Housing Market Institutions Drive Race and Ethnicity Differences in Energy Consumption

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Abstract

When socio-demographic factors are considered in any kind of analysis of household electric and gas utility data, it is common to observe differences in energy use between households with different self-reported race and ethnicity compositions. These differences persist controlling for structure type, e.g., single family dwelling, age and size of housing units, and, other common control variables. Without the information necessary to better explain these differences, they are commonly summarized simply as cultural differences. This paper demonstrates that these differences can be partially explained by differential sorting by structure and ownership, i.e., endogenizing housing choice and rental decisions. We will show that these differences in energy consumption may be because of housing market institutions and restrictions.

1 Introduction

- Differences in energy use by race and ethnicity is frequently reported in the literature

- Much of the difference has to do with differences in income levels and education but not frequently modeled correctly.

- Even with proper race and ethnicity controls with income, some patterns persist.

- We assert that that these differences are at least partially caused by some housing discriminations, forcing people into houseing types different than what they would prefer without discrimination and into renting rather than buying.

- We show this with a model that endogenizes structure type and tenure decision.

- emphasize that this is early work.

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1.1 Race and Ethnicity in Conditional Demand

1.2 How Race and Ethnicity are Interpreted

2 RECS

- Description on RECS data size number of observations sampling method etc.

- Scope of data

- Weighting to account for stratifieed sampling

- We need more tables and graphics here.

	Mobile	SFDetached	SFAttached	SmApartment	LgApartment
FALSEWt	371	5694	544	430	951
FALSEAfAm	24	754	121	174	382
FALSEAsian	1	231	48	52	113
FALSEMulti	6	87	14	12	27
FALSENativeAm	7	35	9	7	15
FALSEOther	2	59	8	13	29
FALSEPacific	1	22	1	2	10
TRUEAfAm	3	8	10	5	8
TRUEAsian	0	5	0	0	1
TRUEMulti	1	10	2	4	4
TRUENativeAm	2	17	3	6	9
TRUEOther	6	41	12	16	24
TRUEPacific	0	2	1	1	0
TRUEWt	97	730	105	184	332

Table 1: Count of Observations by Race and Structure Type

2.1 Race and Ethnicity Differences in Equipment and Structure

- differences in structure type

- differnce in tenure

- differences in energy star controling for own rent

- general differences in own vs rent.

- explain with split incentives story

- difference in age of structure

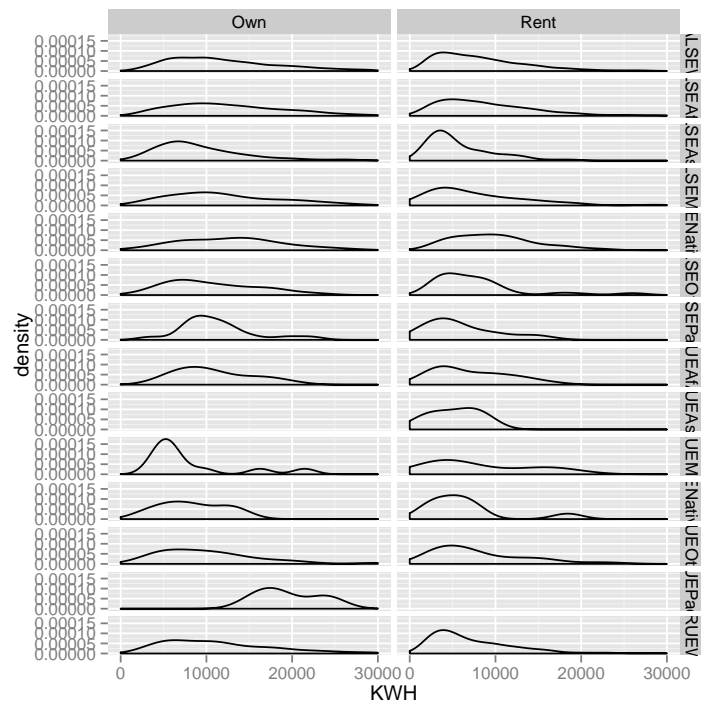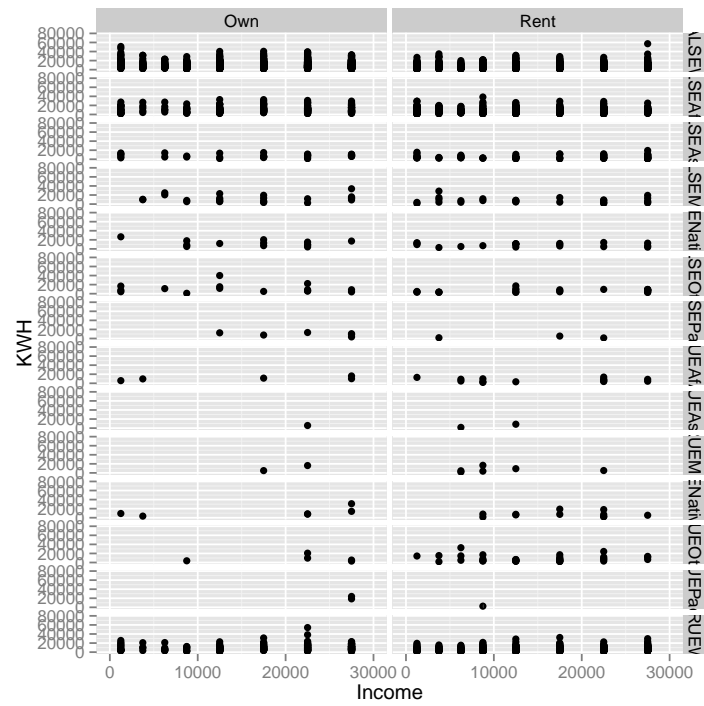Figure 1: Annual kWh by Rent/Own and Race

Figure 2: Annual kWh by Income

- differnces in hot water fuel

- difference in heating fuel

- difference in climate/location

2.2 Differences in Reported Behavior

- Differnces in thermostat settings

- difference in cooking behavior

- difference in reported AC use

2.3 HUD Complaints as a Measure of Discrimination

- trouble finding a good statewide index of housing discrimination

- the HUD complaint measure

- may be endogenous and be indicative of reduced discrimination

3 Conditional Demand Estimation

3.1 Orthodox Results

- Emphasize that we are making better use of race and ethnicity as a control with income than is common.

- We are not using the same estimation method as in RECS estimates of end use. Our model is much simpler and does not use engineering estimates or significant non-linearity.

- Major end-uses are included but relativly unsophisticated.

- discusss the orthodox results.

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	2181.1197	1792.3947	1.22	0.2237
ElecMealsThreeDay	1338.6588	297.7217	4.50	0.0000
ElecMealsTwoDay	1644.3185	185.0764	8.88	0.0000
ElecMealsOneDay	1685.3404	159.1570	10.59	0.0000
ElecMealsFewWeek	1451.1356	183.7584	7.90	0.0000
ElecMealsOneWeek	1726.8842	406.3322	4.25	0.0000
ElecMealsLessWeek	992.8116	424.8594	2.34	0.0195
NUMFRIG	1574.9574	120.8432	13.03	0.0000
AgeFridge2to4Years	49.6457	195.1174	0.25	0.7992
AgeFridge5to9Years	312.9075	183.1243	1.71	0.0875

AgeFridge20PlusYears	282.4503	328.6753	0.86	0.3902
AgeFridge10to14Years	392.2705	207.4396	1.89	0.0587
AgeFridge15to19Years	3.4299	283.6629	0.01	0.9904
NUMPC	345.0370	64.3126	5.37	0.0000
TIMEON1OneTo3Hrs	-142.2026	160.6198	-0.89	0.3760
TIMEON1ThreeTo6Hrs	-5.9463	186.4186	-0.03	0.9746
TIMEON1SixTo10Hrs	224.2810	239.0840	0.94	0.3482
TIMEON1Gr10	823.2281	214.7291	3.83	0.0001
WELLPUMPTRUE	1501.4018	183.5027	8.18	0.0000
ElecWaterSmall	4421.9192	256.3522	17.25	0.0000
ElecWaterMed	4658.3555	163.9114	28.42	0.0000
ElecWaterLrg	5809.5827	189.7584	30.62	0.0000
ElecWaterTankless	3251.7517	755.3718	4.30	0.0000
SWIMPOOLTRUE	3228.7285	222.3292	14.52	0.0000
ElecPoolTRUE	4604.1557	837.0574	5.50	0.0000
RECBATHTRUE	1013.4653	426.3413	2.38	0.0175
ElecTubTRUE	1218.8041	486.6005	2.50	0.0123
NHSLDMEM	952.0720	42.5506	22.38	0.0000
Income	0.0086	0.0016	5.37	0.0000
TVONWD1LessHour:TVTYPE1Standard	-3266.1101	1800.2730	-1.81	0.0697
TVONWD1OneTo3Hrs:TVTYPE1Standard	-3010.1255	1775.5111	-1.70	0.0900
TVONWD1ThreeTo6Hrs:TVTYPE1Standard	-2516.9211	1772.6818	-1.42	0.1557
TVONWD1SixTo10Hrs:TVTYPE1Standard	-1794.7156	1778.9345	-1.01	0.3131
TVONWD1Gr10:TVTYPE1Standard	-1290.6207	1784.9518	-0.72	0.4697
TVONWD1LessHour:TVTYPE1LCD	-2896.8097	1807.2466	-1.60	0.1090
TVONWD1OneTo3Hrs:TVTYPE1LCD	-2313.1891	1773.9814	-1.30	0.1923
TVONWD1ThreeTo6Hrs:TVTYPE1LCD	-1955.8036	1770.9445	-1.10	0.2695
TVONWD1SixTo10Hrs:TVTYPE1LCD	-1593.9919	1777.1898	-0.90	0.3698
TVONWD1Gr10:TVTYPE1LCD	-485.7205	1785.6404	-0.27	0.7856
TVONWD1LessHour:TVTYPE1Plasma	-1497.7500	1988.0024	-0.75	0.4512
TVONWD1OneTo3Hrs:TVTYPE1Plasma	-1664.7504	1800.8346	-0.92	0.3553
TVONWD1ThreeTo6Hrs:TVTYPE1Plasma	-2001.8306	1788.6852	-1.12	0.2631
TVONWD1SixTo10Hrs:TVTYPE1Plasma	-940.8541	1815.7684	-0.52	0.6044
TVONWD1Gr10:TVTYPE1Plasma	418.9083	1846.1024	0.23	0.8205
TVONWD1LessHour:TVTYPE1Projection	-2094.9059	2146.9297	-0.98	0.3292
TVONWD1OneTo3Hrs:TVTYPE1Projection	-1639.6049	1851.1064	-0.89	0.3758
TVONWD1ThreeTo6Hrs:TVTYPE1Projection	-2152.3377	1812.9470	-1.19	0.2352
TVONWD1SixTo10Hrs:TVTYPE1Projection	-925.1902	1837.7040	-0.50	0.6147
TVONWD1Gr10:TVTYPE1Projection	1530.2305	1911.2140	0.80	0.4234
TVONWD1LessHour:TVTYPE1LED	-4513.1128	2901.1001	-1.56	0.1198
TVONWD1OneTo3Hrs:TVTYPE1LED	-1678.7884	2013.2805	-0.83	0.4044
TVONWD1ThreeTo6Hrs:TVTYPE1LED	-2106.7446	1923.5912	-1.10	0.2735
TVONWD1SixTo10Hrs:TVTYPE1LED	-3418.0720	2390.7609	-1.43	0.1528
TOTSQFT_EN:TYPEGLASSSinglePane	-0.1921	0.1586	-1.21	0.2259
TOTSQFT_EN:TYPEGLASSDoublePane	-0.0336	0.1540	-0.22	0.8271
TOTSQFT_EN:TYPEGLASSTriplePane	0.0093	0.2093	0.04	0.9644

	Estimate	Std. Error	t value	Pr(>|t|)
Income:EthRaceFALSEAfAm	0.0031	0.0027	1.14	0.2548
Income:EthRaceFALSEAsian	-0.0243	0.0034	-7.16	0.0000
Income:EthRaceFALSEMulti	-0.0168	0.0069	-2.43	0.0153
Income:EthRaceFALSENativeAm	0.0117	0.0123	0.95	0.3425
Income:EthRaceFALSEOther	-0.0249	0.0083	-2.99	0.0028
Income:EthRaceFALSEPacific	-0.0163	0.0138	-1.18	0.2378
Income:EthRaceTRUEAfAm	-0.0120	0.0165	-0.73	0.4672
Income:EthRaceTRUEAsian	-0.0365	0.0454	-0.80	0.4219
Income:EthRaceTRUEMulti	-0.0291	0.0212	-1.37	0.1693
Income:EthRaceTRUENativeAm	-0.0187	0.0148	-1.26	0.2077
Income:EthRaceTRUEOther	-0.0262	0.0099	-2.63	0.0085
Income:EthRaceTRUEPacific	-0.0122	0.0380	-0.32	0.7474
Income:EthRaceTRUEWt	-0.0192	0.0031	-6.29	0.0000
StrTenureOwnSFDetached:TOTSQFT_EN:HDD65	0.0001	0.0000	4.10	0.0000
StrTenureOwnLgApartment:TOTSQFT_EN:HDD65	-0.0001	0.0001	-0.96	0.3381
StrTenureOwnMobile:TOTSQFT_EN:HDD65	0.0004	0.0001	5.98	0.0000
StrTenureOwnSFAttached:TOTSQFT_EN:HDD65	-0.0000	0.0000	-0.55	0.5812
StrTenureOwnSmApartment:TOTSQFT_EN:HDD65	0.0000	0.0001	0.54	0.5866
StrTenureRentLgApartment:TOTSQFT_EN:HDD65	-0.0002	0.0001	-4.00	0.0001
StrTenureRentMobile:TOTSQFT_EN:HDD65	0.0004	0.0002	1.76	0.0779
StrTenureRentSFAttached:TOTSQFT_EN:HDD65	0.0000	0.0001	0.60	0.5479
StrTenureRentSFDetached:TOTSQFT_EN:HDD65	0.0000	0.0000	0.55	0.5813
StrTenureRentSmApartment:TOTSQFT_EN:HDD65	-0.0001	0.0001	-1.86	0.0632
StrTenureOwnSFDetached:TOTSQFT_EN:CDD65	0.0008	0.0000	19.21	0.0000
StrTenureOwnLgApartment:TOTSQFT_EN:CDD65	-0.0002	0.0002	-0.82	0.4140
StrTenureOwnMobile:TOTSQFT_EN:CDD65	0.0009	0.0001	7.32	0.0000
StrTenureOwnSFAttached:TOTSQFT_EN:CDD65	0.0006	0.0001	5.01	0.0000
StrTenureOwnSmApartment:TOTSQFT_EN:CDD65	0.0001	0.0003	0.40	0.6875
StrTenureRentLgApartment:TOTSQFT_EN:CDD65	0.0000	0.0001	0.39	0.6946
StrTenureRentMobile:TOTSQFT_EN:CDD65	0.0024	0.0004	6.32	0.0000
StrTenureRentSFAttached:TOTSQFT_EN:CDD65	0.0007	0.0002	4.02	0.0001
StrTenureRentSFDetached:TOTSQFT_EN:CDD65	0.0008	0.0001	9.27	0.0000
StrTenureRentSmApartment:TOTSQFT_EN:CDD65	0.0005	0.0002	2.84	0.0046

Table 3: Orthodox kWh Model

- explain the logic behind the making both sqft and structure tenure endogenous.

- primarily that sqft may be related to quality of houseing, newer structures

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	1944.2850	75.4800	25.76	0.0000
RENTHELPTRUE	182.1575	82.5453	2.21	0.0274
StrTenureOwnLgApartment	-1374.2383	67.6666	-20.31	0.0000

StrTenureOwnMobile	-1095.7710	47.1356	-23.25	0.0000
StrTenureOwnSFAttached	-493.4629	52.5900	-9.38	0.0000
StrTenureOwnSmApartment	-776.3654	87.1475	-8.91	0.0000
StrTenureRentLgApartment	-1393.2440	30.1078	-46.28	0.0000
StrTenureRentMobile	-1202.7143	95.8133	-12.55	0.0000
StrTenureRentSFAttached	-807.0103	62.9410	-12.82	0.0000
StrTenureRentSFDetached	-561.3334	38.9760	-14.40	0.0000
StrTenureRentSmApartment	-1142.2015	41.4263	-27.57	0.0000
Income	0.0079	0.0003	30.04	0.0000
reporttot	11.6455	2.0454	5.69	0.0000
EDUCATIONNoHS	45.4843	77.6015	0.59	0.5578
EDUCATIONHS	77.1327	73.4168	1.05	0.2935
EDUCATIONSomeCol	131.9180	74.1386	1.78	0.0752
EDUCATIONAA	123.6675	77.9407	1.59	0.1126
EDUCATIONBA	330.4375	75.4797	4.38	0.0000
EDUCATIONMA	334.8239	80.7072	4.15	0.0000
EDUCATIONProf	585.2435	104.0935	5.62	0.0000
EDUCATIONPHD	436.0771	115.7913	3.77	0.0002
URUrban	-232.6741	24.4942	-9.50	0.0000
reporttot:EthRaceFALSEAfAm	-6.9645	4.4105	-1.58	0.1143
reporttot:EthRaceFALSEAsian	-6.5949	8.0953	-0.81	0.4153
reporttot:EthRaceFALSEMulti	-18.6324	10.3186	-1.81	0.0710
reporttot:EthRaceFALSENativeAm	-11.9507	11.6925	-1.02	0.3068
reporttot:EthRaceFALSEOther	0.1925	14.9557	0.01	0.9897
reporttot:EthRaceFALSEPacific	-34.7044	19.0077	-1.83	0.0679
reporttot:EthRaceTRUEAfAm	-18.4892	31.5771	-0.59	0.5582
reporttot:EthRaceTRUEAsian	-24.6105	43.8328	-0.56	0.5745
reporttot:EthRaceTRUEMulti	4.1417	17.6508	0.23	0.8145
reporttot:EthRaceTRUENativeAm	-19.0098	37.4768	-0.51	0.6120
reporttot:EthRaceTRUEOther	5.9743	13.0668	0.46	0.6475
reporttot:EthRaceTRUEPacific	-19.2825	57.2286	-0.34	0.7362
reporttot:EthRaceTRUEWt	-22.7295	5.5102	-4.12	0.0000

Table 4: Orthodox Square Foot Model

```
# weights:  290 (252 variable)
initial  value 255279175.178814
iter  10 value 158759783.153462
iter  20 value 147734978.629459
iter  30 value 135834833.627709
iter  40 value 132987175.762559
iter  50 value 132269842.703172
iter  60 value 132062253.285192
iter  70 value 131982161.901188
iter  80 value 131927174.073165
iter  90 value 131895272.068967
```

```
iter 100 value 131868925.672645
final  value 131868925.672645
stopped after 100 iterations

Call:
multinom(formula = StrTenure ~ RENTHELP + TOTSQFT_EN + Income +
    NHSLDMEM + reporttot + EDUCATION + reporttot + reporttot:EthRace +
    UR, data = RECS, weights = NWEIGHT)

Coefficients:
              (Intercept) RENTHELPTRUE     TOTSQFT_EN        Income   NHSLDMEM
OwnLgApartment  -1.3808040    1.8797350  -0.0014637995  1.285291e-05 -0.3451880
OwnMobile        1.8158893   -2.9512761  -0.0017777893 -5.942269e-06  0.1529041
OwnSFAttached   -2.4077803    2.4754344  -0.0002288197 -6.344140e-06 -0.2108895
OwnSmApartment  -2.9826304    0.8501427  -0.0010120758  7.383476e-06 -0.2570713
RentLgApartment  0.8250417    3.4670900  -0.0013677145 -8.407128e-06 -0.1406245
RentMobile       0.6175719    2.4300496  -0.0023185001 -6.786343e-06  0.2163635
RentSFAttached  -2.2291010    3.6783343  -0.0011203088  1.520286e-06  0.0645405
RentSFDetached  -1.8030243    2.8958817  -0.0010143061  1.630697e-06  0.2862199
RentSmApartment -0.2967769    3.2795483  -0.0014345714 -1.986143e-06  0.1005100
                  reporttot EDUCATIONNoHS EDUCATIONHS EDUCATIONSomeCol
OwnLgApartment   0.019880503    0.14774921  0.23712770       0.42144272
OwnMobile       -0.024051432   -0.33918510 -0.56375814      -0.54284784
OwnSFAttached    0.006725643    0.45275677  0.52194480       0.57131931
OwnSmApartment   0.002463547   -0.69929218 -0.28734880      -0.47590664
RentLgApartment -0.015553801   -0.06954818 -0.05389211       0.07306169
RentMobile      -0.017521457   -0.13628980 -0.54398528      -0.64822044
RentSFAttached   0.010917990    0.12518558 -0.01100473       0.24286692
RentSFDetached  -0.015422437    0.53717185  0.43057208       0.53281535
RentSmApartment -0.128408374    0.01523668 -0.14224343       0.04692095
                EDUCATIONAA EDUCATIONBA EDUCATIONMA EDUCATIONProf EDUCATIONPHD
OwnLgApartment   0.52229832  0.75353255  1.13834506    1.59050805   0.94367442
OwnMobile       -0.55274437 -0.96180683 -1.92704473   -0.73482246  -2.23158706
OwnSFAttached    0.56363862  0.66564938  0.83483596    0.98627268   0.87268719
OwnSmApartment  -0.40490433 -0.22878214 -0.29812714   -0.04205592   0.55040818
RentLgApartment  0.06679163  0.42446829  0.29963017    0.53434670   0.64879754
RentMobile      -0.86440977 -0.66745383 -1.38567115    0.67219521   1.34147040
RentSFAttached   0.01338672  0.14465141  0.17819711   -0.22985000   0.02300164
RentSFDetached   0.24309995  0.35007366 -0.04625938    0.37903764   0.07361758
RentSmApartment -0.04923053  0.05546657 -0.08204262    0.12289508   0.29292534
                  URUrban reporttot:EthRaceFALSEAfAm
OwnLgApartment   0.6570805               -0.056105696
OwnMobile       -0.9674963               -0.210861748
OwnSFAttached    0.8263923                0.036084995
OwnSmApartment   1.9888922                0.039560570
RentLgApartment  1.2013768               -0.005796055
```

```
RentMobile        -0.7494310                -0.225234648
RentSFAttached     0.9537916                 0.107604806
RentSFDetached     0.3888769                 0.121425308
RentSmApartment    1.0422443                 0.115540252
                reporttot:EthRaceFALSEAsian reporttot:EthRaceFALSEMulti
OwnLgApartment               0.11642043                 -0.028896243
OwnMobile                   -0.37239676                 -0.009364117
OwnSFAttached                0.11477384                  0.016246448
OwnSmApartment               0.01191723                  0.004991006
RentLgApartment              0.10910339                  0.030824318
RentMobile                  -0.17017724                 -0.121811195
RentSFAttached               0.03240114                 -0.002046843
RentSFDetached              -0.03893083                  0.136103946
RentSmApartment              0.16511968                  0.019058631
                reporttot:EthRaceFALSENativeAm reporttot:EthRaceFALSEOther
OwnLgApartment                  -0.04123330                 0.143868961
OwnMobile                        0.04318066                -0.299076412
OwnSFAttached                    0.09576023                 0.010399728
OwnSmApartment                  -0.06752926                 0.003252314
RentLgApartment                  0.03849811                 0.060504183
RentMobile                      -0.08332932                -0.044122404
RentSFAttached                   0.11794364                 0.028953135
RentSFDetached                  -0.05483029                 0.007387540
RentSmApartment                  0.14717793                 0.160029423
                reporttot:EthRaceFALSEPacific reporttot:EthRaceTRUEAfAm
OwnLgApartment                  -0.01053068                 0.05233122
OwnMobile                       -0.03539041                -0.13596965
OwnSFAttached                   -0.08536773                 0.24119790
OwnSmApartment                  -0.02341831                -0.02406384
RentLgApartment                  0.05311680                 0.14097708
RentMobile                      -0.12032710                 0.26548562
RentSFAttached                  -0.06796612                 0.20839233
RentSFDetached                   0.03264203                 0.19243295
RentSmApartment                 -0.31214586                 0.23140671
                reporttot:EthRaceTRUEAsian reporttot:EthRaceTRUEMulti
OwnLgApartment              -0.07895009                 0.011989066
OwnMobile                   -0.77760772                -1.259699465
OwnSFAttached               -0.09553309                 0.002451215
OwnSmApartment              -0.36867095                 0.132283628
RentLgApartment             -0.08761999                 0.046187798
RentMobile                  -0.61034604                -0.014858229
RentSFAttached              -0.26230380                -0.011850993
RentSFDetached               0.04328904                 0.021276614
RentSmApartment             -2.80190304                 0.234295539
                reporttot:EthRaceTRUENativeAm reporttot:EthRaceTRUEOther
OwnLgApartment                  1.638682e-01                -0.02393643
```

```
OwnMobile                          7.634675e-02             -0.08188404
OwnSFAttached                      4.546190e-02              0.02012594
OwnSmApartment                     1.103255e-01              0.09249212
RentLgApartment                    6.842472e-02              0.05519402
RentMobile                        -9.102506e-01              0.16098970
RentSFAttached                     1.337601e-01              0.11944727
RentSFDetached                     1.203474e-05              0.05819886
RentSmApartment                    1.303347e-01              0.14290828
                  reporttot:EthRaceTRUEPacific reporttot:EthRaceTRUEWt
OwnLgApartment                      -0.04426958            -0.064083001
OwnMobile                           -0.17456167            -0.012400010
OwnSFAttached                        0.11515548             0.036464807
OwnSmApartment                       0.01762609            -0.033773659
RentLgApartment                     -0.11190849            -0.026287123
RentMobile                          -0.17885086            -0.011035661
RentSFAttached                      -0.37461474             0.001689925
RentSFDetached                      -0.18918832            -0.031980835
RentSmApartment                      0.15462478             0.146924120

Std. Errors:
                (Intercept) RENTHELPTRUE   TOTSQFT_EN       Income
OwnLgApartment 2.804615e-10 2.256163e-12 6.482417e-07 1.220273e-08
OwnMobile      3.642268e-10 3.238303e-14 6.160650e-07 1.748914e-08
OwnSFAttached  1.064679e-10 3.776625e-12 3.446159e-07 1.229751e-08
OwnSmApartment 3.447036e-10 1.172403e-12 8.540345e-07 1.897742e-08
RentLgApartment 1.811342e-10 1.810139e-11 3.293905e-07 9.198244e-09
RentMobile     9.374497e-10 2.179126e-11 1.307564e-06 3.403626e-08
RentSFAttached 2.925585e-10 2.192346e-11 6.326804e-07 1.590451e-08
RentSFDetached 1.756909e-10 7.432628e-12 4.092411e-07 1.078800e-08
RentSmApartment 2.656272e-10 1.358162e-11 4.915795e-07 1.230647e-08
                    NHSLDMEM    reporttot EDUCATIONNoHS   EDUCATIONHS
OwnLgApartment 5.640274e-10 2.146993e-09  2.723062e-11 9.055121e-11
OwnMobile      9.910158e-10 2.213798e-09  9.135041e-11 1.503373e-10
OwnSFAttached  2.327377e-10 7.311109e-10  1.860675e-11 4.117191e-11
OwnSmApartment 7.231066e-10 2.399937e-09  3.405395e-11 1.455696e-10
RentLgApartment 4.223747e-10 1.128101e-09  5.458379e-11 6.907118e-11
RentMobile     2.805845e-09 5.776393e-09  3.139175e-10 3.592750e-10
RentSFAttached 7.930024e-10 2.129260e-09  5.530325e-11 1.050955e-10
RentSFDetached 5.996300e-10 1.131219e-09  4.425417e-11 6.808416e-11
RentSmApartment 7.700732e-10 1.375331e-09  6.459063e-11 9.609811e-11
                EDUCATIONSomeCol  EDUCATIONAA  EDUCATIONBA  EDUCATIONMA
OwnLgApartment      7.187516e-11 3.544124e-11 3.516998e-11 1.462653e-11
OwnMobile           7.838175e-11 2.086252e-11 5.586738e-12 5.604955e-13
OwnSFAttached       2.580455e-11 8.138922e-12 1.227194e-11 2.767598e-12
OwnSmApartment      7.910184e-11 3.505417e-11 3.478754e-11 6.589822e-12
RentLgApartment     3.977788e-11 1.323680e-11 1.856447e-11 3.209177e-12
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11

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RentMobile            1.644049e-10 3.881109e-11 1.258953e-11 1.341302e-12
RentSFAttached        8.320877e-11 2.415231e-11 1.817169e-11 1.873211e-12
RentSFDetached        4.639286e-11 1.269321e-11 1.016402e-11 1.289784e-12
RentSmApartment       6.524430e-11 2.146425e-11 1.396495e-11 9.256764e-13
                EDUCATIONProf EDUCATIONPHD    URUrban
OwnLgApartment    3.218023e-12 3.619174e-12 2.178313e-10
OwnMobile         2.900884e-13 3.558890e-13 1.562943e-10
OwnSFAttached     8.074232e-13 5.458122e-13 8.266410e-11
OwnSmApartment    3.783149e-13 1.802757e-12 3.195226e-10
RentLgApartment   6.936756e-13 3.786375e-12 1.454905e-10
RentMobile        4.164229e-13 1.832576e-11 4.785908e-10
RentSFAttached    1.533925e-13 1.035860e-12 2.432163e-10
RentSFDetached    3.373356e-13 8.867578e-13 1.268780e-10
RentSmApartment   4.565830e-13 1.621815e-12 2.278170e-10
                reporttot:EthRaceFALSEAfAm reporttot:EthRaceFALSEAsian
OwnLgApartment                1.689251e-10                3.756456e-11
OwnMobile                     1.373353e-10                4.191575e-13
OwnSFAttached                 1.007404e-10                1.557180e-11
OwnSmApartment                3.634714e-10                2.761003e-12
RentLgApartment               1.599844e-10                1.815375e-11
RentMobile                    3.231039e-10                8.930719e-12
RentSFAttached                5.261382e-10                7.272405e-12
RentSFDetached                2.935850e-10                6.521536e-12
RentSmApartment               3.304033e-10                1.677059e-11
                reporttot:EthRaceFALSEMulti reporttot:EthRaceFALSENativeAm
OwnLgApartment                 4.854299e-12                   1.243352e-11
OwnMobile                      1.370957e-11                   6.146206e-11
OwnSFAttached                  5.297115e-12                   1.562180e-11
OwnSmApartment                 6.848358e-12                   7.555949e-12
RentLgApartment                9.113511e-12                   1.571004e-11
RentMobile                     1.639655e-11                   5.607545e-11
RentSFAttached                 1.188234e-11                   5.826948e-11
RentSFDetached                 2.550526e-11                   7.378500e-12
RentSmApartment                7.589725e-12                   2.511002e-11
                reporttot:EthRaceFALSEOther reporttot:EthRaceFALSEPacific
OwnLgApartment                 5.935472e-11                   5.823579e-12
OwnMobile                      1.629085e-12                   6.223891e-12
OwnSFAttached                  3.830362e-12                   7.106787e-13
OwnSmApartment                 7.023030e-12                   2.639320e-12
RentLgApartment                1.799921e-11                   4.102726e-12
RentMobile                     1.715910e-11                   2.612423e-12
RentSFAttached                 1.102086e-11                   3.929249e-13
RentSFDetached                 5.998203e-12                   3.430481e-12
RentSmApartment                1.827408e-11                   8.432855e-14
                reporttot:EthRaceTRUEAfAm reporttot:EthRaceTRUEAsian
OwnLgApartment                1.483406e-12               4.680231e-13
```

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OwnMobile                             1.079497e-11                    1.156905e-13
OwnSFAttached                         2.538357e-12                    2.503943e-13
OwnSmApartment                        8.733343e-13                    1.251831e-13
RentLgApartment                       1.372835e-11                    7.692726e-13
RentMobile                            7.151945e-11                    7.081917e-13
RentSFAttached                        7.750871e-12                    2.209303e-13
RentSFDetached                        1.385738e-11                    2.848894e-12
RentSmApartment                       1.140121e-11                    1.538109e-16
                  reporttot:EthRaceTRUEMulti reporttot:EthRaceTRUENativeAm
OwnLgApartment                        8.158892e-12                    4.968944e-12
OwnMobile                             2.542419e-15                    5.012235e-12
OwnSFAttached                         3.364180e-12                    7.220828e-13
OwnSmApartment                        6.417319e-11                    2.886251e-12
RentLgApartment                       1.631473e-11                    3.963477e-12
RentMobile                            6.297691e-12                    5.380459e-13
RentSFAttached                        3.429080e-12                    4.499912e-12
RentSFDetached                        3.398268e-12                    1.438555e-12
RentSmApartment                       3.809257e-11                    4.334738e-12
                  reporttot:EthRaceTRUEOther reporttot:EthRaceTRUEPacific
OwnLgApartment                        2.231910e-12                    2.454064e-13
OwnMobile                             1.173327e-11                    1.321607e-12
OwnSFAttached                         1.365850e-11                    4.698338e-13
OwnSmApartment                        2.255867e-11                    3.978720e-13
RentLgApartment                       1.018448e-10                    1.479809e-13
RentMobile                            3.872833e-10                    2.986741e-12
RentSFAttached                        1.042841e-10                    8.703513e-14
RentSFDetached                        5.365307e-11                    6.936656e-13
RentSmApartment                       5.117027e-11                    2.938559e-12
                  reporttot:EthRaceTRUEWt
OwnLgApartment                        7.548911e-11
OwnMobile                             2.708235e-10
OwnSFAttached                         6.952859e-11
OwnSmApartment                        1.120952e-10
RentLgApartment                       1.547004e-10
RentMobile                            9.077334e-10
RentSFAttached                        1.735717e-10
RentSFDetached                        1.215658e-10
RentSmApartment                       3.388638e-10

Residual Deviance: 263737851
AIC: 263738355
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3.2 System Estimation

- results are bootstrapped 400 times for standard deviation estimates. More can be done.

- probablities of structure type rather than forecast were used.

- no censoring for square footage less than zero.

- boot strap samples were restricted to samples that allowed for all parameters to be estimated.

4   Summary and Conclusions

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	State	Population	Reports (per 100,000)
1	Alabama	4,677,464	7.50
2	Alaska	688,125	13.01
3	Arizona	6,499,377	3.68
4	Arkansas	2,867,764	9.26
5	California	36,580,371	3.03
6	Colorado	4,935,213	1.97
7	Connecticut	3,502,932	20.50
8	Delaware	876,211	14.00
9	District of Columbia	590,074	14.00
10	Florida	18,423,878	3.93
11	Georgia	9,697,838	2.06
12	Hawaii	1,287,481	13.01
13	Idaho	1,527,506	9.94
14	Illinois	12,842,954	2.88
15	Indiana	6,388,309	9.14
16	Iowa	2,993,987	19.92
17	Kansas	2,797,375	10.31
18	Kentucky	4,287,931	7.50
19	Louisiana	4,451,513	9.26
20	Maine	1,319,691	20.50
21	Maryland	5,658,655	14.00
22	Massachusetts	6,543,595	4.51
23	Michigan	10,002,486	4.97
24	Minnesota	5,230,567	19.92
25	Mississippi	2,940,212	7.50
26	Missouri	5,956,335	4.99
27	Montana	968,035	9.94
28	Nebraska	1,781,949	10.31
29	Nevada	2,615,772	5.08
30	New Hampshire	1,321,872	20.50
31	New Jersey	8,663,398	2.34
32	New Mexico	1,986,763	5.08
33	New York	19,467,789	4.60
34	North Carolina	9,247,134	4.22
35	North Dakota	641,421	19.92
36	Ohio	11,528,072	9.14
37	Oklahoma	3,644,025	9.26
38	Oregon	3,782,991	13.01
39	Pennsylvania	12,566,368	1.87
40	Rhode Island	1,053,502	20.50
41	South Carolina	4,503,280	4.22
42	South Dakota	804,532	19.92
43	Tennessee	6,240,456	2.61
44	Texas	24,304,290	4.18
45	Utah	2,727,343	9.94
46	Vermont	621,049	20.50
47	Virginia	7,795,424	2.03
48	Washington	6,566,073	13.01
49	West Virginia	1,814,873	14.00
50	Wisconsin	5,627,610	1.81
51	Wyoming	532,981	9.94

Table 2: HUD Complaints per 100,000 Population