The most wonderful time of the year? Thin markets, house price seasonality, and the December discount
ASSA-AREUEA, San Diego

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Overview

Research questions

- Is there a December discount?
- If yes, how big is it?
- What mechanisms generate the December discount?

Monthly prices (prices~Year FE + Month FE)
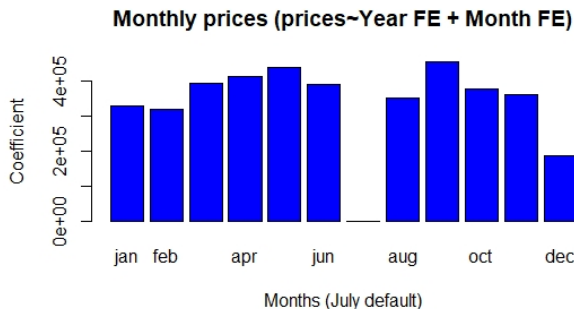
Motivation

- **Why do we care?**
- A December discount may be inconsistent with efficiency
- It sheds light on welfare gains of high-quality matches
- It informs us on the dual search problem for moving owner-occupiers
- It demonstrates the value of more bidders for sellers
- It indicates differences between thin and thick market effects

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Contribution

- Our contribution is purely empirical
- We use unique data to establish a December discount and explore the underlying mechanisms
- The data:
    1. 279,840 transactions with exact date of highest bid accepted, ask price, and appraisal value
    2. 125,986 auctions with every single bid and its date and time (precise down to the minute)
- We present evidence that points toward an explanation involving:
    1. Thin markets
    2. Impatient sellers

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Main empirical challenges

- We have to account for:
  1. Unobserved unit heterogeneity (omitted variables)
  2. Unobserved seller heterogeneity (self-selection)
- Unit heterogeneity:
  1. Unit FE (repeat-sales)
  2. Ask price
  3. Appraisal value
  4. Segmentation (for sale in August/September)
- Seller heterogeneity:
  1. IV (appraisal)
  2. Segmentation

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Related paper

- Ngai and Tenreyro (2014): Hot and cold markets in the housing market, *American Economic Review*
- We use their notion of thick markets as sum of buyers and sellers
- We control for time-variant unobserved unit heterogeneity (ask price)
- We control for unobserved seller heterogeneity (appraisal value)
- Precision of temporal grid (days for sales, minutes for bids)
- Use bid-by-bid auction data to measure impatience

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Data

- Transaction data:
  1. Sourced from Eiendomsverdi, a private firm that develops AVMs
  2. 279,840 observations
  3. Date at which bid was accepted
  4. Ask price
  5. Appraisal value
- Auction data:
  1. 125,986 auctions
  2. Bid-by-bid, date and time (minutes)
  3. Realtor ID
  4. Bidder ID

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December discount: Hedonic model

	I	II
Intercept	12.4 (0.12)	12.4 (0.12)
Logsize	-0.130 (0.05)	-0.150 (0.05)
Sqlogsize	0.090 (0.005)	0.092 (0.005)
Type, Geo., Constr. FE	YES	YES
Sales year FE	YES	NO
Time trend (Months)	-	0.00481 (1.4e-5)
Feb-June FE	YES	YES
Jan	0.014 (0.003)	0.0399 (0.003)
Sept	0.057 (0.003)	0.0488 (0.003)
Oct	0.044 (0.003)	0.0311 (0.003)
Nov	0.040 (0.003)	0.0220 (0.003)
Dec	0.019 (0.004)	-0.0038 (0.004)
Degrees of freedom	260,966	260,977
(Deleted due to missingness)	(18,811)	(18,811)
Adj. R2	0.715	0.710
F-statistic (p-value)	1.05e4 (2.2e-16)	1.25e4 (2.2e-16)

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RDD

	OLS of log(sell price) on			
	I*	II*	III*	IV**
Intercept	14.7 (5.0e-3)	12.7 (1.6e-2)	1.80e-1 (9.8e-3)	2.73e-1 (1.3e-2)
log(size)		0.44 (3.6e-3)	-1.85e-2 (7.1e-4)	-3.31e-3 (1.5e-3)
log(ask)			9.81e-1 (7.4e-4)	9.87e-1 (1.1e-3)
Type FE				YES
City FE				YES
Sale Year FE				YES
Construction Year FE				YES
log(size)*Type				YES
log(size)*City				YES
Days since 1 Aug	-1.46e-3 (9.1e-5)	-2.45e-3 (8.3e-5)	-1.03e-3 (1.2e-5)	-9.93e-4 (1.3e-5)
Dec*Days since 1 Aug	7.71e-5 (1.2e-4)	3.01e-4 (1.1e-4)	1.60e-4 (1.5e-5)	1.60e-4 (1.7e-5)
Sell months in sample		Aug-Dec		
Announced for sale		Aug-Sep		
N	56,413	56,413	56,413	56, 056
Adj. R2	0.0055	0.181	0.981	0.982

IV

	OLS			2SLS	
	I	II	III	IV	V
Intercept	12.69 (0.011)	0.0918 (0.0071)	0.229 (0.011)	0.0684 (0.0063)	0.0761 (0.0088
log(size)	0.417 (0.0025)	-0.0299 (0.00051)	-0.0095 (0.0012)	-0.0308 (0.00049)	-0.0297 (0.0006
log(ask)		1.004 (0.00054)	0.987 (0.00091)	1.0062 (0.00048)	1.0050 (0.0006
Type FE			YES		
City FE			YES		
Sale Year FE			YES		
Construction Year FE			YES		
log(size)*Type			YES		
log(size)*City			YES		
December	-0.0822 (0.0050)	-0.0168 (0.00079)	-0.0161 (0.00078)	-0.0166 (0.00081)	-0.012 (0.0008
Sell months in sample	Aug-Dec	Aug-Dec	Aug-Dec	Aug-Dec	Oct-Dec
N	115,756	115,756	114,877	115,792	60,052
Adj. R2	0.163	0.979	0.979	0.979	0.979

December Discount   4 January 2020   11 / 23

Fixed effect

	OLS	Fixed Effect			FE/IV	FE
		Log(sell) regressed on				
	I	II	III	IV	V	VI
Intercept	14.6***					
December	-0.076***	-0.024***	-0.0042	-0.010***	-0.0064*	-0.010***
Unit FE	NO	YES	YES	YES	YES	YES
Time FE	NO	NO	YES	YES	YES	YES
Log(ask)				0.821***		0.822***
Log(ask) on IV					0.236***	
Log(appraisal)						-0.0018
No. obs.	146,228	74,030	74,030	74,030	74,030	74,030
No. repeated	-	2	2	2	2	2
Adj. R2	0.00088	0	0.619	0.865	0.677	0.865

Skeleton models: Search and match-quality and stressed seller

- High match-quality $\rightarrow$ high WTP
- One bidder w/WTP $>$ reservation price $\rightarrow$ transaction
- Two bidders w/WTP $>$ reservation price $\rightarrow$ sell price $= WTP_{-1}$
- More bidders $\rightarrow$ higher probability of high price
- Thick markets $\rightarrow$ high prices

Some math stuff

- Optimum waiting time
- Utility maximization w/constraints $\rightarrow$ solution t^0
- Discontinuity in constraints $\rightarrow$ discontinuity in solution

Some more math stuff

Thin markets

	PS		
	I (on VS)	II (on HD)	III (on VS + HD)
VS	0.131 (0.011)		0.174 (0.039)
HD		0.316 (0.027)	-0.118 (0.098)
No. segments	230	231	230
No. obs.		449,719*	
Adj. R-sq.	0.401	0.331	0.403

Note: PS = price seasonality. VS = volume seasonality. HD = horizontal differentiation

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Stressed/impatient sellers I

Dependent variable	Sell-ask		Sell-appraisal
	I	II	III
Intercept	9.78e-2 (9.3e-4)	8.60e-2 (2.1e-3)	9.69e-2 (2.1e-3)
Size	-1.68e-4 (5.8e-6)	-5.24e-5 (1.1e-5)	-1.24e-4 (9.4e-6)
Appraisal		-3.45e-9 (3.8e-10)	
Type FE		YES	YES
Sale Year FE		YES	YES
City FE		YES	YES
Construction Year FE		YES	YES
Days since 1 Aug	-1.06e-3 (1.2e-5)	-1.01e-3 (1.2e-5)	-1.24e-3 (1.4e-5)
Dec*Days since 1 Aug	1.73e-4 (1.5e-5)	1.70e-4 (1.5e-5)	1.52e-4 (1.9e-5)
Sell months in sample		Aug-Dec	
Announced for sale		Aug-Sep	
N	56,413		56,033
Adj. R2	0.134	0.160	0.170
Predicted spread 21 Nov	-0.019		-0.054
Predicted spread 1 Dec	-0.028		-0.065
Predicted spread 11 Dec	-0.036		-0.076

Note: Predicted spreads for detached house in Oslo, size 100 sq.m., built after 2000, transaction year 2012

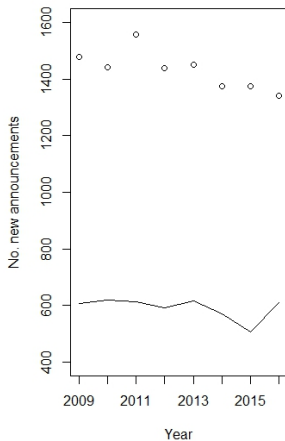# Stressed/impatient sellers II

Stressed/impatient sellers III

Survival rate. Days after registration
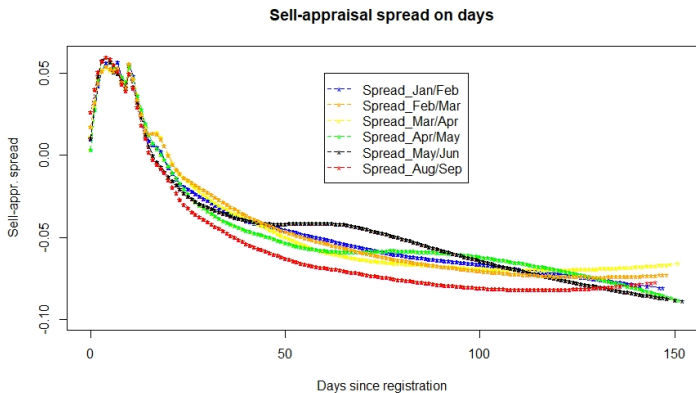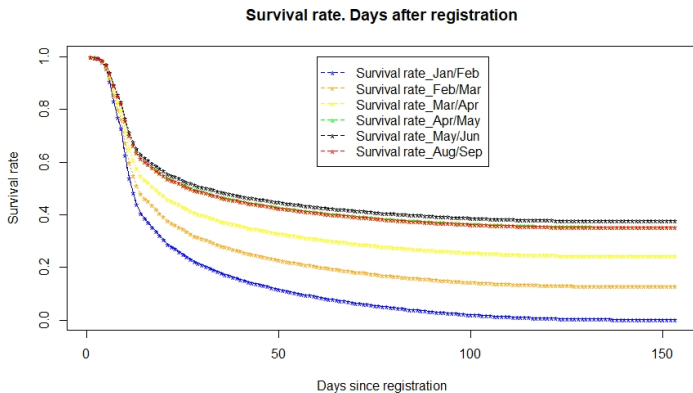
Impatient seller

	Diff. acc. decl.	Diff. acc. decl.	Days b/w acc. decl.	Days b/w acc. decl.
August	-0.340	-0.524	-4.701	14.447
	(0.226)	(0.346)	(17.020)	(20.134)
September	-0.742***	-0.913***	-57.711***	-34.518*
	(0.222)	(0.334)	(16.538)	(19.466)
October	-0.967***	-1.090***	-72.591***	-47.746**
	(0.222)	(0.337)	(16.617)	(19.587)
November	-0.788***	-1.193***	-57.482***	-58.016***
	(0.229)	(0.343)	(16.967)	(19.978)
December	-0.895***	-1.248***	-88.046***	-78.179***
	(0.264)	(0.393)	(19.347)	(22.873)
Days since decline		-0.000**		
		(0.000)		
TOM		-0.006***		0.230***
		(0.001)		(0.049)
N	25,568	12,445	20,792	12,445
R2	0.00208	0.180	0.00260	0.155
Controls		✓		✓
House type FE		✓		✓
Zip-code FE		✓		✓
Year FE		✓		✓
Realtor FE		✓		✓

Demand side: Bidding data set

	No. auc.	No. int.	No. bidders	No. bids	Bids per bidder	Perc. contested	Diff. acc. decl.
Detached:							
Month							
January-July	24996	8.47	2.14	6.34	2.86	6.97	5.81
August	4121	8.60	2.16	6.34	2.81	7.55	6.07
September	4901	8.58	2.09	6.24	2.87	6.65	5.71
October	4384	8.51	2.04	6.06	2.87	6.39	5.05
November	3669	8.16	2.06	6.21	2.94	6.62	5.76
December	1554	8.27	1.92	5.57	2.86	4.83	5.13
Apartments:							
January-July	38257	6.70	2.28	6.52	2.76	8.57	5.45
August	6180	6.73	2.27	6.52	2.75	8.38	5.44
September	6500	6.55	2.17	6.27	2.78	7.60	4.58
October	6042	6.34	2.12	6.09	2.78	7.15	4.32
November	5338	6.60	2.16	6.32	2.82	7.47	4.75
December	2313	6.67	2.10	5.99	2.80	6.61	4.88
All							
January-July	73694	7.37	2.22	6.47	2.81	7.95	5.58
August	11871	7.53	2.23	6.52	2.80	8.17	5.67
September	13236	7.41	2.13	6.27	2.83	7.18	5.08
October	12229	7.24	2.09	6.14	2.84	6.93	4.67
November	10461	7.14	2.10	6.22	2.87	6.86	4.99
December	4495	7.31	2.03	5.83	2.82	5.98	4.84

Supply side: New advertisements

New ads per year, Nov. vs Dec.

Mean new ads 2009-2016
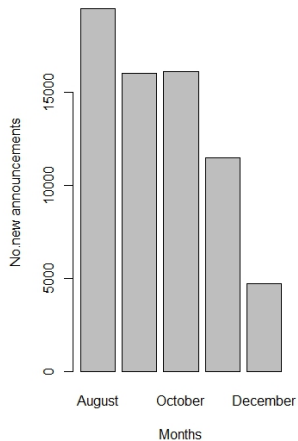
Note: November = points, December = line.

- There is a December discount
- It is at least 1 percent of sell price
- The discount is consistent with thin markets
- The discount is consistent with impatient sellers
- The discount is not consistent with stressed sellers
- Fewer bids and fewer new advertisements in December

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Skeleton model: Search and match-utility

$$M_{bh} = \begin{cases} H, & m(F_b, A_h) \geq m_H \\ M, & m_L < m(F_b, A_h) \leq m_H, \\ L, & \text{otherwise,} \end{cases} \quad (1)$$

$$P_h = \begin{cases} \pi_h = max_{-1,b}(WTP_{bh}), N_h \geq 2, max_{-1,b}(WTP_{bh}) \geq R_h \\ R_h, max_b(WTP_{bh}) \geq R_h, max_{-1,b}(WTP_{bh}) < R_h \\ no\ transaction, \text{otherwise,} \end{cases} \quad (2)$$

$$Prob(P_h = \pi_h) = \sum_{n=2}^{N_h} \binom{N_h}{n} \rho_G^n (1 - \rho_G)^{N_h - n}. \quad (3)$$

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Optimum waiting time and discounts

$$v_h(t) = max_t \quad B_h(t) - C_h(t) \qquad given \qquad f(B_h(t), C_h(t), V_h(t)) = 0 \qquad (4)$$

- Solution t^o

There are different empirical traces on a) the sell-appraisal spread, b) TOM, and c) the survival rate:

1. No changes in $V_h(t)$
2. A gradual change in $V_h(t)$ (growing impatience)
3. A discontinuity in $V_h(t)$ (stressed seller)

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