Northern Illinois University

Density Seems to Matter

The Impact of COVID-19 Pandemic on Housing Prices on Oahu Island, Hawaii

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Key Questions

- How did the government response to the Covid-19 Pandemic impact the value of residential property?
  - Interest rate changes
  - “Free” money
- How did any change in housing consumer preferences in response to the Covid-19 Pandemic impact the value of residential property?
  - Working from home
  - Having neighbors

Literature Review

- Overall results are mixed, primarily due to the small window from which the data is drawn.

No Impact

Delgado & Katafuchi (2020) - Japan

Yoruk, B. K. (2022) – Metro Areas

Zeng & Yi (2022) – Wuhan area

Generally found decreases in volume but no discernable impact on price.

Negative Impact

Del Giudice, et. al. (2020): Italy (4.16%)

Hu, et. al. (2021) – Austrian (0.35 – 1.26%)

Qian, et. al. (2021): Ireland (2.47%)

Francke & Korevaar (2021): Amsterdam and Paris (risk premium ↑)

Liu & Su (2021): (shift by density)

Positive Impact

Kadi, et. al. (2020): Austria (B&B to Rental)

Verma & Husain (2020): Canada

Arcaya, et. al. (2020)

Yang & Zhou (2021): China

Mixed Impact

Li & Zhang (2021): US (population density)

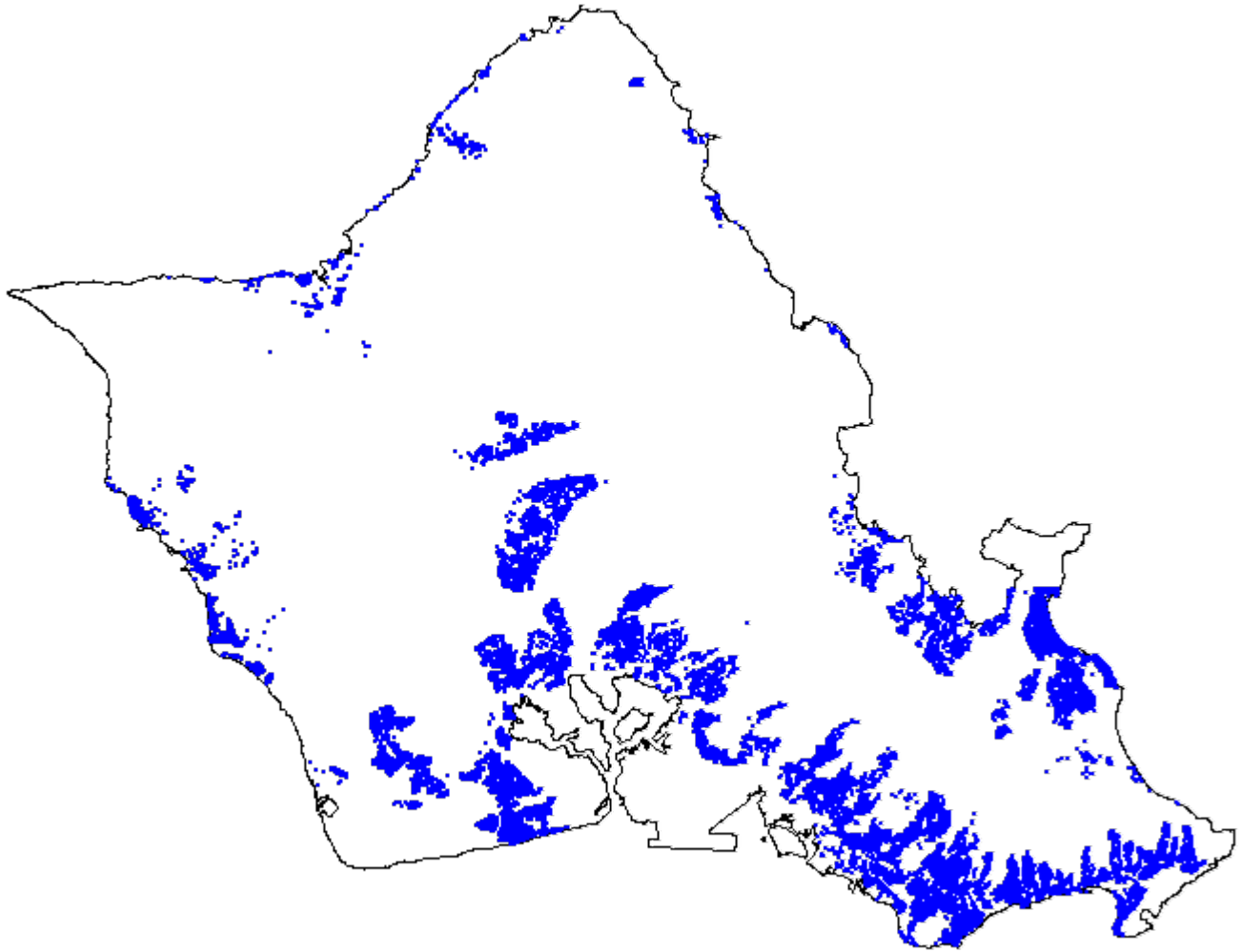
Wang (2021): US Metro (Houston, Santa Clara, Irvine, Des Moines increase; Honolulu decrease)

Gupta, et. al. (2022): US (city vs. suburban)

D'Lima, et. al. (2022): US (population density)

Yang, et. al. (2023): China (low vs. high income housing)

Data



- All arms-length transactions from Multiple Listing Service of HiCentral MLS, Ltd. (thank you Honolulu Board of REALTORS®)
- Original data held 57,217 transactions for 51,239 unique units.
- After cleaning data, we are left with 50,394 observations over 43,057 unique units.

Sold Once	36,367 units
Sold Twice	6,075 units
Sold Three Time	586 units
Sold Four or Five Times	29 units

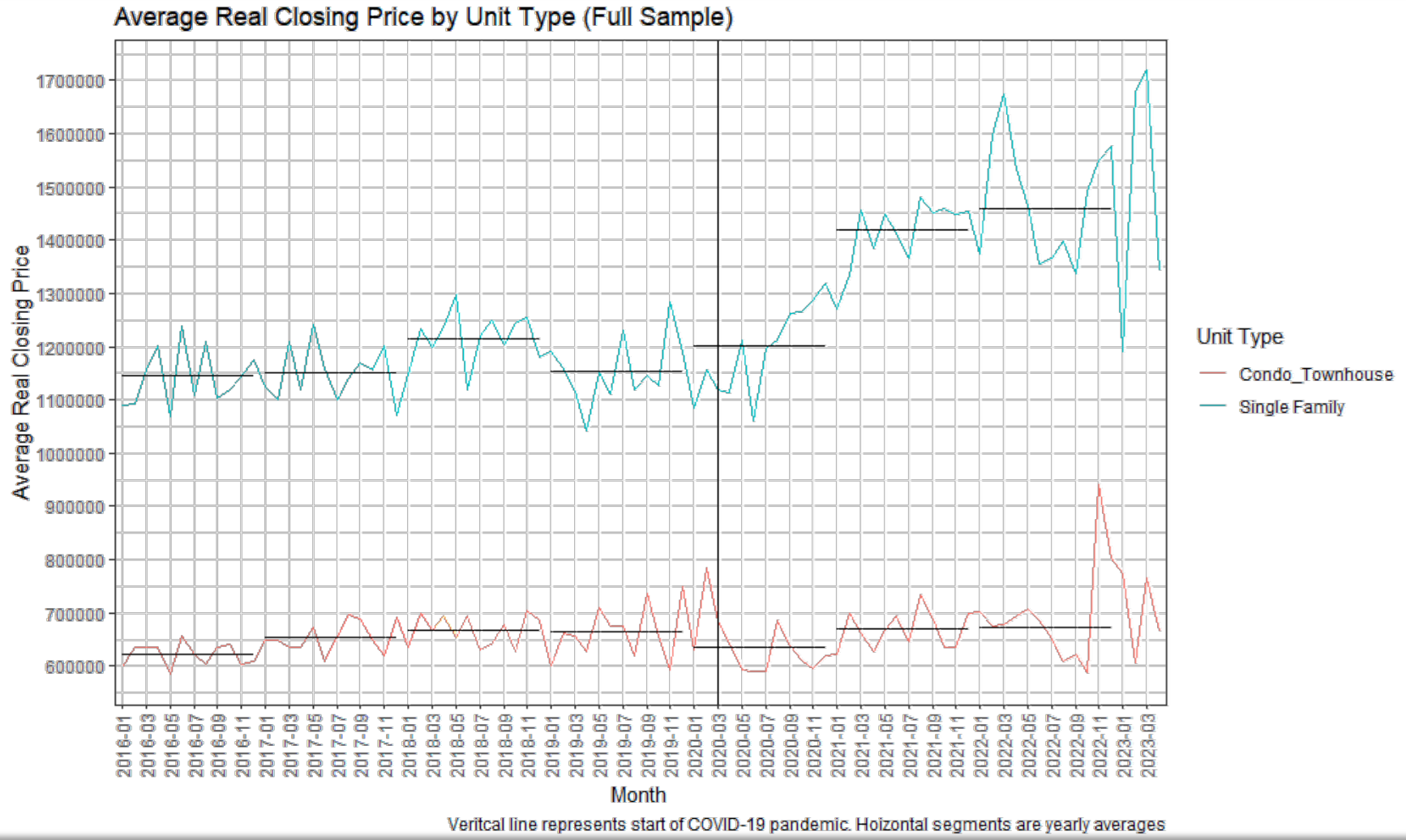
Data

Table One

Summary Statistics for Full Sample and Townhouse and Single Family Subsamples for entire sample period

	Full Sample						Townhouse Subsample						Single Family Subsample					
	Full Sample		Pre-Covid		Post-Covid		Full Sample		Pre-Covid		Post-Covid		Full Sample		Pre-Covid		Post-Covid	
Description	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Real Closing Price (100K)	9.28	8.28	8.87	7.90	9.84	8.73	6.57	5.72	6.54	5.90	6.60	5.45	12.53	9.59	11.64	9.00	13.73	10.22
Number of times sold	1.32	0.55	1.32	0.55	1.32	0.55	1.33	0.56	1.33	0.56	1.33	0.55	1.30	0.54	1.29	0.53	1.32	0.55
=1 for sales during or after 3/2020	0.42	0.49	-	-	1.00	0.00	0.43	0.49	-	-	1.00	0.00	0.42	0.49	-	-	1.00	0.00
Total Squarefootage (1K)	1,473.24	982.46	1,459.27	951.34	1,492.26	1,022.99	963.10	437.41	965.57	434.83	959.76	440.88	2,082.55	1,098.86	2,046.78	1,059.19	2,131.45	1,149.13
Age of the home	36.91	19.66	35.25	19.33	39.17	19.88	35.39	16.00	34.12	15.64	37.10	16.32	38.74	23.16	36.60	22.88	41.66	23.21
Days on the Market	44.36	58.82	51.11	59.03	35.17	57.26	46.06	60.62	50.71	58.34	39.77	63.04	42.32	56.52	51.59	59.84	29.65	48.86
Observations	50,394		29,046		21,348		27,429		15,783		11,646		22,965		13,263		9,702	

Data


Average Real Closing Price by Unit Type (Full Sample)
Average Real Closing Price
1700000
1600000
1500000
1400000
1300000
1200000
1100000
1000000
900000
800000
700000
600000
2016-01
2016-03
2016-05
2016-07
2016-09
2016-11
2017-01
2017-03
2017-05
2017-07
2017-09
2017-11
2018-01
2018-03
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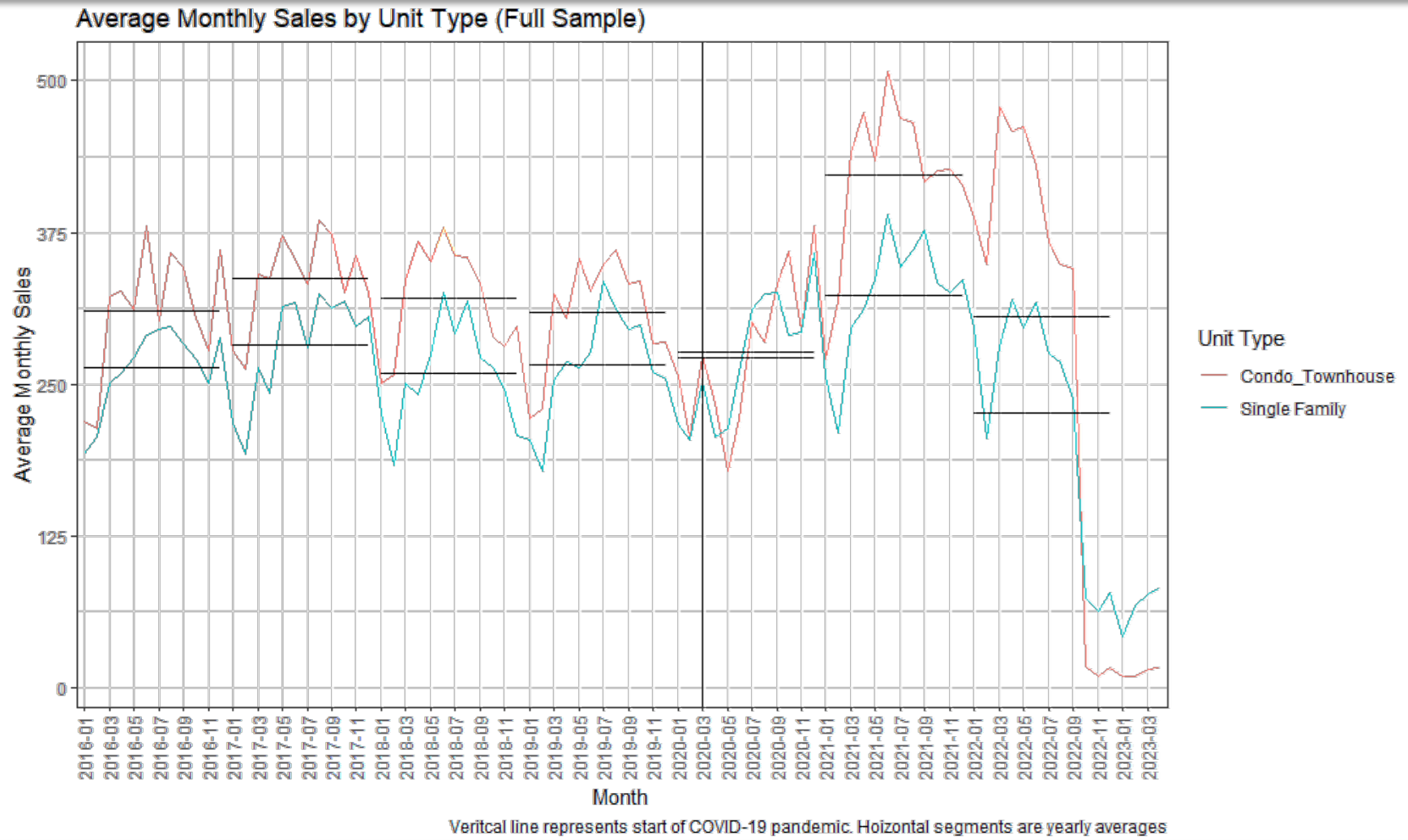
2021-07
2021-09
2021-11
2022-01
2022-03
2022-05
2022-07
2022-09
2022-11
2023-01
2023-03
Month
Unit Type
Condo_Townhouse
Single Family
Veritcal line represents start of COVID-19 pandemic. Hoizontal segments are yearly averages

Data


Average Monthly Sales by Unit Type (Full Sample)
Average Monthly Sales
500
375
250
125
0
2016-01
2016-03
2016-05
2016-07
2016-09
2016-11
2017-01
2017-03
2017-05
2017-07
2017-09
2017-11
2018-01
2018-03
2018-05
2018-07
2018-09
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2021-09
2021-11
2022-01
2022-03
2022-05
2022-07
2022-09
2022-11
2023-01
2023-03
Month
Unit Type
Condo_Townhouse
Single Family
Veritcal line represents start of COVID-19 pandemic. Hoizontal segments are yearly averages

Methodology

- Estimate a Hedonic Regressions using both OLS and Spatial Techniques
- Spatially we estimate a Spatial Durbin Model

$$\ln(P_i) = \rho W_1 P + \beta_0 + X_i \beta_1 + W_2 X \theta + \epsilon_i$$

- We assume that $W_1 = W_2$ and is row normalized
- Originally, W is created without respect to temporal factors except that we remove repeated sales keeping either first or most recent sale.

Results

Table Five

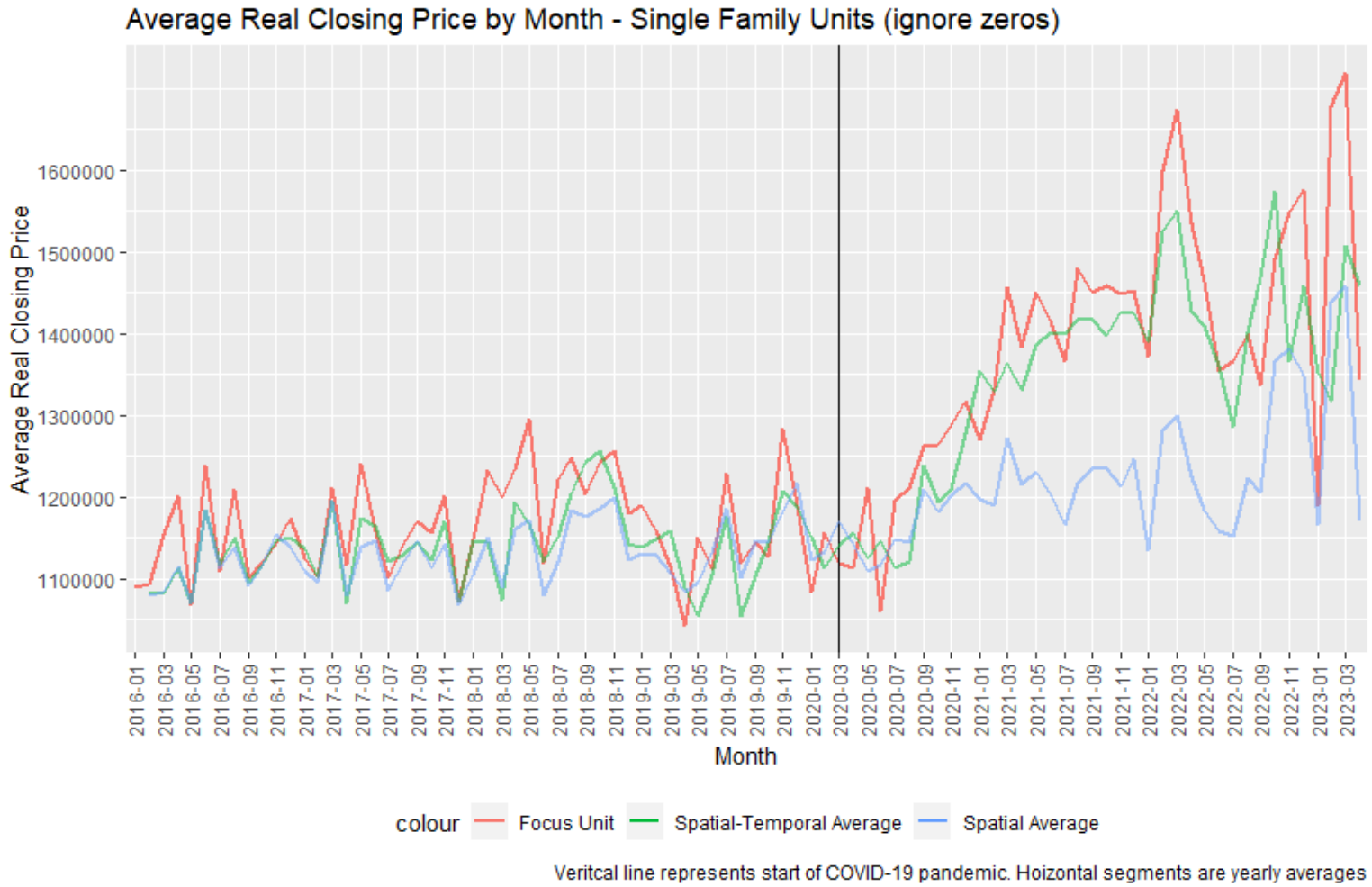
Estimates from Spatial Durbin Model with Simulated Impacts (5,000 Iterations)

	All Unit Types		Townhome/Codo Unit		Single Family Unit	
	Recent Sale	First Sale	Recent Sale	First Sale	Recent Sale	First Sale
Covid	0.0114*	0.0106	0.0017	0.0017	0.0392***	0.0361***
	0.0068	0.0069	0.0075	0.0078	0.0083	0.0086
lagged Covid	0.0720**	0.0178	0.0009***	0.0008***	-0.0088	-0.0360
	0.0322	0.0326	0.0001	0.0001	0.0389	0.0376
Rho	0.8389***	0.8418***	0.8567***	0.8545***	0.7877***	0.7917***
Direct Impact	0.0205**	0.0137	0.0160*	0.0061	0.0408***	0.0406***
Indirect Impact	0.4943**	0.1644	0.7795***	0.2436	0.0804	0.2184
Total Impact	0.5148**	0.1781	0.7956***	0.2497	0.1212	0.2590
Observations	43259	43259	23359	23359	19900	19900
AIC	-26309.00	-26562.00	-24312.00	-24359.00	-18611.00	-18422.00
LogLik	13271.41	13398.09	12271.09	12294.59	9412.37	9318.19

Methodology

- The extremely large ρ seems to indicate an over-specification of the spatial weight matrix, mostly like due to ignorance of temporal factors (Pace, et. al.).
- Two approaches:
  - Pace, et. al. (2000): Decompose the W into $S, T, ST, and\ TS$ after sorting observations by close date.
  - Thanos, Dubé, Legros (2016): Create separate $S\ and\ T$ matrix and then use the Haramand Product to create a usable $W_{HP} = S \odot T$

Visualizations



Results

Single Family

Full Sample

	Beta	S	T	ST	TS	Beta	S*T
Covid	0.024	-0.046	0.021	-0.122	0.627	0.039***	0.01
	-0.022	-0.073	-0.056	-0.117	-0.456	-0.012	-0.008
lnClose		0.201***	-0.342	-0.148	0.318		0.005**
		-0.012	-0.419	-0.384	-0.391		-0.002
Observations			22,735			22,735	
R^2			0.8050			0.7950	
Adjusted R^2			0.8040			0.7940	
Residual Std. Error			0.206 (df = 22581)			0.211 (df = 22668)	
F Statistic			610.071*** (df = 153; 22581)			1,331.947*** (df = 66; 22668)	

Spatial Zeros Removed

	Beta	S	T	ST	TS	Beta	S*T
Covid	0.02	-0.043	-0.027	-0.165	0.896*	0.035***	0.012
	-0.023	-0.074	-0.065	-0.12	-0.487	-0.013	-0.009
lnClose		0.200***	-0.445	0.08	0.287		0.006**
		-0.012	-0.52	-0.394	-1.148		-0.003
Observations			22,505			19,755	
R^2			0.8060			0.7950	
Adjusted R^2			0.8040			0.7940	
Residual Std. Error			0.206 (df = 22351)			0.210 (df = 19688)	
F Statistic			605.101*** (df = 153; 22351)			1,153.409*** (df = 66; 19688)	

Results

Single Family - Covid ends in 2022

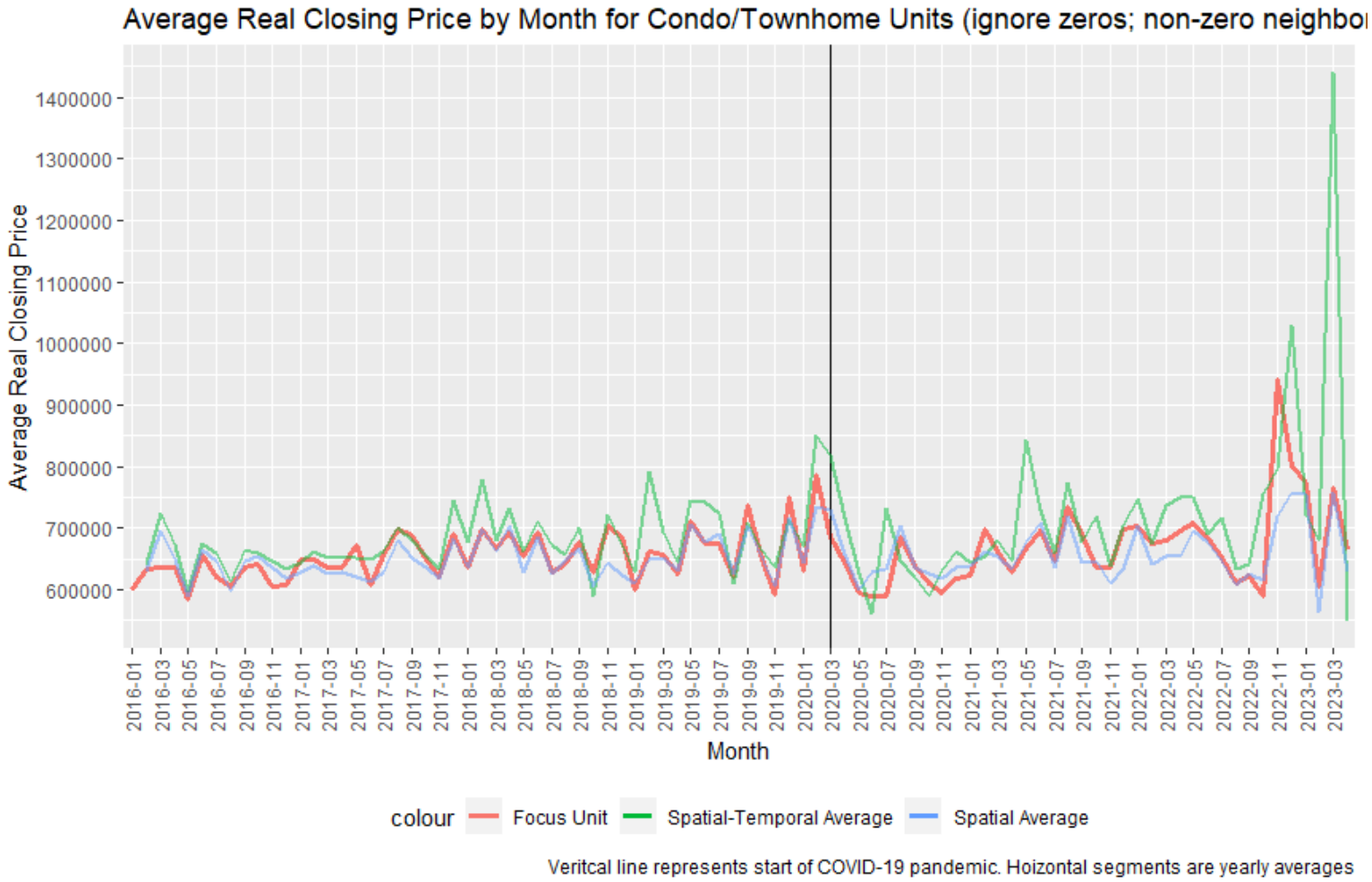
Full Sample

	Beta	S	T	ST	TS	Beta	S*T
Covid2	0.006	0.064	0.035	-0.119	0.811*	0.016**	0.020***
	-0.016	-0.069	-0.035	-0.115	-0.414	-0.007	-0.007
lnClose		0.201***	-0.529	-0.183	0.38		0.005**
		-0.012	-0.429	-0.379	-0.396		-0.002
Observations			22,735			22,735	
R^2			0.8050			0.7950	
Adjusted R^2			0.8040			0.7940	
Residual Std. Error			0.206 (df = 22581)			0.211 (df = 22668)	
F Statistic			610.081*** (df = 153; 22581)			1,332.059*** (df = 66; 22668)	

Spatial Zeros Removed

	Beta	S	T	ST	TS	Beta	S*T
Covid2	0.006	0.077	0.031	-0.16	0.924**	0.019**	0.017**
	-0.016	-0.07	-0.044	-0.117	-0.433	-0.008	-0.008
lnClose		0.200***	-0.843	0.027	1.487		0.005**
		-0.012	-0.586	-0.388	-1.334		-0.003
Observations			22,505			19,755	
R^2			0.8060			0.7950	
Adjusted R^2			0.8040			0.7940	
Residual Std. Error			0.206 (df = 22351)			0.210 (df = 19688)	
F Statistic			605.089*** (df = 153; 22351)			1,153.543*** (df = 66; 19688)	

Visualizations



Results

Condo/Townhouse Sample - Different Building

Full Sample

	Beta	S	T	ST	TS	Beta	S*T
Covid	0.029	0.078	-0.318***	0.072	1.371***	0.016	-0.009
	-0.023	-0.048	-0.08	-0.082	-0.345	-0.012	-0.006
lnClose		0.057***	-0.542	0.623**	-0.434*		0.006***
		-0.006	-0.429	-0.284	-0.256		-0.002
Observations			27,154			27,154	
R^2			0.7980			0.7940	
Adjusted R^2			0.7970			0.7930	
Residual Std. Error			0.227 (df = 26985)			0.229 (df = 27081)	
F Statistic			633.608*** (df = 168; 26985)			1,447.647*** (df = 72; 27081)	

Spatial Zeros Removed

	Beta	S	T	ST	TS	Beta	S*T
Covid	0.045*	0.083*	-0.410***	0.017	1.553***	0.008	-0.011
	-0.024	-0.05	-0.096	-0.092	-0.427	-0.016	-0.008
lnClose		0.066***	-0.543	0.583*	-1.123		0.003
		-0.007	-0.683	-0.308	-0.854		-0.003
Observations			25,713			17,158	
R^2			0.7980			0.7910	
Adjusted R^2			0.7970			0.7910	
Residual Std. Error			0.227 (df = 25544)			0.231 (df = 17085)	
F Statistic			602.031*** (df = 168; 25544)			900.194*** (df = 72; 17085)	

Results

Condo/Townhouse Sample - Different Building

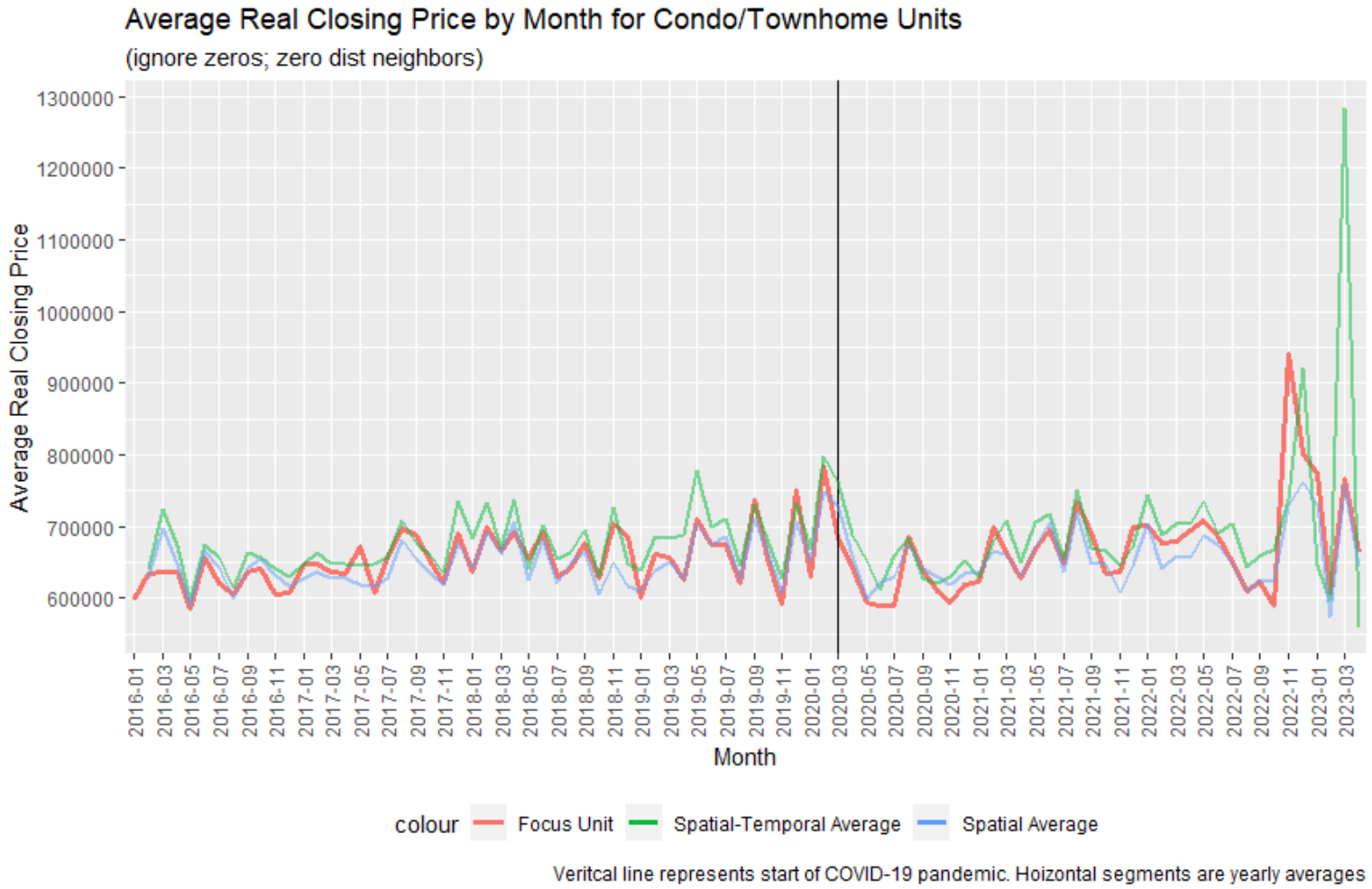
Full Sample

	Beta	S	T	ST	TS	Beta	S*T
Covid2	0.021	0.089*	-0.166***	0.069	0.915***	0.001	-0.008
	(0.016)	(0.046)	(0.051)	(0.082)	(0.300)	(0.007)	(0.006)
lnClose		0.057***	-0.27	0.672**	-0.392		0.006***
		(0.006)	(0.422)	(0.289)	(0.254)		(0.002)
Observations			27,154			27,154	
R^2			0.7980			0.7940	
Adjusted R^2			0.7960			0.7930	
Residual Std. Error			0.227 (df = 26985)			0.229 (df = 27081)	
F Statistic			633.482*** (df = 168; 26985)			1,447.549*** (df = 72; 27081)	

Spatial Zeros Removed

	Beta	S	T	ST	TS	Beta	S*T
Covid2	0.030*	0.093*	-0.180***	0.013	0.876**	0.006	-0.011
	-0.017	-0.048	-0.06	-0.092	-0.376	-0.009	-0.008
lnClose		0.066***	-0.022	0.633**	-1.346		0.003
		-0.007	-0.677	-0.314	-0.856		-0.003
Observations			25,713			17,158	
R^2			0.7980			0.7910	
Adjusted R^2			0.7970			0.7910	
Residual Std. Error			0.227 (df = 25544)			0.231 (df = 17085)	
F Statistic			601.793*** (df = 168; 25544)			900.229*** (df = 72; 17085)	

Visualizations



Results

Condo/Townhouse Sample - Same Building

Full Sample

	Beta	S	T	ST	TS	Beta	S*T
Covid	0.013	0.193***	-0.278***	-0.002	0.939***	0.015	-0.005
	-0.023	-0.06	-0.077	-0.1	-0.306	-0.012	-0.007
lnClose		0.057***	0.155	0.454	-0.201		0.008***
		-0.007	-0.415	-0.341	-0.242		-0.002
Observations			27,154			27,154	
R^2			0.7980			0.7940	
Adjusted R^2			0.7970			0.7930	
Residual Std. Error			0.227 (df = 26985)			0.229 (df = 27081)	
F Statistic			633.688*** (df = 168; 26985)			1,445.324*** (df = 72; 27081)	

Spatial Zeros Removed

	Beta	S	T	ST	TS	Beta	S*T
Covid	0.027	0.212***	-0.331***	-0.078	1.282***	0.018	-0.002
	-0.024	-0.064	-0.094	-0.11	-0.383	-0.014	-0.007
lnClose		0.067***	-0.304	0.372	-1.549*		0.008***
		-0.007	-0.702	-0.372	-0.925		-0.002
Observations			25,713			21,204	
R^2			0.7980			0.7950	
Adjusted R^2			0.7970			0.7940	
Residual Std. Error			0.227 (df = 25544)			0.230 (df = 21131)	
F Statistic			602.445*** (df = 168; 25544)			1,135.920*** (df = 72; 21131)	

Results

Condo/Townhouse Sample - Same Building

Full Sample

	Beta	S	T	ST	TS	Beta	S*T
Covid2	0.015	0.237***	-0.143***	-0.014	0.536**	-0.001	-0.002
	(0.016)	(0.059)	(0.0520	(0.100)	(0.257)	(0.007)	(0.0060
lnClose		0.057***	0.393	0.56	-0.094		0.008***
		(0.007)	(0.408)	(0.345)	(0.239)		(0.002)
Observations			27,154			27,154	
R^2			0.7980			0.7930	
Adjusted R^2			0.7970			0.7930	
Residual Std. Error			0.227 (df = 26985)			0.229 (df = 27081)	
F Statistic			633.698*** (df = 168; 26985)			1,445.213*** (df = 72; 27081)	

Spatial Zeros Removed

	Beta	S	T	ST	TS	Beta	S*T
Covid2	0.019	0.254***	-0.184***	-0.093	0.819***	0.001	0.001
	-0.017	-0.062	-0.06	-0.11	-0.307	-0.008	-0.007
lnClose		0.066***	0.128	0.482	-1.871**		0.008***
		-0.007	-0.65	-0.377	-0.888		-0.002
Observations			25,713			21,204	
R^2			0.7980			0.7950	
Adjusted R^2			0.7970			0.7940	
Residual Std. Error			0.227 (df = 25544)			0.230 (df = 21131)	
F Statistic			602.513*** (df = 168; 25544)			1,135.811*** (df = 72; 21131)	

Conclusions

- **Single Family**
  - The Pace, et.al. decomposition shows essentially zero COVID-19 impact among single family housing except a larger impact with the TS part – but what does this mean?
  - The Thanos, et.al. decomposition shows a clear direct impact from Covid-19 sales and, depending on when Covid-19 “ends” an indirect impact as well.
- **Condo/Townhome**
  - The Pace, et.al. decomposition shows a significant positive spatial impact (S) that is larger within the same building, a significant negative impact (T) that is also slightly larger in the same building, no impact from ST and a very large positive impact from TS.
  - The Thanos, et.al. shows no statistically significant direct or indirect impact from a Covid-19 sale without regards to location (same or different building)