Metro SP Phase II Task B

Model Estimation

6/22/2017

Task A

Three weights from Task A to be tested in Task B:

- b. county x htype2 (SF, MF) x tenure x age_group5 x hhinc2
- d. county x htype2 x tenure x age_group3 x hhinc4a
- e. county x htype2 x tenure x age_group5 x hhinc4b

Replicate results using Roger's and Sonny's weights

- rbc
- sc

Task B

- B.1 Estimation by Sources and Evaluation of Sampling Bias
- B.2 Estimate and Compare Models county vs. MSA
- B.3 Mixed Logit Model
- B.4 Explore and test schemes for market segmentation
- B.5 Combine SP and RP data
- B.6 Neighborhood Choice

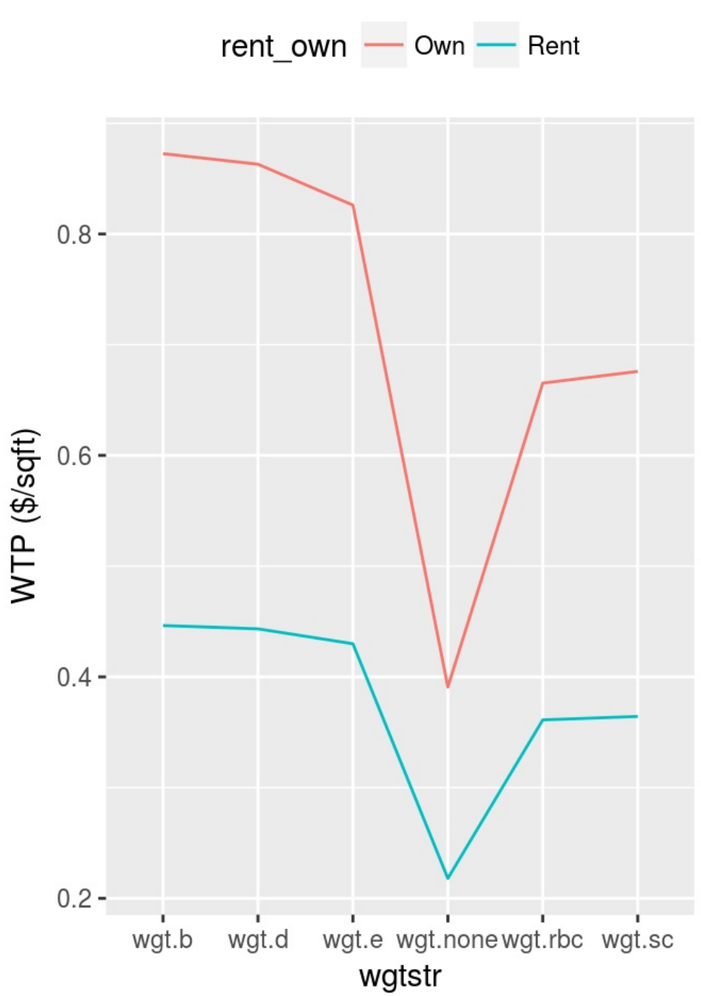
Coefficients by weighting schemes

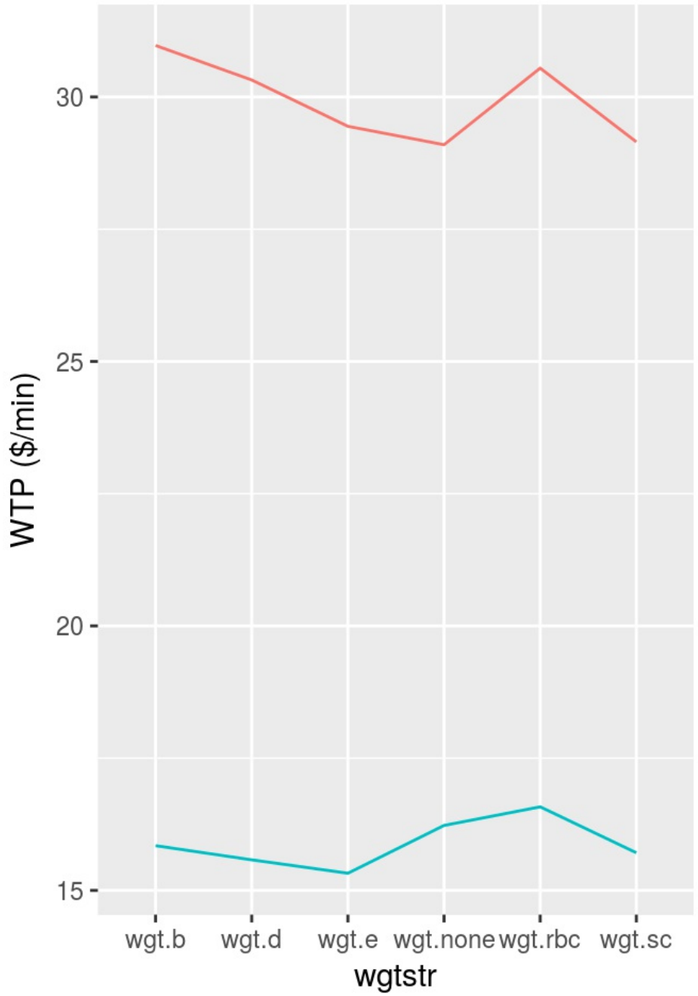
	wgt.none (1)	wgt.b (2)	wgt.d (3)	wgt.e (4)	wgt.sc (5)	wgt.rbc (6)
1:(intercept)	0.088***	0.083***	0.112***	0.088***	0.074***	0.088***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
price	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.00003)	(0.00003)	(0.00003)	(0.00003)	(0.00003)	(0.00003)
own	-0.100***	-0.356***	-0.356***	-0.352***	-0.290***	-0.225***
	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)
commute_time	-0.017***	-0.021***	-0.020***	-0.020***	-0.020***	-0.019***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
size	0.0002***	0.001***	0.001***	0.001***	0.0005***	0.0004***
	(0.00004)	(0.00005)	(0.00004)	(0.00005)	(0.00004)	(0.00004)
sfd	0.907***	0.633***	0.621***	0.631***	0.751***	0.766***
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
sfa	0.616***	0.538***	0.517***	0.521***	0.579***	0.572***
	(0.018)	(0.019)	(0.019)	(0.019)	(0.018)	(0.019)
N1	0.362***	0.309***	0.288***	0.280***	0.449***	0.414***
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
N2	0.569***	0.518***	0.530***	0.520***	0.597***	0.592***
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
N3	0.115***	0.156***	0.161***	0.150***	0.122***	0.121***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
price:own	0.0005***	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00002)
Observations	58,825	57,871	57,826	57,691	58,825	57,988
R^2	0.118	0.126	0.127	0.126	0.124	0.121

WTPs by weighting schemes

wgtstr	n	Rent $/sqft	Rent $/min	Own $/sqft	Own $/min
wgt.none	58825	0.218	16.228	0.391	29.096
wgt.b	57871	0.446	15.845	0.873	30.973
wgt.d	57826	0.443	15.577	0.863	30.320
wgt.e	57691	0.430	15.324	0.826	29.444
wgt.sc	58825	0.364	15.711	0.676	29.150
wgt.rbc	57988	0.361	16.580	0.665	30.545

WTPs by weighting schemes





Task B.1 Estimation by Sources and Evaluation of Sampling Bias

Coefficients by Sources (no weights)

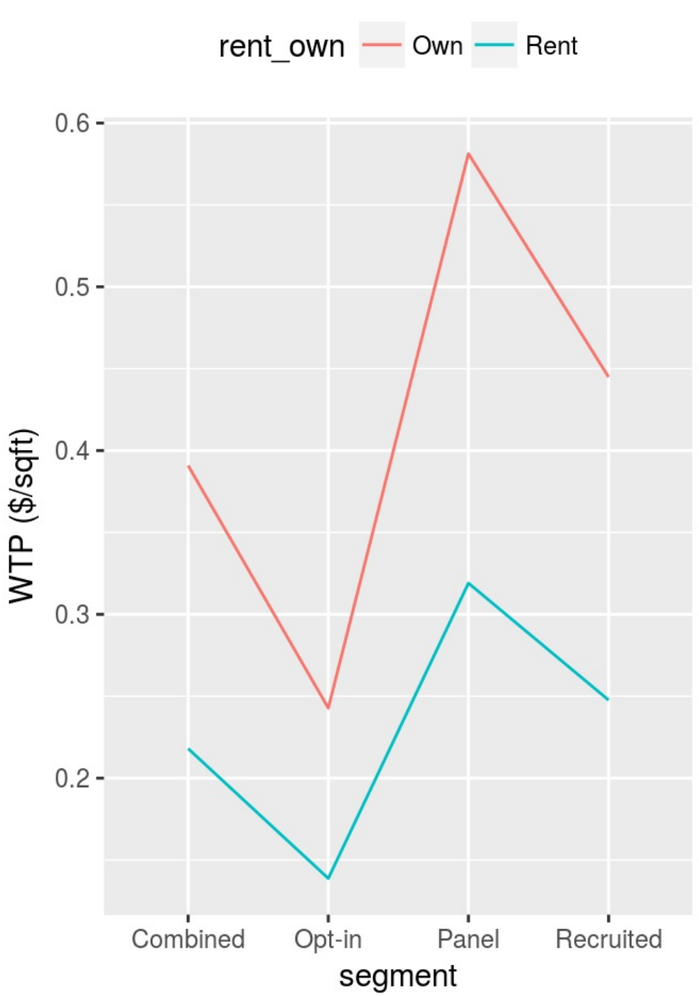
Coefficients by Sources (no weights)

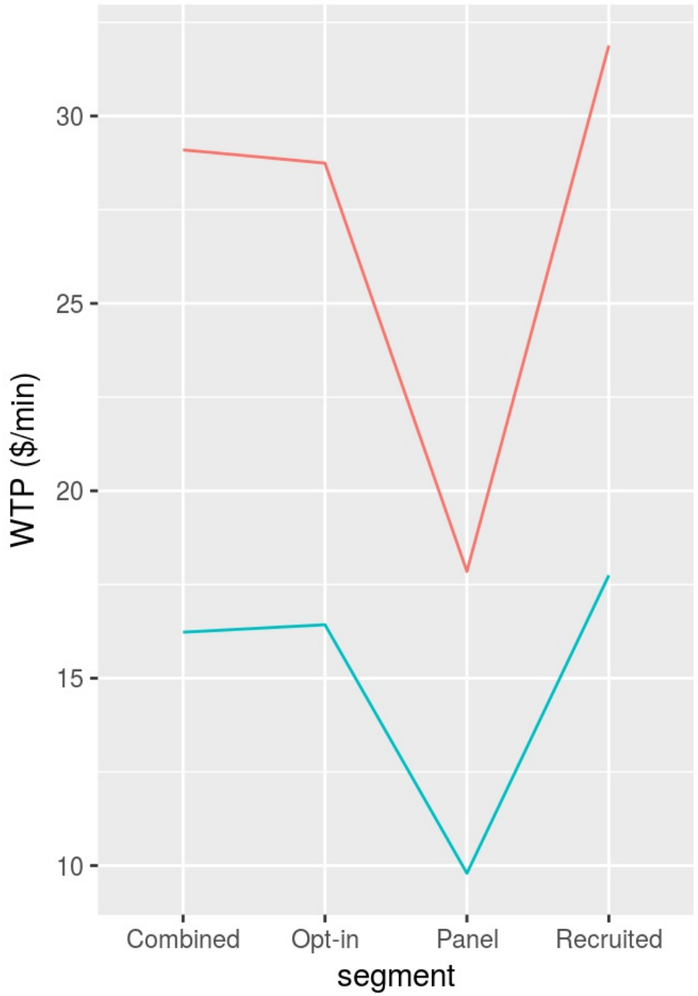
	Combined (1)	Recruited (2)	Panel (3)	Opt-in (4)
1:(intercept)	0.088***	0.105***	0.026	0.090***
	(0.012)	(0.022)	(0.035)	(0.017)
price	-0.001***	-0.001***	-0.001***	-0.001***
	(0.00003)	(0.00005)	(0.0001)	(0.00004)
own	-0.100***	0.050	-0.315***	-0.120**
	(0.038)	(0.073)	(0.099)	(0.050)
commute_time	-0.017***	-0.015***	-0.014***	-0.018***
	(0.001)	(0.001)	(0.002)	(0.001)
size	0.0002***	0.0002***	0.0005***	0.0001**
	(0.00004)	(0.0001)	(0.0001)	(0.0001)
sfd	0.907***	1.014***	0.798***	0.900***
	(0.033)	(0.061)	(0.094)	(0.044)
sfa	0.616***	0.643***	0.640***	0.607***
	(0.018)	(0.034)	(0.052)	(0.025)
N1	0.362***	0.243***	0.116	0.481***
	(0.033)	(0.060)	(0.093)	(0.044)
N2	0.569***	0.506***	0.210***	0.691***
	(0.023)	(0.041)	(0.063)	(0.030)
N3	0.115***	0.143***	0.223***	0.078**
	(0.024)	(0.043)	(0.066)	(0.032)
price:own	0.0005***	0.0004***	0.001***	0.0005***
	(0.00002)	(0.00004)	(0.0001)	(0.00003)
Observations	58,825	18,207	7,368	33,250
R^2	0.118	0.120	0.132	0.122

WTPs by Sources (no weights)

segment	n	Rent $/sqft	Rent $/min	Own $/sqft	Own $/min
Combined	58825	0.218	16.228	0.391	29.096
Recruited	18207	0.248	17.745	0.445	31.882
Panel	7368	0.319	9.796	0.581	17.849
Opt-in	33250	0.139	16.427	0.243	28.743

WTPs by Sources (no weights)





WTPs by Sources (no weights)

There is sizable difference in the WTPs across different sources when weights are not used in estimation:

- Surveyees from the Panel have the highest WTP for spaces ($/sqft) and lowest WTP for travel time saving ($/minute of commuting time);
- Surveyees in the Opt-in sample have the lowest WTP for spaces ($/sqft);
- Recruited surveyees have the highest WTP for travel time saving ($/minute of commuting time).

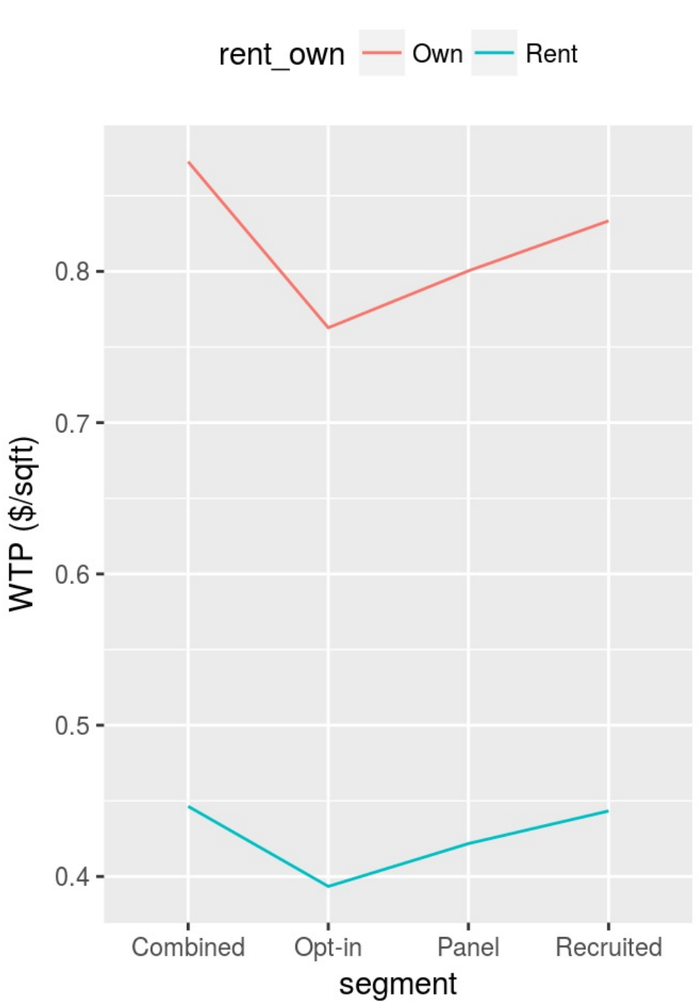
Coefficients by Sources (weights=wgt.b)

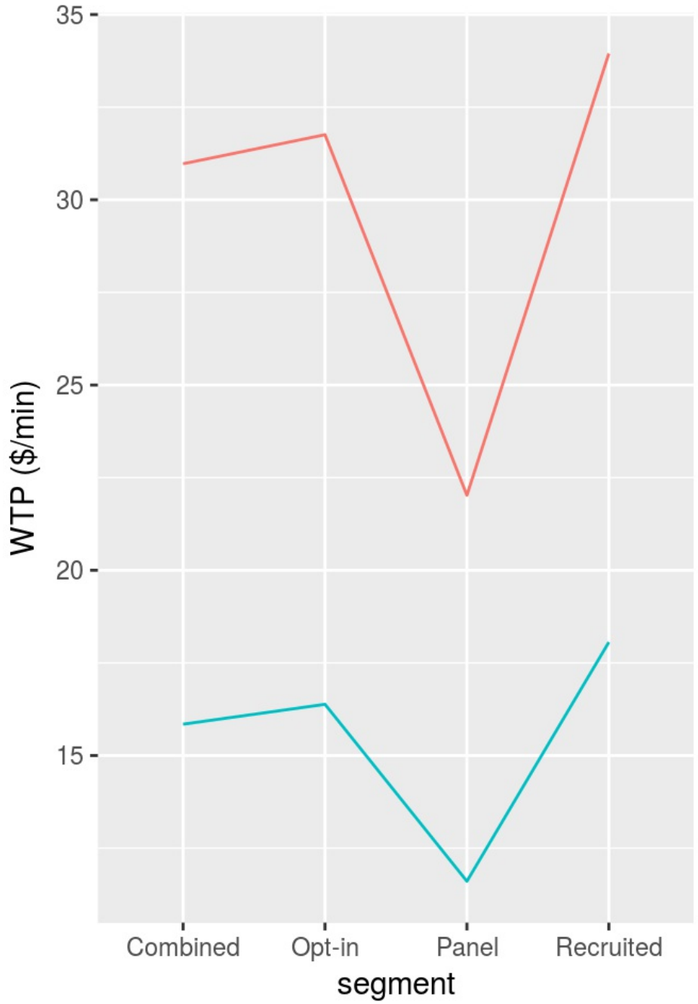
	Combined (1)	Recruited (2)	Panel (3)	Opt-in (4)
1:(intercept)	0.083***	0.132***	0.066*	0.072***
	(0.012)	(0.023)	(0.035)	(0.017)
price	-0.001***	-0.001***	-0.002***	-0.001***
	(0.00003)	(0.0001)	(0.0001)	(0.00004)
own	-0.356***	-0.034	-0.459***	-0.422***
	(0.038)	(0.074)	(0.100)	(0.050)
commute_time	-0.021***	-0.019***	-0.019***	-0.021***
	(0.001)	(0.001)	(0.002)	(0.001)
size	0.001***	0.0005***	0.001***	0.001***
	(0.00005)	(0.0001)	(0.0001)	(0.0001)
sfd	0.633***	0.904***	0.540***	0.602***
	(0.033)	(0.063)	(0.094)	(0.043)
sfa	0.538***	0.592***	0.537***	0.530***
	(0.019)	(0.034)	(0.052)	(0.025)
N1	0.309***	0.335***	0.002	0.472***
	(0.033)	(0.062)	(0.095)	(0.044)
N2	0.518***	0.543***	0.251***	0.666***
	(0.023)	(0.042)	(0.064)	(0.030)
N3	0.156***	0.161***	0.268***	0.090***
	(0.024)	(0.044)	(0.068)	(0.032)
price:own	0.001***	0.0005***	0.001***	0.001***
	(0.00002)	(0.00004)	(0.0001)	(0.00003)
Observations	57,871	17,379	7,287	33,205
R^2	0.126	0.126	0.149	0.127

WTPs by Sources (weights=wgt.b)

segment	n	Rent $/sqft	Rent $/min	Own $/sqft	Own $/min
Combined	57871	0.446	15.845	0.873	30.973
Recruited	17379	0.443	18.059	0.833	33.949
Panel	7287	0.422	11.606	0.800	22.023
Opt-in	33205	0.393	16.382	0.763	31.757

WTPs by Sources (weights=wgt.b)





WTPs by Sources (weights=wgt.b)

- Surveyees from the Panel still have the lowest WTP for travel time saving ($/minute of commuting time), but they **no longer** have the highest WTP for spaces ($/sqft);
- Surveyees in the Opt-in sample **no longer** have the lowest WTP for spaces ($/sqft);
- Recruited surveyees still have the highest WTP for travel time saving ($/minute of commuting time).
- These differences in the coefficients and WTPs are an indication of possible sampling bias, but the weights help address it, in particular, for the lowest WTP for spaces ($/sqft).

Task B.2 Estimate and Compare Models county vs. MSA

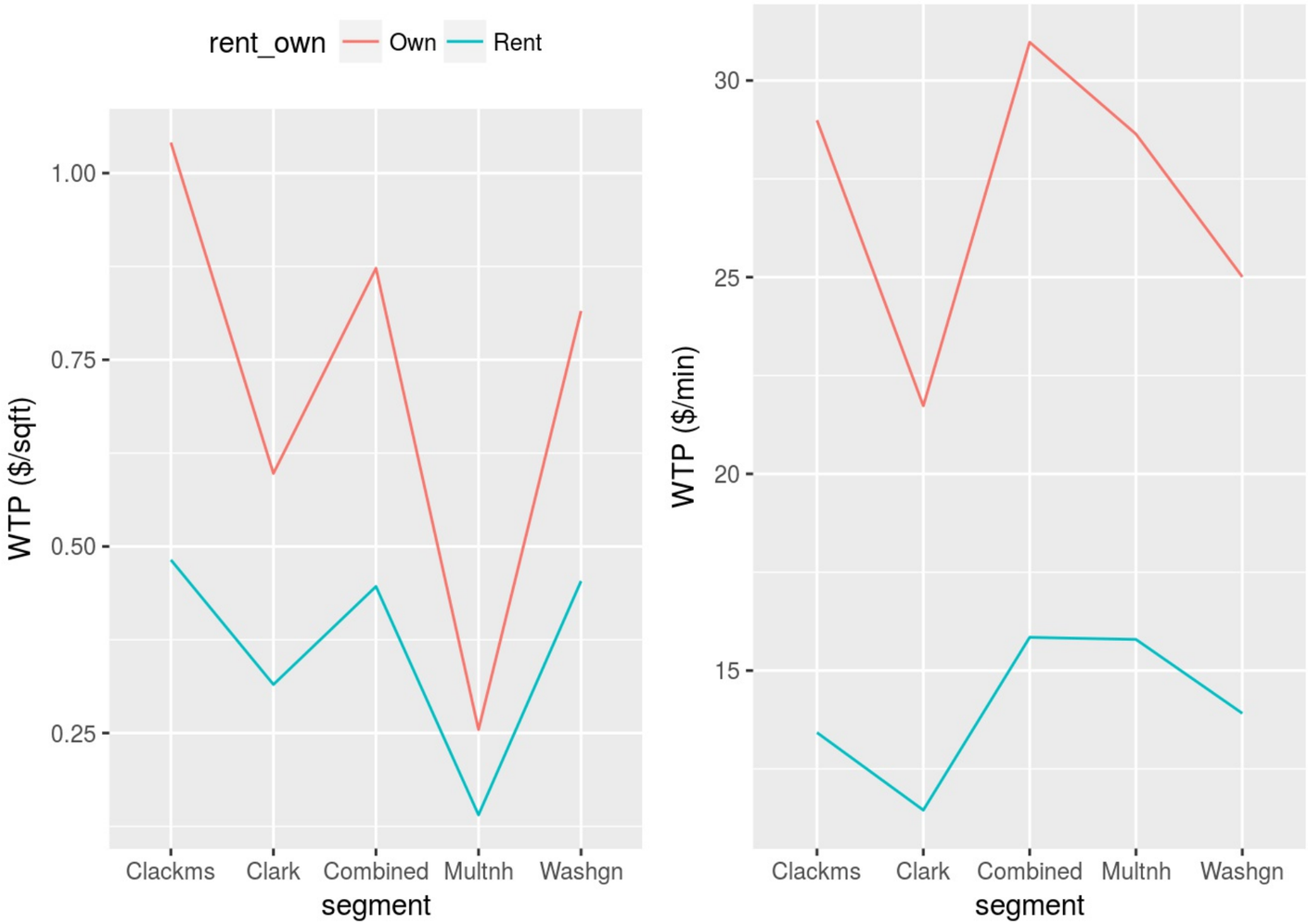
Coefficients by County (weights=wgt.b)

	wgt.b (1)	wgt.b (2)	wgt.b (3)	wgt.b (4)	wgt.b (5)
1:(intercept)	0.083***	0.088***	0.087***	0.070**	0.089
	(0.012)	(0.018)	(0.022)	(0.030)	(0.067)
price	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.00003)	(0.00004)	(0.0001)	(0.0001)	(0.0002)
own	-0.356***	-0.316***	-0.334***	-0.409***	-0.201
	(0.038)	(0.053)	(0.074)	(0.102)	(0.190)
commute_time	-0.021***	-0.020***	-0.020***	-0.017***	-0.016***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.004)
size	0.001***	0.0002***	0.001***	0.001***	0.0004*
	(0.00005)	(0.0001)	(0.0001)	(0.0001)	(0.0002)
sfd	0.633***	0.683***	0.850***	0.738***	0.750***
	(0.033)	(0.046)	(0.065)	(0.090)	(0.182)
sfa	0.538***	0.542***	0.618***	0.592***	0.582***
	(0.019)	(0.027)	(0.034)	(0.048)	(0.099)
N1	0.309***	0.933***	0.177***	-0.351***	-0.153
	(0.033)	(0.048)	(0.062)	(0.086)	(0.188)
N2	0.518***	1.079***	0.305***	-0.121**	0.355***
	(0.023)	(0.034)	(0.042)	(0.056)	(0.124)
N3	0.156***	0.084**	0.251***	-0.011	0.316**
	(0.024)	(0.035)	(0.044)	(0.061)	(0.128)
price:own	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.00002)	(0.00003)	(0.00004)	(0.0001)	(0.0001)
Observations	57,871	27,964	18,362	9,497	2,048
R^2	0.126	0.143	0.155	0.140	0.152

WTPs by County (weights=wgt.b)

segment	n	Rent $/sqft	Rent $/min	Own $/sqft	Own $/min
Combined	57871	0.446	15.845	0.873	30.973
Multnh	27964	0.140	15.791	0.255	28.637
Washgn	18362	0.454	13.913	0.815	25.008
Clackms	9497	0.482	13.424	1.041	28.990
Clark	2048	0.315	11.453	0.598	21.730

WTPs by County (weights=wgt.b)



WTPs by County (weights=wgt.b)

- The results show substiantial and significant (p=0) variation in WTP across counties, which is expected, however, the relative magnitude of the WTP across counties is counter-intuitive:
  - Residents of Multnomah County have the lowest WTP for space ($/sqft) and the highest WTP for travel time savings ($/minutes of communiting time);
  - Residents of Clackamas County have the highest WTP for space ($/sqft);
  - Residents of Clarck County have the lowest WTP for travel time savings ($/minutes of communiting time);

B.3 Mixed Logit Model

Coefficients of the mixed logit model (weights=wgt.b)

1:(intercept)	1.085	0.014	5.752	< 0.001
price	0.998	0	-43.99	< 0.001
own	0.661	0.041	-10.176	< 0.001
sfd	2.33	0.042	20.267	< 0.001
sfa	1.947	0.022	30.096	< 0.001
N1	1.497	0.038	10.583	< 0.001
N2	1.843	0.026	23.639	< 0.001
N3	1.169	0.027	5.725	< 0.001
price:own	1.001	0	31.299	< 0.001
commute_time	0.977	0.001	-25.399	< 0.001
size	1.001	0	8.248	< 0.001
sd.commute_time	1.018	0.001	24.657	< 0.001
sd.size	1.002	0	47.212	< 0.001
df	57871		logLikehood	-33312.0928219

Coefficients of the fixed effect logit model (weights=wgt.b)

1:(intercept)	1.087	0.012	6.735	< 0.001
price	0.999	0	-44.925	< 0.001
own	0.701	0.038	-9.332	< 0.001
commute_time	0.98	0.001	-29.857	< 0.001
size	1.001	0	12.918	< 0.001
sfd	1.883	0.033	19.103	< 0.001
sfa	1.712	0.019	28.921	< 0.001
N1	1.362	0.033	9.255	< 0.001
N2	1.678	0.023	22.652	< 0.001
N3	1.169	0.024	6.482	< 0.001
price:own	1.001	0	30.417	< 0.001
df	57871		logLikehood	-35034.1307182

Fixed effect vs Mixed Logit Model

A likelihood ratio test indicates a significant improvement in model goodness-of-fit (Chi-square=3444.1, df=2, p<0.001) of the mixed logit model and thus there is significant correlation between responses of the same surveyee such that the mixed logit model is a better model for the SP data.

```
## Likelihood ratio test
##
## Model 1: choice ~ price * own + commute_time + size + sfd + sfa + N1 +
##     N2 + N3 | 1
## Model 2: choice ~ price * own + commute_time + size + sfd + sfa + N1 +
##     N2 + N3 | 1
##   #Df LogLik Df  Chisq Pr(>Chisq)
## 1  11 -35034
## 2  13 -33312  2 3444.1  < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

WTP Fixed effect vs Mixed Logit Model

Mean WTPs from the mixed logit model (mxl) is lower than those from the multinomial logit model (mnl).

wgtstr	modelstr	n	Rent $/sqft	Rent $/min	Own $/sqft	Own $/min
wgt.b	mxl	57871	0.320	13.728	0.596	25.554
wgt.b	mnl	57871	0.446	15.845	0.873	30.973

B.4 Explore and test schemes for market segmentation

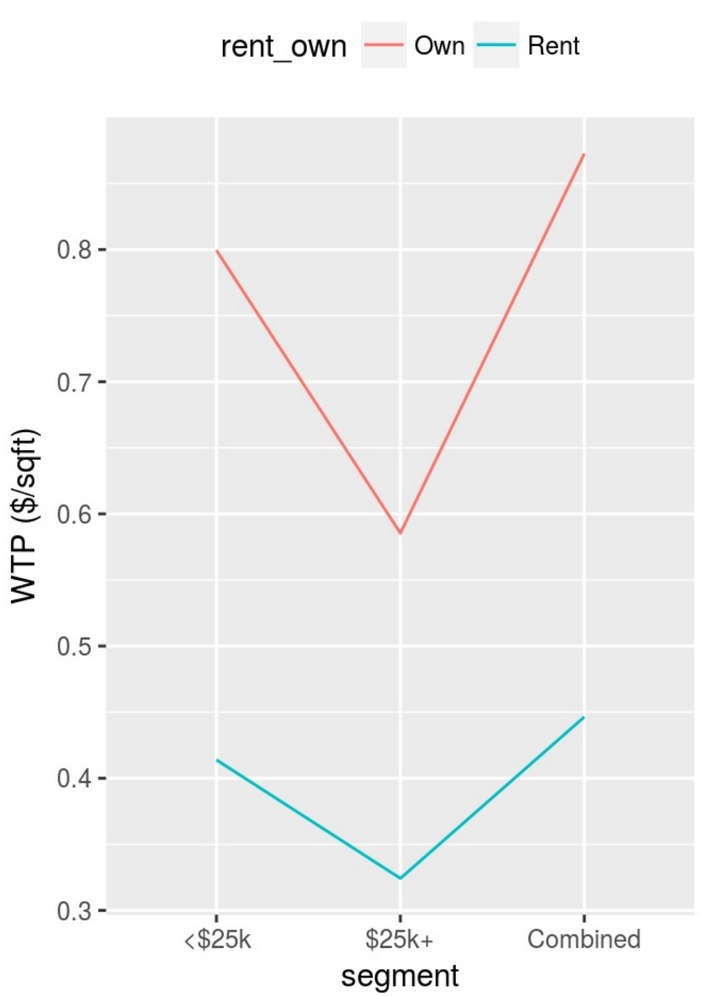
Coefficients by Income Group (weights=wgt.b)

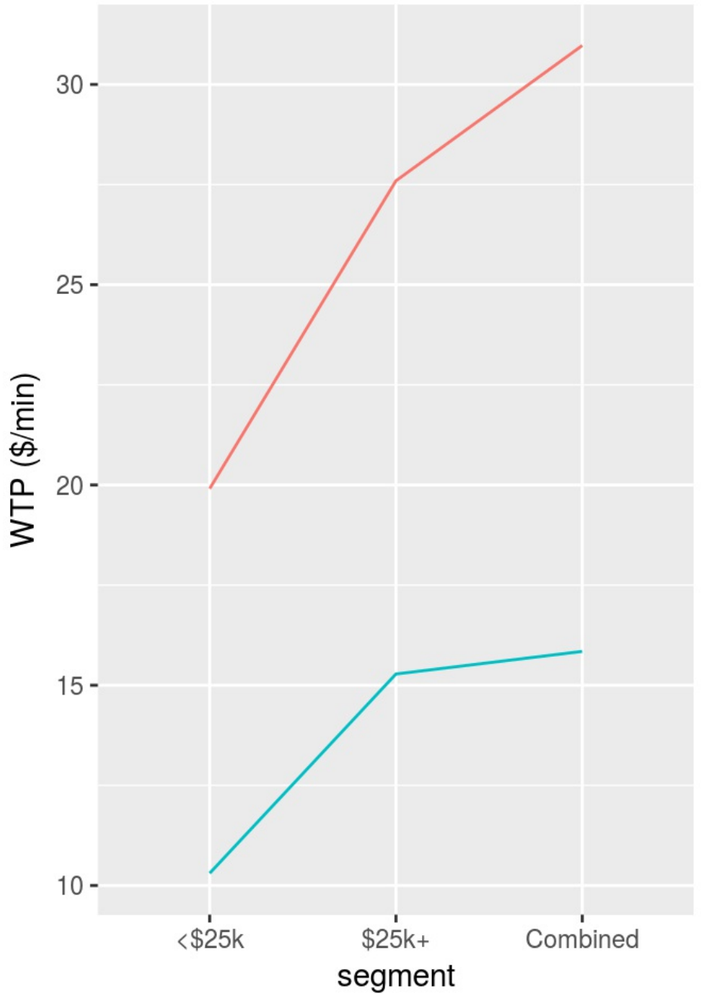
	Combined (1)	25k+ (2)	<25k (3)
1:(intercept)	0.083***	0.081***	0.096**
	(0.012)	(0.013)	(0.045)
price	-0.001***	-0.001***	-0.002***
	(0.00003)	(0.00003)	(0.0001)
own	-0.356***	-0.166***	-0.849***
	(0.038)	(0.041)	(0.118)
commute_time	-0.021***	-0.018***	-0.024***
	(0.001)	(0.001)	(0.003)
size	0.001***	0.0004***	0.001***
	(0.00005)	(0.00005)	(0.0002)
sfd	0.633***	0.850***	0.134
	(0.033)	(0.035)	(0.110)
sfa	0.538***	0.616***	0.292***
	(0.019)	(0.020)	(0.066)
N1	0.309***	0.333***	0.318***
	(0.033)	(0.035)	(0.118)
N2	0.518***	0.533***	0.486***
	(0.023)	(0.024)	(0.081)
N3	0.156***	0.141***	0.195**
	(0.024)	(0.025)	(0.084)
price:own	0.001***	0.001***	0.001***
	(0.00002)	(0.00002)	(0.0001)
Observations	57,871	53,340	4,531
R^2	0.126	0.128	0.140

WTPs by Income Group (weights=wgt.b)

segment	n	Rent $/sqft	Rent $/min	Own $/sqft	Own $/min
Combined	57871	0.446	15.845	0.873	30.973
$25k+	53340	0.324	15.281	0.585	27.595
<$25k	4531	0.414	10.306	0.799	19.908

WTPs by Income Group (weights=wgt.b)





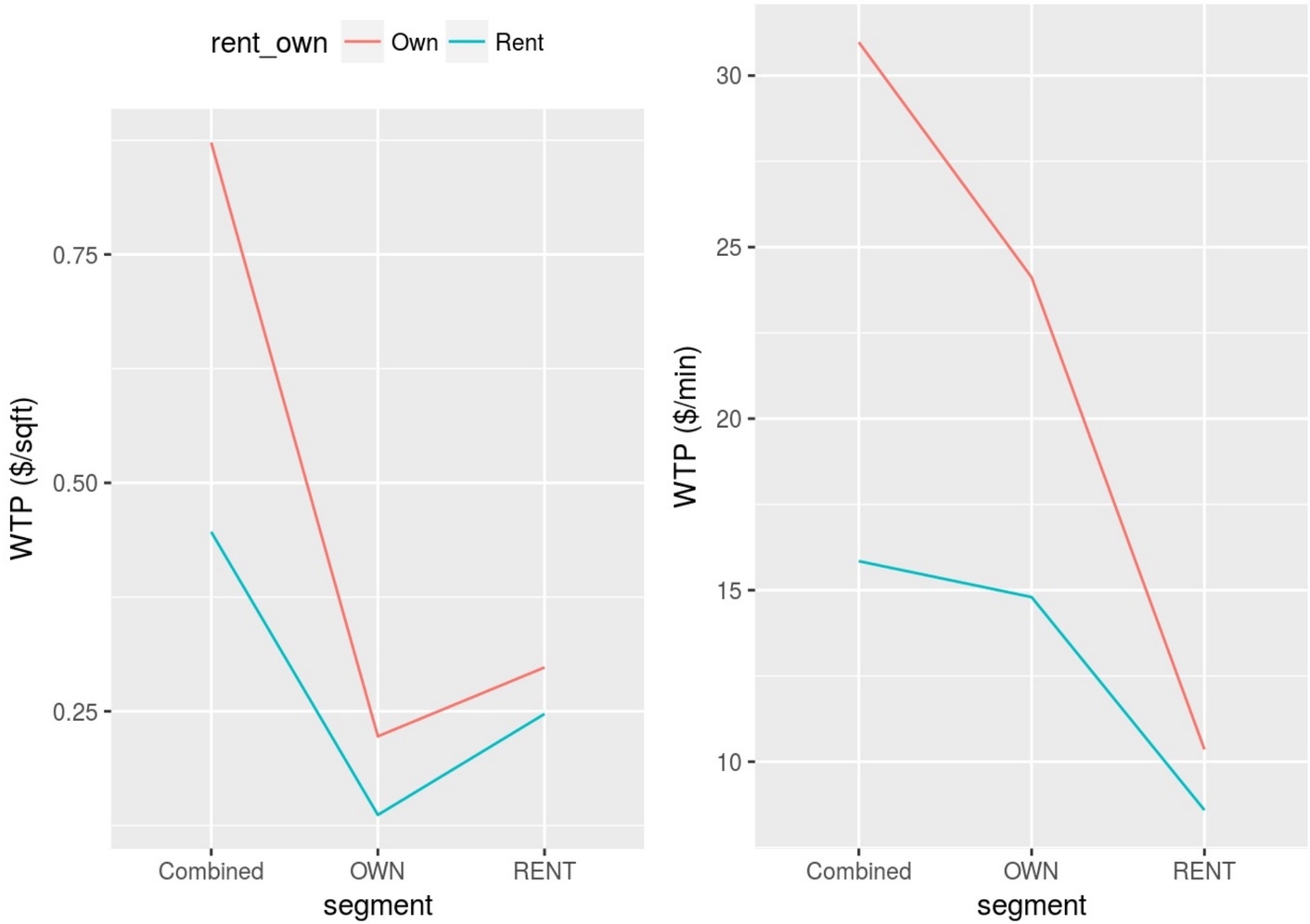
Coefficients by Tenure Status (weights=wgt.b)

	Combined (1)	OWN (2)	RENT (3)
1:(intercept)	0.083***	0.068***	0.108***
	(0.012)	(0.014)	(0.029)
price	-0.001***	-0.001***	-0.002***
	(0.00003)	(0.00003)	(0.0001)
own	-0.356***	0.129**	-0.119
	(0.038)	(0.050)	(0.082)
commute_time	-0.021***	-0.014***	-0.019***
	(0.001)	(0.001)	(0.002)
size	0.001***	0.0001**	0.001***
	(0.00005)	(0.0001)	(0.0001)
sfd	0.633***	0.986***	0.595***
	(0.033)	(0.039)	(0.071)
sfa	0.538***	0.604***	0.438***
	(0.019)	(0.021)	(0.042)
N1	0.309***	0.096**	0.731***
	(0.033)	(0.038)	(0.076)
N2	0.518***	0.405***	0.790***
	(0.023)	(0.025)	(0.052)
N3	0.156***	0.154***	0.190***
	(0.024)	(0.027)	(0.053)
price:own	0.001***	0.0004***	0.0004***
	(0.00002)	(0.00002)	(0.0001)
Observations	57,871	45,992	11,879
R^2	0.126	0.121	0.158

WTPs by Tenure Status (weights=wgt.b)

segment	n	Rent $/sqft	Rent $/min	Own $/sqft	Own $/min
Combined	57871	0.446	15.845	0.873	30.973
OWN	45992	0.137	14.798	0.223	24.117
RENT	11879	0.247	8.589	0.298	10.359

WTPs by Tenure Status (weights=wgt.b)



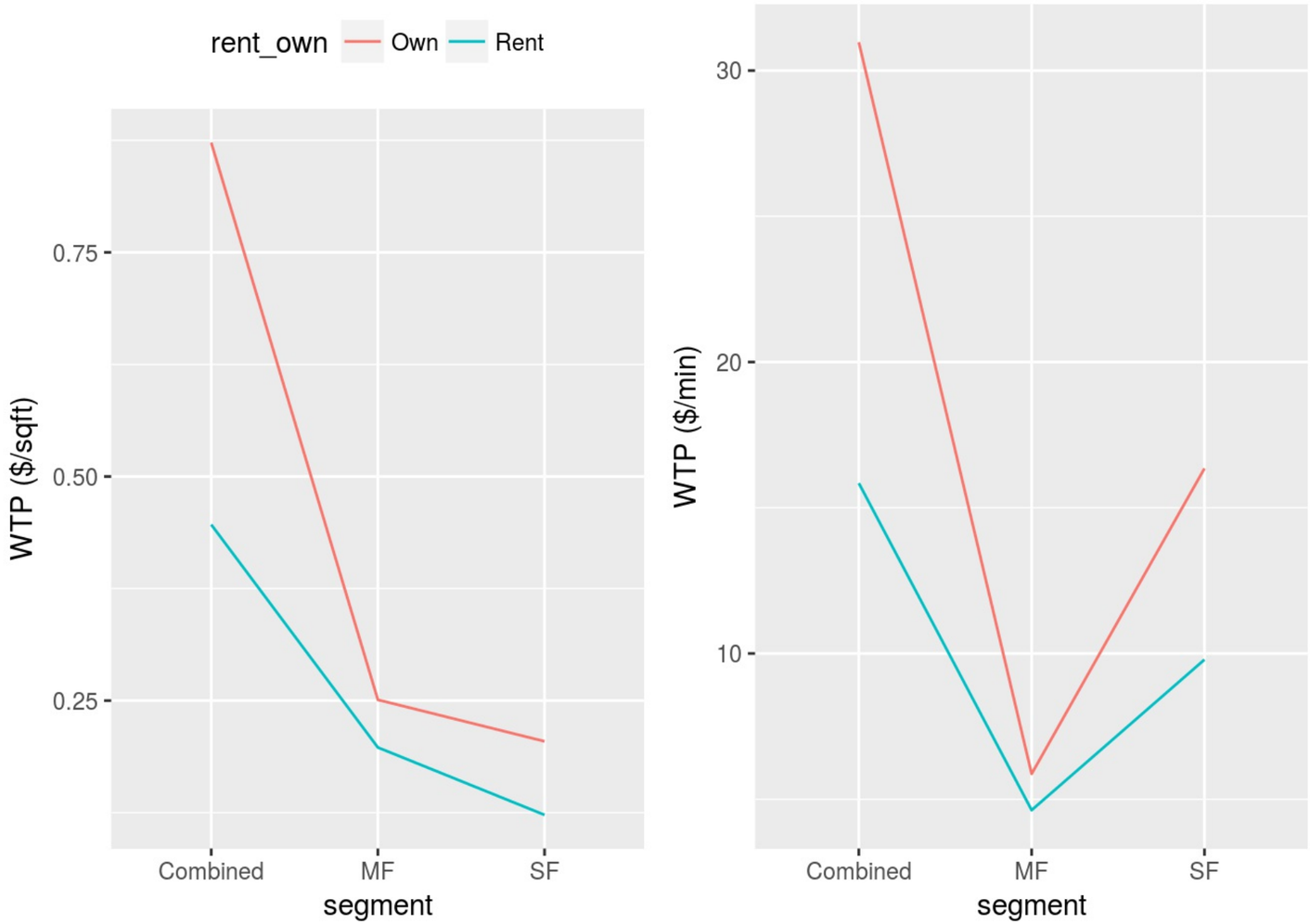
Coefficients by Current Housing Types (weights=wgt.b)

	Combined (1)	SF (2)	MF (3)
1:(intercept)	0.083***	0.070***	0.084**
	(0.012)	(0.013)	(0.035)
price	-0.001***	-0.001***	-0.002***
	(0.00003)	(0.00003)	(0.0001)
own	-0.356***	0.040	-0.235***
	(0.038)	(0.046)	(0.087)
commute_time	-0.021***	-0.010***	-0.011***
	(0.001)	(0.001)	(0.002)
size	0.001***	-0.0001**	-0.0005**
	(0.00005)	(0.00005)	(0.0002)
sfd	0.633***	1.291***	0.815***
	(0.033)	(0.039)	(0.105)
sfa	0.538***	0.761***	0.451***
	(0.019)	(0.021)	(0.053)
N1	0.309***	0.132***	0.824***
	(0.033)	(0.037)	(0.090)
N2	0.518***	0.398***	0.958***
	(0.023)	(0.025)	(0.063)
N3	0.156***	0.126***	0.234***
	(0.024)	(0.026)	(0.065)
price:own	0.001***	0.0004***	0.001***

WTPs by Current Housing Types (weights=wgt.b)

segment	n	Rent $/sqft	Rent $/min	Own $/sqft	Own $/min
Combined	57871	0.446	15.845	0.873	30.973
SF	48922	0.123	9.790	0.205	16.349
MF	8949	0.198	4.627	0.251	5.871

WTPs by Current Housing Types (weights=wgt.b)



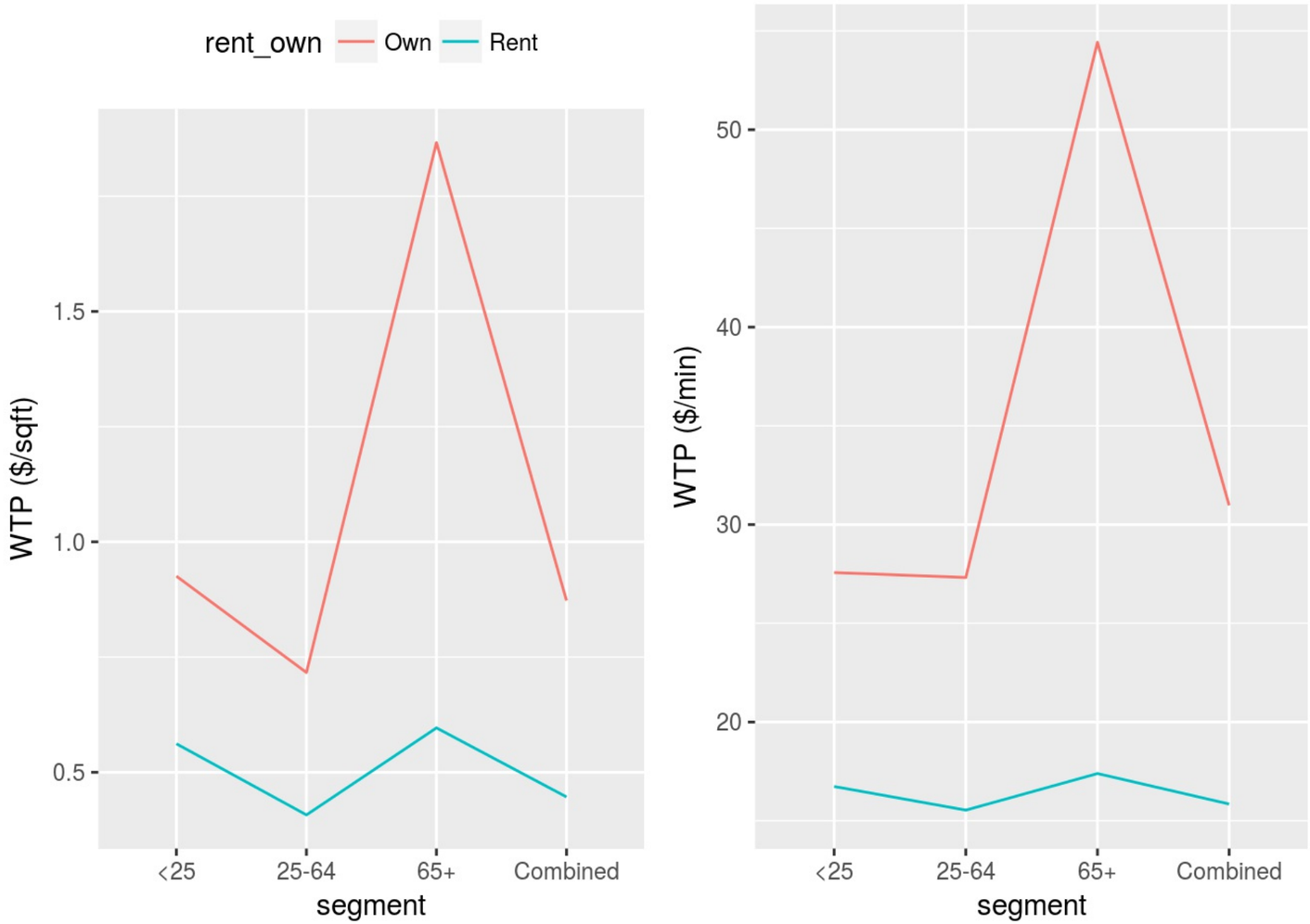
Coefficients by Age Group (weights=wgt.b)

	Combined (1)	25-64 (2)	65+ (3)	<25 (4)
1:(intercept)	0.083***	0.088***	0.054*	0.176
	(0.012)	(0.014)	(0.028)	(0.114)
price	-0.001***	-0.001***	-0.001***	-0.002***
	(0.00003)	(0.00003)	(0.0001)	(0.0004)
own	-0.356***	-0.193***	-0.790***	-0.873***
	(0.038)	(0.042)	(0.096)	(0.307)
commute_time	-0.021***	-0.021***	-0.020***	-0.039***
	(0.001)	(0.001)	(0.002)	(0.007)
size	0.001***	0.001***	0.001***	0.001***
	(0.00005)	(0.0001)	(0.0001)	(0.0005)
sfd	0.633***	0.794***	0.129*	0.081
	(0.033)	(0.037)	(0.077)	(0.308)
sfa	0.538***	0.624***	0.248***	0.259
	(0.019)	(0.021)	(0.043)	(0.181)
N1	0.309***	0.357***	0.078	1.224***
	(0.033)	(0.038)	(0.075)	(0.311)
N2	0.518***	0.536***	0.418***	1.017***
	(0.023)	(0.026)	(0.053)	(0.214)
N3	0.156***	0.132***	0.264***	0.217
	(0.024)	(0.027)	(0.055)	(0.216)
price:own	0.001***	0.001***	0.001***	0.001***
	(0.00002)	(0.00002)	(0.00005)	(0.0002)
Observations	57,871	46,332	10,763	776
R^2	0.126	0.138	0.095	0.216

WTPs by Age Group (weights=wgt.b)

segment	n	Rent $/sqft	Rent $/min	Own $/sqft	Own $/min
Combined	57871	0.446	15.845	0.873	30.973
25-64	46332	0.407	15.537	0.716	27.318
65+	10763	0.596	17.389	1.866	54.430
<25	776	0.562	16.734	0.925	27.568

WTPs by Age Group (weights=wgt.b)



B.5 Combine SP and RP data

Assessment of task B.5

- Benefits of combining Stated Preference (SP) data and Revealed Preference (RP) data
  - SP data
  - RP data: surveyee's current residence (housing type, tenure, size, price, etc)
- Difficulties of combining SP data and RP data
  - The unchosen alternative is unknown for surveyee's current residence
  - Residential location choice modleing research with RP only generally uses sampling of (unchosen) alternatives in this case
  - Not aware of application of sampling of alternative when combing RP with SP data
  - If we pursue the route, we can only sample 1 unchosen alternative to have consistent data structure with SP, which is very/too small compared with common practice

B.6 Neighborhood Choice

Neighborhood Type Preference

Neigbhorhood type preference model	
2:(intercept)	-0.637
	(0.815)
3:(intercept)	-5.730***
	(1.082)
4:(intercept)	-2.681***
	(0.832)
same_ngbhtype	1.692***
	(0.037)
2:age	-0.002
	(0.004)
3:age	0.026***
	(0.005)
4:age	0.013***
	(0.005)
2:hhinc4b.25-49.9k	0.174
	(0.173)
3:hhinc4b.25-49.9k	0.414**
	(0.186)
4:hhinc4b.25-49.9k	0.946***
	(0.189)
2:hhinc4b.< 25k	-0.048
	(0.214)
3:hhinc4b.< 25k	0.573**
	(0.233)
4:hhinc4b.< 25k	0.952***
	(0.233)
2:hhinc4b.50-99.9k	0.152
	(0.127)
3:hhinc4b.50-99.9k	0.271**
	(0.135)
4:hhinc4b.50-99.9k	0.593***
	(0.140)
2:genderfemale	0.499
	(0.743)
3:genderfemale	1.689*
	(1.002)
4:genderfemale	-0.815

Housing Type Preference

	Housing type preference model
2:(intercept)	-5.597***
	(1.115)
3:(intercept)	-5.284***
	(0.807)
same_htype	1.298***
	(0.053)
2:age	0.024***
	(0.004)
3:age	0.030***
	(0.004)
2:hhinc4b.25-49.9k	0.498***
	(0.160)
3:hhinc4b.25-49.9k	0.326*
	(0.170)
2:hhinc4b.< 25k	0.347*
	(0.208)
3:hhinc4b.< 25k	0.561***
	(0.197)
2:hhinc4b.50-99.9k	0.332***
	(0.128)
3:hhinc4b.50-99.9k	0.094
	(0.137)
2:genderfemale	1.602
	(1.056)
3:genderfemale	0.572
	(0.708)
2:gendermale	1.608
	(1.057)
3:gendermale	0.854
	(0.708)
2:genderother	0.892
	(1.494)
3:genderother	1.284
	(0.981)
2:tenurechrRENT	-0.085
	(0.140)
3:tenurechrRENT	-0.414***
	(0.151)
2:npers_lt18	-0.143
	(0.106)
3:npers_lt18	-0.275**
	(0.122)