped in age.
2. Dealer's price premium in percentage terms is greater than one and increasing in age.

Intuition: Older cars more likely to be lemons – buyer values dealer certainty. But as cars get really old, depreciation wins out.

Car Resales

3. Buyer less likely to resell car if originally purchased from a dealer.

Intuition: All lemons want to be sold + liquidity shock cars.

Data

VA and PA car registrations / transactions
- Transaction date
- VIN (squish) of car
- odometer
- buyer zipcode,
- seller identity (if dealer) or zip (if individual).

VA Data (dealer premium)
- 2007-2014, 5.2 mil transactions
- Observe "squish VIN."

PA Data (resales)
- 2014-2016 1.8 mil. transactions
- Observe full VIN.

# Dealer Premium – Data

Table: Summary of Virginia DMV Data

	Mean	SD	Q25	Q50	Q75
Private Party Transactions					
Price	3,960	5,144	1,000	2,000	4,500
Mileage	134,376	67,290	92,183	132,315	171,300
Age	11.14	4.38	8	11	14
Dealer Transactions					
Price	13,032	8,518	6,349	12,000	17,779
Mileage	77,402	53,325	36,449	66,675	107,811
Age	5.99	4.05	3	5	9

Dealer Sales: 60.09%
Total Observations: 5,469,241

Dealer Premium – Data

- The dealer's price premium is humped shaped in age.

- The dealer's price premium in percentage terms is increasing in age.
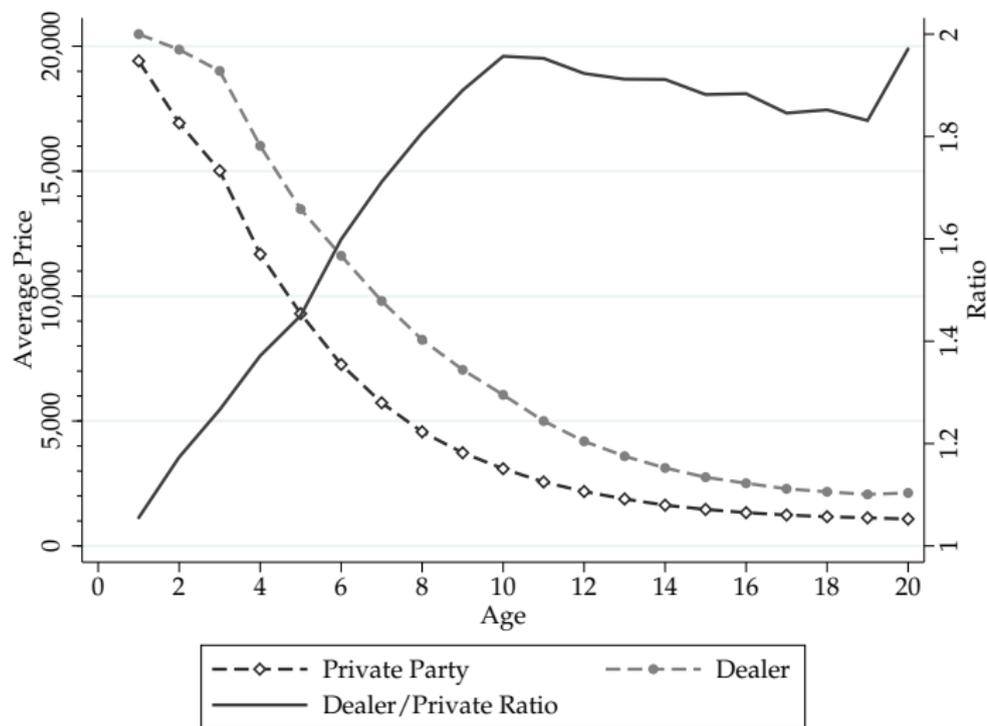
Dealer Price Premium – Empirical Strategy

- Hedonic price regression with model/make/MY/trim fixed effects.

- Include seller type (dealer) and car age dummy interactions.

- Idea: compare the price of the same type of car between dealers and private sales.

- Use four samples:
  - Baseline
  - Exclude new-car dealers
  - Exclude "unpopular" models
  - Exclude age<4

Dealer Price Premium – Results
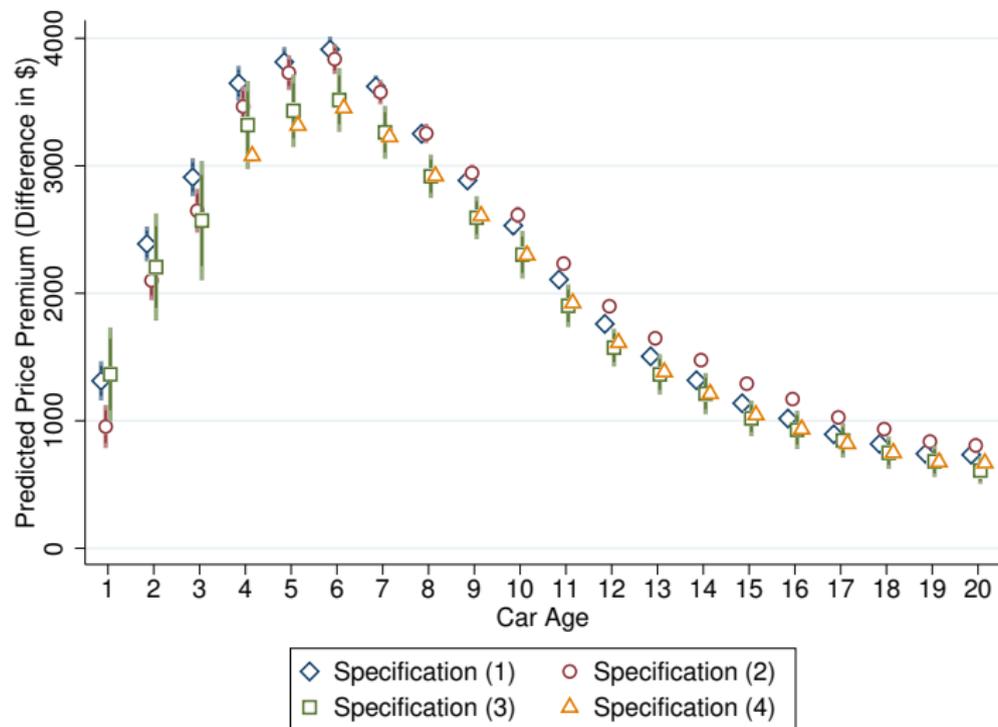
Dealer Price Premium – Results
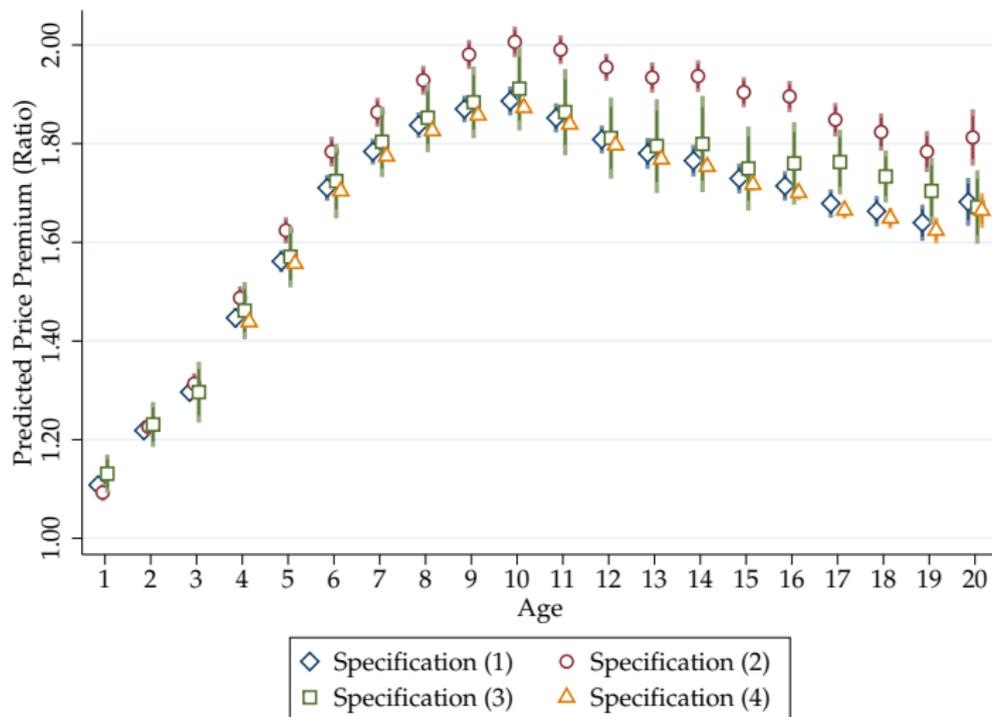
Car Resales – Data

Implication: A buyer is less likely to resell his car if the car was purchased from a dealer.

- We take all cars that we observe transacted in 2014 and follow them.

Table: Resales after Purchase

	Dealer Sales		Private Sales	
No. of Sales	648,106	(57%)	491,290	(43%)
Resale within one quarter	6,150	(0.95%)	10,865	(2.21%)
Resale within two quarters	12,938	(2.00%)	19,067	(3.88%)
Resale within three quarters	20,765	(3.20%)	27,183	(5.53%)
Resale within four quarters	29,661	(4.58%)	35,843	(7.30%)

Note: Percentage of cars transacted in 2014 resold after one, two, three, and four quarters.
Source: Pennsylvania Department of Transportation.

Car Resales – Empirical Strategy

- Look at resale rates by 3 month intervals.

- Control for model/make/MY/trim fixed effects.

- Instrument for seller type
  - Type of person to buy from dealer is more likely not to resell (high value of time...).

  - IV: local make/model dealer inventories.

Car Resales – Results

Table: Immediate Resale after Purchase: Logit with Product Fixed Effects

		Resale Time Window		
	One Quarter	Two Quarters	Three Quarters	Four Quarters
Bought from Dealer	-0.392	-0.259	-0.186	-0.144
	(0.018)	(0.013)	(0.011)	(0.009)
Log Mileage	0.135	0.179	0.176	0.170
	(0.019)	(0.014)	(0.011)	(0.010)

Car Resales – IV Results

Table: Immediate Resale after Purchase: Control Function

| | Fixed Effects Logit | | Control Function | |
| | Resale Window | | Resale Window | |
	One Quarter	Two Quarters	One Quarter	Two Quarters
Bought from Dealer	-0.540	-0.441	-0.488	-0.441
	(0.063)	(0.045)	(0.062)	(0.045)
Log Mileage	0.212	0.272	0.323	0.273
	(0.070)	(0.051)	(0.122)	(0.093)

Alternative: Middlemen Reducing Search Frictions

- Cars of different ages considered as different sub-markets. In each submarket,
    - A monopoly dealer can frictionlessly trade with other parties
    - Buyers and sellers with idiosyncratic search costs decide whether go to dealer or search directly for each other

Alternative: Middlemen Reducing Search Frictions

- Cars of different ages considered as different sub-markets. In each submarket,

  - A monopoly dealer can frictionlessly trade with other parties

  - Buyers and sellers with idiosyncratic search costs decide whether go to dealer or search directly for each other

- 1. Random Search: distributions of buyers' search cost are identical in all submarkets

  - dealer price premium in dollars would be ***constant*** in car age, in percentage would be ***decreasing*** in car age

Alternative: Middlemen Reducing Search Frictions

- Cars of different ages considered as different sub-markets. In each submarket,

  - A monopoly dealer can frictionlessly trade with other parties

  - Buyers and sellers with idiosyncratic search costs decide whether go to dealer or search directly for each other

- 1. Random Search: distributions of buyers' search cost are identical in all submarkets

  - dealer price premium in dollars would be ***constant*** in car age, in percentage would be ***decreasing*** in car age

- 2. Search and Sorting: distributions of buyers' search cost vary across all submarkets

  - dealer share and price premium are ***positively*** correlated

Alternative: Middlemen Reducing Search Frictions

- 3. Search and Market Thickness:
  - In thicker markets, products sell quicker and dealer price premium should be lower
  - Dealer price premium and time on the market are *positively* correlated

Table 6: Weeks on the Market before Sale

Car Age	1	2	3	4	5	6	7	8	9	10
Mean	7.39	7.15	7.09	6.88	6.27	6.03	5.85	5.58	5.19	5.02
SE	6.76	6.59	6.51	6.48	5.97	5.80	5.89	5.81	5.58	5.60
No. of Cars	20,293	19,148	19,081	11,240	8,175	6,095	8,515	7,520	6,616	5,854
Car Age	11	12	13	14	15	16	17	18	19	20
Mean	4.96	4.71	4.39	4.27	4.25	4.08	3.86	3.61	4.18	3.85
SE	5.72	5.64	5.54	5.72	5.73	5.31	5.53	4.54	5.17	5.30
No. of Cars	5,039	4,016	3,036	2,127	1,654	1,158	748	594	360	293

Note: This table reports the means and standard deviations of weeks before sale for dealer cars by car age. It also reports the number of dealer cars that were on sale by car age. The sample includes 131,567 used cars sold by dealers in four areas of Pennsylvania from January 2015 to July 2016. Source: Pennsylvania Department of Transportation and Cars.com.

Summary and Discussion

- We present a model where dealers act as experts to screen cars based on privately informed quality.

- The model predicts
  - The premium a dealer can charge is increasing in the age of the cars.

  - Buyer less likely to resell car if originally purchased from a dealer.

- We find empirical support for these implications in car registrations data.

- Findings suggests dealers play an important role in certifying quality and resolving information asymmetries, which is captured through a dealer premium.