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Measuring environmental (dis)amenity value during a pandemic: Early evidence from Maryland

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Abstract
With the outbreak of COVID-19 and the implementation of stay-at-home (SAH) orders aimed to mitigate its spread, households became less mobile and sheltered in place. This behavior has potential implications for how households’ value environmental (dis)amenities, especially those that are underutilized during the pandemic. In this paper, we explore changes in the valuation of two prominent environmental (dis)amenities — major roadway and open space proximity — by households within the Baltimore metropolitan region. We find evidence that the housing price capitalization of immediate major roadway proximity changes due to the SAH order and associated policies that impact economic activity, suggesting a shift in household perceptions, while there is no evidence of open space valuation changes. These results may have significant implications for homeowner welfare if the altered capitalization of environmental (dis)amenities is temporary due to the SAH order.

1. Introduction

The outbreak of COVID-19 and measures taken to decrease its spread have led to significant changes in household behaviors. Mobility has severely declined in response to protective policies, with highway travel decreasing at 53 percent across U.S. metropolitan areas (Fishbane and Tomer 2020; Engle et al., 2020). Given these behavioral adjustments and uncertainty surrounding their permanence, perceptions of environmental (dis)amenities may be impacted by COVID-19. We address these perceptions by examining the change in housing price capitalization of major roadway and open space proximity during the period following a COVID-19 stay-at-home (SAH) order. The results indicate that homebuyer perceptions of immediate major roadway features, but not open space, are impacted by the stay-at-home (SAH) order’s disruption to the larger economy and significant welfare effects may manifest if the impacts of the SAH order are transitory.

This paper builds upon a broad environmental valuation literature, with a focus on the well-studied topics of major roadway and open space proximity. Roadway proximity is associated with the negative externalities of air and noise pollution, which are shown to negatively affect cardiovascular health, hypertension, lung development, and premature birth (WHO}
Hedonic research finds a preference to avoid roadway noise (von Graevenitz, 2018). Quiros et al. (2013) examine the temporal dissipation of road-related pollutants from traffic reductions, finding ultrafine particle concentrations declined 80 percent during major highway closure, suggesting commuting changes have an abrupt impact on pollution. Focusing on open space, Acharya and Bennett (2001) find a positive impact on housing prices, but at a decreasing rate relative to open space levels. McConnell and Walls (2005) provide a literature overview noting a heterogeneous, small, and typically positive capitalization of public parks in nearby houses.

We advance the literature by examining the impact of COVID-19 and its related mitigation policies on housing price capitalization of environmental (dis)amenities. We utilize housing sales and spatial (dis)amenity data from the Baltimore Metropolitan Statistical Area (MSA) between 2018 and 2020. Using a difference-in-differences approach, we regress housing prices on home attributes, spatial controls, and temporal measures to isolate the impact of COVID-19 and SAH polices on roadway and open space valuation. These were directly impacted by policies seeking to mitigate COVID-19, with partial closures of open spaces and decreased traffic on roadways.

The estimates provide initial evidence that the negative capitalization for houses within 200-feet of major roadways is tempered after the implementation of the SAH, while larger distances were unaffected. In contrast, open space has no variation in capitalization stemming from the SAH order. The change in the capitalization of roadway proximity may have substantial impacts on household welfare if homebuyers were unaware of externalities associated with their locational choice. Assuming negative capitalization of these amenities is the correct state of the world, homebuyers created an aggregate property value wedge up to $1.6 million for those near major roadways relative to the estimated property value absent the SAH order.

2. Study area and data

We use the Baltimore MSA as our study area, which is oft-utilized in valuation research due to the availability of transactions data from MDProperty View, a state database of property data (see Irwin et al. (2019) for a recent research compendium). The Baltimore MSA consists of six counties and the independent city of Baltimore. The MSA has a combined population of 2.7 million, 20th in the United States according to the 2010 Census. The impact of the COVID-19 pandemic in Maryland has been typical compared to the U.S., with over 115,000 cases, nearly 3,800 deaths, and a SAH order effective from March 30 through May 15 followed by a phased economic reopening. The reopening, while lifting the SAH order, severely restricted the types of businesses that operated and minimized large groups in a similar manner to the SAH, directly impacting roadway travel with implications for homebuyer open space preferences. Therefore, even though the official SAH order ended on May 15th, its effects continued through the end of our study period and, arguably, will continue until all restrictions on economic activity are lifted.

We obtain arms-length single-family transactions from MDProperty View for the MSA covering January 2018 through July 2020. We clean the data to remove extreme outliers and observations missing key structural variables. In the upper left of Fig. 1, we show the pattern of transactions by month and year for all of the houses in our sample. Generally, the pattern of sales increases through the spring, with a peak in June, before tapering off. 2020 was typical of previous years in January and February before sizable declines in sales from March through July due to the effects of COVID-19 and the SAH order. However, there were still 4,400 houses sold in the MSA after the SAH implementation. In the upper right and lower left panels of Fig. 1, we show the average (nominal) monthly sales price over our study period, which shows similarities across all years prior to the outbreak of COVID-19 and through the early portions of the SAH period. Table 1 reports the summary statistics for the whole sample and split by SAH. We note the statistics are very similar across groups, indicating the transactions composition was not significantly different during the post-SAH period. We show the spatial dispersion of transactions in Fig. 2.

We link the transactions to a suite of additional data to aid our empirical estimation. We utilize the Maryland Tiger/Line shapefiles, which contains all primary (limited-access) and secondary (main arterial) roads and calculate the Euclidean distance from each house centroid to the nearest major roadway. Next, we obtain shapefiles for a variety of open space types from Maryland’s open GIS portal, including data on locally protected lands — parks and community space — in addition to data on state-managed and federally-owned lands which may be valuable open space for proximate homebuyers. We perform a similar distance calculation and report the distances in Table 1. The spatial difference in distance from each house to major roadways and open space provides the variation necessary for identifying temporal differences in the capitalization of these measures resulting from COVID-19 policies in our models.

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1 Anne Arundel, Baltimore, Carroll, Harford, Howard, and Queen Anne’s.
2 As of September 20, 2020.
3 Results are qualitatively consistent across the sample period when disaggregated between the official SAH order and early stages of reopening, indicating the impact on valuation did not change from reopening. Therefore, we use the SAH label throughout for simplification.
4 One key structural variable missing is bathrooms, a prominent determinant of prices. MDProperty View no longer provides this datapoint as of their recent statewide data standardization, despite doing so in the past.
5 The sales volume for July shows an unexpected decline that runs counter to national evidence of increased summer sales. We believe this is due to MDProperty View data reporting delays from counties and we have used the full data as it is available.
Note: These figures display the overall total sales volume by month in our sample years (upper left), the number of houses sold within 200 feet of a major roadway by month (upper right), the number of sales sold within 400 feet of open space by month (lower left), and the average sale price by month (lower right). Additional sale volume figures differentiated by proximity are available from the authors by request.

**Fig. 1.** Housing sales by type and average sale prices.

**Table 1**
Summary statistics.

| Variable                        | Full Sample (Jan. 2018–July 31, 2020) | Pre-SAH (Jan. 2018–April 30, 2020) | Post-SAH (April 30, 2020–July 31, 2020) |
|---------------------------------|--------------------------------------|------------------------------------|----------------------------------------|
|                                 | Mean   | Std. Dev. | Min. | Max. | Mean   | Std. Dev. | Mean   | Std. Dev. |
| Sale price ($1000)              | $375.60| $213.81   | $10  | $2000| $375.27| $215.30   | $380.03| $192.87   |
| House size (100's sqft.)        | 18.98  | 8.84      | 5.04 | 74.81| 19.97  | 8.86      | 19.09  | 8.51      |
| Parcel size (acres)             | 0.46   | 0.85      | 0.00 | 10.00| 0.46   | 0.84      | 0.52   | 0.94      |
| Year built                      | 1978   | 27        | 1918 | 2020| 1978   | 27        | 1977   | 26        |
| Age                             | 40.75  | 26.87     | 0.00 | 100  | 40.60  | 26.92     | 42.81  | 26.00     |
| Stories                         | 1.82   | 0.56      | 1.00 | 3.00 | 1.82   | 0.56      | 1.88   | 0.51      |
| Basement (0/1)                  | 0.70   | 0.46      | 0.00 | 1.00 | 0.70   | 0.46      | 0.73   | 0.44      |
| Structural grade (1–9)          | 3.81   | 0.84      | 1.00 | 9.00 | 3.81   | 0.84      | 3.82   | 0.82      |
| Vinyl siding (0/1)              | 0.64   | 0.48      | 0.00 | 1.00 | 0.64   | 0.48      | 0.63   | 0.48      |
| Brick structure (0/1)           | 0.15   | 0.36      | 0.00 | 1.00 | 0.15   | 0.36      | 0.16   | 0.36      |
| Distance to nearest major roadway (miles) | 0.50   | 0.48      | 0.00 | 5.35 | 0.50   | 0.48      | 0.50   | 0.47      |
| Distance to nearest open space (miles) | 0.40   | 0.39      | 0.00 | 3.86 | 0.40   | 0.39      | 0.38   | 0.39      |
| Number of observations          | 64,510 |           |      |      | 60,022 |           | 14,488 |           |
3. Empirical implementation

We implement a hedonic price model (Rosen, 1974) to investigate the impact of COVID-19 and the SAH polices on (dis)amenity capitalization. Following the discussion in Cropper et al. (1988), we implement the following log-linear regression to curtail estimation error:

Note: The localities in the MSA are (from top left on the west of the Chesapeake Bay): Carroll County, Baltimore County, Harford County, Howard County, Baltimore City, and Anne Arundel County. Queen Anne’s County is located on the east side of the Chesapeake Bay and connected to Anne Arundel County by the Bay Bridge.

Fig. 2. Residential transactions in Baltimore MSA.
where equation (1) estimates the relationship between housing prices, \( P \), and \( X \) which is a vector of house attributes from Table 1, a distance cut-off parameter to the nearest roadway or open space type, \( A \), an indicator variable for a house selling 30 days\(^6\) after the SAH order went into effect, SAH, and the interaction of the latter two variables. In equation (1), \( i, j, \) and \( t \) index individual houses, locations, and time, respectively. \( \delta_j \) is a block-group fixed effect controlling for unobserved school quality, public services, and other spatially varying attributes that may bias our estimates. A control for temporal variation, \( \gamma_t \), at the quarter-year level is included. Given the log-linear nature of equation (1), we apply Halvorsen and Palmquist’s (1980) indicator variable correction. The variable of interest in our model is the interaction of the amenity in question — roadway proximity or open space — and the SAH order. The interaction measures the difference in the valuation of roadway proximity and open space before and after the SAH order, which provides an estimate valuation change attributable to the SAH policy, i.e., a difference-in-difference.

We define proximity in the following manner: for distance to major roadways, we create a dummy variable for houses within 200- and 400-feet of the roadway as this is the approximate distance whereby the decibel levels\(^7\) decrease substantially, conditional on noise barriers or geography (Caltrans, 2013). For open space, proximity is in terms of walkability, (400- and 800-feet) meaning houses will receive aesthetic open space value or are within walking distance of accessible space. In Fig. 3, we provide residual plots of prices for transactions after controlling for time

\[ \ln(P_{it}) = \beta_0 + \beta_HX_i + \beta_AA_i + \beta_SSAH_t + \beta_ASAH_tSAH_t + \delta_j + \gamma_t + \epsilon_{it} \]

4. Results

We report the results of our first estimation — proximity to a major roadway — in Table 2.\(^9\) In Column (1), we find a negative and significant value for houses located within 200-feet of a major roadway pre-SAH on the order of 3.4 percent — roughly $12,850 at mean price — which agrees with previous economic literature and indicates a negative externality associated with proximity to busy roads. Turning to the indicator variable for houses sold post-SAH, we find no evidence of any price effects for houses sold during this period, alleviating concern that these houses were atypical of pre-SAH sales. In the interaction term, we find that it is positive and significant at a low level of significance (10 percent), indicating that there is a weak positive capitalization effect for the set of houses near major roadways post-SAH.

Although there is weak significance on this proximity variable, the more profound result is that houses sold pre-SAH have the expected negative capitalization, but houses sold during the post-SAH period no longer fully negatively capitalize this environmental externality into prices. We attribute this capitalization change to the fact significantly fewer cars were on the road during the SAH order, which provided false information about typical road noise and pollution levels. In turn, homesellers that purchased these houses with a price discount from the externality received a higher price than they would have pre-SAH. We note that these results are based on a short temporal window and future research will be needed to unpack the persistence of this effect as the economy re-opens and traffic returns.

To investigate the sensitivity of major roadway distance, we increase our proximity to 400-feet, more than doubling the number of affected houses and report the new results in Table 2, Column (2). Pre-SAH, the capitalization of roadway proximity is statistically significant but tempered compared to the 200-feet distance. With this expanded distance parameter, we find no evidence of a change in capitalization for the set of houses sold after the SAH. Our overall results provide clear and compelling evidence that the SAH order substantially tempered capitalization of major roadway proximity for those closest and most likely to be impacted by roadway externalities while having no effect at increased distances. We believe this outcome stems from the SAH’s effect on major roadway traffic due to the closing of non-essential businesses and schools despite the possible temporariness of the change.\(^10\)

We turn next to estimating if open space valuation has similarly changed in response to the SAH order. In Table 2, Column (3), we report our results for houses that are within 400-feet of any open space and find that houses sold pre-SAH see a very

\(^6\) We assume a standard 30-day closing window, allowing for the possible effects of COVID-19 on the valuation of these (dis)amenities to be included in homebuyer price formation. Our results are qualitatively similar if we relax this assumption to 60 days as shown in Appendix (Tables 3 and 4).

\(^7\) Previous research on roadway noise has utilized decibel level mapping to differentiate noise, which was not available.

\(^8\) The inclusion of tract fixed-effects leads to qualitatively similar results.

\(^9\) Complete regression tables in appendix.

\(^10\) It is possible that valuation changes are linked to household preferences for larger houses or more acres to compensate for SAH. We control for this by incorporating SAH interaction variables for house size and acres within the regressions. The coefficients are not statistically significant, indicating capitalization for these features was unaffected by the SAH order. Results reported in Appendix Table 1.
small decrease in house prices of approximately one percent, which we attribute to the downside of being near open space such as park lights, event noise, and/or crowd congestion (McConnell and Walls, 2005; Anderson and West, 2006). However, we note that this estimate is significant only at the 10 percent level, indicating a weak capitalization effect. Turning to houses sold post-SAH, we find no evidence of any capitalization change for open space proximity in the nearest houses, indicating

Table 2
Regression results for changing capitalization of proximity to roadways and open space.

| Dependent Variable: Log Sale Price | (1) | (2) | (3) | (4) |
|-----------------------------------|-----|-----|-----|-----|
| Near roadway/open space           | -0.035*** | -0.022*** | -0.009* | -0.001 |
| (0.009)                           | (0.006) | (0.005) | (0.006) |
| Sold after SAH                    | -0.015  | -0.014  | -0.013  | -0.013  |
| (0.013)                           | (0.013) | (0.013) | (0.013) |
| Near X Sold after SAH             | 0.043*  | 0.002   | -0.001  | -0.003  |
| (0.024)                           | (0.016) | (0.011) | (0.009) |
| Property Characteristics         | Yes   | Yes   | Yes   | Yes   |
| Fixed Effects                     | Block group | Block group | Block group | Block group |
| Temporal Fixed Effects            | Quarter-year | Quarter-year | Quarter-year | Quarter-year |
| R-Squared                         | 0.76  | 0.76  | 0.76  | 0.76  |
| Observations near roadway         | 1991 | 5780 | 9845 | 18,999 |
| Observations sold after SAH       | 4488 | 4488 | 4488 | 4488 |
| Observations in interaction group | 128 | 384 | 783 | 1449 |
| Total Observations                | 64,510 | 64,510 | 64,510 | 64,510 |

Notes: This table presents the estimation results of equation (1) for major roadway proximity (columns 1 & 2) and open space proximity (3 & 4). Near is defined as within the distance indicated in each column. Property characteristics are suppressed for space but reported in the Appendix.

***p < .01, **p < .05, *p < .1. Robust standard errors shown in parenthesis are clustered at the indicated spatial fixed effects level.

Note: This figure reports the results of house price residuals for our key results in major roadway and open space proximity. These residuals are calculated from a simple regression of the natural log of houses prices regressed against time fixed effects to remove any temporal trends in the data.

Fig. 3. Residual figures for roadway and open space proximity.
that the SAH impact on open space properties is indistinguishable from zero. Expanding our walkability to 800-feet in Table 2, Column (4), we find no pre-SAH capitalization for this set of houses, indicating that the observed negative effects of close proximity to open space may only manifest for the nearest of houses. We also continue to find a null result for houses sold post-SAH in this distance.\textsuperscript{11}

From a policy perspective, these results have multiple important takeaways. First, homebuyers shopping for a house during the SAH period may respond differently to (dis)amenities than previous homebuyers, and in the case of roadway noise and pollution, counter to the literature. This has considerable aggregate welfare implications—up to $1.6 million near major roadways—due to the absence of compensation via decreased prices, i.e., if there is no offset for any noise or health effects as established in previous research. Second, the stability of the open space estimates demonstrates temporary changes do not impact perceptions for all (dis)amenities. Overall, the SAH order induced a price wedge between houses prices that account for the 200-feet roadway (dis)amenity externality and prices when externalities are temporarily absent, solely due to the SAH order. Together, the estimates suggest that disclosures or other education programs may be necessary if changes in (dis)amenities are expected to temporarily deviate from normal. This may mean that studying housing transactions during the entirety of the COVID-19 pandemic can reveal results that are unexpected and counter-intuitive; thus, the results would need important contextualization from researchers if the changes in the housing market are temporary.

5. Conclusion

COVID-19 and its associated policies represent a substantial shift in societal and household behavior. With this research, we investigate the impact of SAH orders on housing price capitalization of major roadways and open space proximity to examine the change in valuation of these (dis)amenities expressed through the housing market. The results indicate that the negative capitalization associated with close (200-feet) roadway proximity was tempered by the SAH order and its associated impacts on economic activity, and the capitalization of larger roadway distances and open space were unaffected. While the negative externalities associated with immediate roadway proximity decreased during the SAH period, it is unclear how persistent these changes will be when the economy fully reopens, workers return to offices, and traffic increases. Policymakers may find it necessary to implement disclosure programs to educate homebuyers on these potential externalities or face constituents who may demand costly remediation activity.

While this research has illuminated the immediate impact of COVID-19 on the valuation of spatial (dis)amenities, additional research is needed in tandem with new data. Untangling and better understanding the types of consumers on either end of these transactions and the permanence of the changes in capitalization is needed, as well as examining if similar effects manifest in other spatially provided (dis)amenities. Are these houses sold during the SAH under duress by homeowners who are worried about their economic future? Are homebuyers coming from inside or outside the MSA? Are there knock-on effects from expanded unemployment benefits on future housing markets? While these questions cannot be fully answered immediately, gaining understanding of the churn in the housing market and the extent to which this is causing MSA demographic shifts would be helpful to policymakers trying to respond to unprecedented economic conditions with the potential to create significant long-term damages both locally and nationally.

Appendix

Appendix Table 1
Complete regression results from roadway and open space proximity estimation (Table 2 in text)

| Dependent Variable: Log Sale Price | (1) | (2) | (3) | (4) |
|------------------------------------|-----|-----|-----|-----|
|                                    | major road w/i 200 feet | major road w/i 400 feet | Open space w/i 400 ft. | Open space w/i 800 ft. |
| Near                               | -0.035***          | -0.022***              | -0.009*           | -0.001          |
|                                    | (0.0093)           | (0.0063)               | (0.0050)          | (0.0065)       |
| Sold after SAH                     | -0.015            | -0.013                 | -0.013            | -0.013         |
|                                    | (0.0134)           | (0.0134)               | (0.0134)          | (0.0134)       |
| Near X Sold after SAH              | 0.043*            | 0.002                  | -0.001            | -0.003         |
|                                    | (0.0244)           | (0.0161)               | (0.0110)          | (0.0099)       |
| Distance to highway/open space (miles) | 0.041***          | 0.038***               | 0.034***          | 0.037**        |
|                                    | (0.0110)           | (0.0110)               | (0.0110)          | (0.0110)       |

\textsuperscript{11} In Appendix Table 2, we further expand our walkability measure to 1600-feet and find similar results, i.e., no change in pre/post-SAH capitalization. We also explore the possibility that certain types of open space may be especially valued in the SAH period but again find no change in capitalization.
## Appendix Table 1 (continued)

| Dependent Variable: Log Sale Price | (1) Major road w/i 200 feet | (2) Major road w/i 400 feet | (3) Open space w/i 400 ft. | (4) Open space w/i 800 ft. |
|-----------------------------------|-----------------------------|-----------------------------|---------------------------|---------------------------|
| House size (100's sqft)           | 0.043***                    | 0.043***                    | 0.043***                  | 0.043***                  |
|                                   | (0.001)                     | (0.001)                     | (0.001)                   | (0.001)                   |
| House size (100's sqft) x Sold after SAH | 0.001                      | 0.001                       | 0.001                     | 0.001                     |
|                                   | (0.001)                     | (0.001)                     | (0.001)                   | (0.001)                   |
| Acres                             | 0.084***                    | 0.085***                    | 0.087***                  | 0.087***                  |
|                                   | (0.008)                     | (0.008)                     | (0.008)                   | (0.008)                   |
| Acres x Sold after SAH            | 0.000                       | 0.000                       | 0.000                     | 0.000                     |
|                                   | (0.009)                     | (0.009)                     | (0.009)                   | (0.009)                   |
| House size squared                | -0.000***                   | -0.000***                   | -0.000***                 | -0.000***                 |
|                                   | (0.000)                     | (0.000)                     | (0.000)                   | (0.000)                   |
| Acres squared                     | -0.008***                   | -0.008***                   | -0.008***                 | -0.008***                 |
|                                   | (0.001)                     | (0.001)                     | (0.001)                   | (0.001)                   |
| Age                               | -0.001                      | -0.001                      | -0.000                    | -0.000                    |
|                                   | (0.001)                     | (0.001)                     | (0.001)                   | (0.001)                   |
| Age squared                       | 0.000*                      | -0.000*                     | -0.000                   | -0.000                     |
|                                   | (0.000)                     | (0.000)                     | (0.000)                   | (0.000)                   |
| Stories                           | -0.07***                    | -0.07***                    | -0.07***                  | -0.07***                  |
|                                   | (0.006)                     | (0.006)                     | (0.006)                   | (0.006)                   |
| Basement                          | 0.021***                    | 0.021***                    | 0.021***                  | 0.021***                  |
|                                   | (0.006)                     | (0.006)                     | (0.006)                   | (0.006)                   |
| Structural grade                  | 0.108***                    | 0.108***                    | 0.109***                  | 0.109***                  |
|                                   | (0.007)                     | (0.007)                     | (0.007)                   | (0.007)                   |
| Vinyl siding                      | 0.002                       | 0.002                       | 0.001                     | 0.001                     |
|                                   | (0.007)                     | (0.007)                     | (0.007)                   | (0.007)                   |
| Brick structure                   | -0.045***                   | -0.045***                   | -0.047***                 | -0.047***                 |
|                                   | (0.009)                     | (0.009)                     | (0.009)                   | (0.009)                   |
| Constant                          | 11.71***                    | 11.71***                    | 11.71***                  | 11.71***                  |
|                                   | (0.047)                     | (0.047)                     | (0.046)                   | (0.047)                   |
| Spatial fixed effects             | Block group                 | Block group                 | Block group               | Block group               |
| Temporal fixed effects            | Quarter-year                | Quarter-year                | Quarter-year              | Quarter-year              |
| Observations                      | 64,510                      | 64,510                      | 64,510                    | 64,510                    |
| R-squared                         | 0.76                        | 0.76                        | 0.76                      | 0.76                      |

Notes: This table presents the complete estimation results of equation (1) for major roadway proximity (columns 1 & 2) and open space proximity (3 & 4). Near is defined as within the distance indicated in each column. ***p < .01, **p < .05, *p < .1. Robust standard errors shown in parenthesis are clustered at the indicated spatial fixed effects level.

## Appendix Table 2

Estimation results from extending open space proximity and varying open space type

| Dependent Variable: Log Sale Price | (1) Open space w/i 1600 ft. | (2) Explicit open space w/i 1600 ft. | (3) Park w/i 1600 ft. | (4) Easement w/i 1600 ft. |
|-----------------------------------|-----------------------------|-----------------------------|-----------------------|--------------------------|
| Walkable to open space            | -0.004                      | 0.008                       | -0.002                | -0.008                   |
|                                   | (0.008)                     | (0.012)                     | (0.009)               | (0.015)                  |
| Sold after SAH                    | -0.016                      | -0.014                      | -0.013                | -0.014                   |
|                                   | (0.014)                     | (0.013)                     | (0.013)               | (0.013)                  |
| Walkable to open space X Sold after SAH | 0.003                      | -0.003                      | -0.006                | 0.000                    |
|                                   | (0.009)                     | (0.012)                     | (0.014)               | (0.02)                   |
| Distance to open space (miles)    | 0.034***                    | 0.039***                    | 0.037***              | 0.037***                 |
|                                   | (0.012)                     | (0.011)                     | (0.011)               | (0.011)                  |
| House size (sqft)                 | 0.043***                    | 0.043***                    | 0.043***              | 0.043***                 |
|                                   | (0.001)                     | (0.001)                     | (0.001)               | (0.001)                  |
| House size (sqft) x Sold after SAH| 0.001                       | 0.001                       | 0.001                | 0.001                    |
|                                   | -0.001                      | (0.001)                     | (0.001)               | (0.001)                  |
| Acres                             | 0.087***                    | 0.087***                    | 0.087***              | 0.087***                 |
|                                   | (0.008)                     | (0.008)                     | (0.008)               | (0.008)                  |
| Acres x Sold after SAH            | 0.000                       | 0.000                       | 0.000                | 0.000                    |
|                                   | (0.009)                     | (0.009)                     | (0.009)               | (0.009)                  |
| House size squared                | -0.000***                   | -0.000***                   | -0.000***            | -0.000***                |
|                                   | (0.000)                     | (0.000)                     | (0.000)               | (0.000)                  |
### Appendix Table 2 (continued)

| Dependent Variable: Log Sale Price | (1) | (2) | (3) | (4) |
|-----------------------------------|-----|-----|-----|-----|
| **Open space w/i 1600 ft.** | Acres squared | −0.008*** | −0.008*** | −0.008*** | −0.008*** |
| **Explicit open space w/i 1600 ft.** | Age | −0.000 | −0.000 | −0.000 | −0.000 |
| | Age squared | −0.000** | −0.000** | −0.000** | −0.000** |
| | Stories | −0.067*** | −0.07*** | −0.07*** | −0.07*** |
| | Basement | 0.021*** | 0.021*** | 0.021*** | 0.021*** |
| | Structural grade | 0.109*** | 0.109*** | 0.109*** | 0.109*** |
| | Vinly siding | 0.001 | 0.001 | 0.001 | 0.001 |
| | Brick structure | −0.047*** | −0.047*** | −0.047*** | −0.047*** |
| | Constant | 11.71*** | 11.71*** | 11.71*** | 11.71*** |
| **Spatial fixed effects** | Block group | (0.05) | (0.046) | (0.046) | (0.046) |
| **Temporal fixed effects** | Quarter-year | 11.71*** | 11.71*** | 11.71*** | 11.71*** |
| **Observations** | 64,510 | 64,510 | 64,510 | 64,510 |
| **R-squared** | 0.76 | 0.76 | 0.76 | 0.76 |

Notes: This table presents the estimation results of extending open space proximity to 1600 feet (column 1) and then uses that proximity distance to explore differential capitalization of selected types of open space that previous literature suggests may capitalize into prices (2–4). ***p < .01, **p < .05, *p < .1. Robust standard errors shown in parenthesis are clustered at the indicated spatial fixed effects level. BG is block group and Q-Y is quarter-year.

### Appendix Table 3

Roadway proximity results with 60-day closing

| Dependent Variable: Log Sale Price | (1) | (2) |
|-----------------------------------|-----|-----|
| **Major road w/i 200 feet** | Near major roadway | −0.034*** | −0.022*** |
| | Sold after SAH | −0.002 | −0.001 |
| | Near major roadway X Sold after SAH | 0.033 | 0.002 |
| **SAH Closing Restriction** | 60 days | 60 days |
| **Property Characteristics** | Yes | Yes |
| **Fixed Effects** | Block group | Block group |
| **Temporal Fixed Effects** | Quarter-year | Quarter-year |
| **R-Squared** | 0.76 | 0.76 |
| **Observations near roadway** | 1991 | 1991 |
| **Observations sold after SAH** | 3065 | 3065 |
| **Observations in interaction group** | 86 | 86 |
| **Total Observations** | 64,510 | 64,510 |

Notes: These estimation results provide a robustness check for the highway proximity results by modifying the SAH closing restriction from our original assumption of a 30-day closing period to a 60-day closing period for all housing transactions. ***p < .01, **p < .05, *p < .1. Robust standard errors shown in parenthesis are clustered at the block group level.
### Appendix Table 4
Open space proximity results with 60-day closing

| Dependent Variable: Log Sale Price | (1) Open space w/i 400 ft. | (2) Open space w/i 800 ft. | (3) Open space w/i 1600 ft. | (4) Explicit open space w/i 1600 ft. | (5) Park w/i 1600 ft. | (6) Easement w/i 1600 ft. |
|-----------------------------------|---------------------------|---------------------------|-----------------------------|-------------------------------------|----------------------|--------------------------|
| Walkable to open space            | -0.009                    | -0.000                    | -0.004                      | 0.008                               | -0.003               | -0.008                   |
|                                   | (0.005)                   | (0.006)                   | (0.008)                     | (0.012)                             | (0.009)              | (0.015)                  |
| Sold after SAH                    | 0.001                     | 0.004                     | -0.004                      | -0.000                              | 0.000                | -0.000                   |
|                                   | (0.014)                   | (0.015)                   | (0.016)                     | (0.014)                             | (0.014)              | (0.014)                  |
| Walkable to open space X Sold     | -0.005                    | -0.011                    | 0.005                       | -0.006                              | -0.005               | -0.004                   |
| after SAH                         | (0.013)                   | (0.011)                   | (0.011)                     | (0.013)                             | (0.019)              | (0.02)                   |
| SAH Closing Restriction           | 60                        | 60                        | 60                          | 60                                  | 60                   | 60                       |
| Property Characteristics          | Yes                       | Yes                       | Yes                         | Yes                                 | Yes                  | Yes                      |
| Fixed Effects                     | Block group               | Block group               | Block group                 | Block group                         | Block group          | Block group              |
| Temporal Fixed Effects            | Quarter-year              | Quarter-year              | Quarter-year                | Quarter-year                        | Quarter-year         | Quarter-year             |
| R-Squared                         | 0.76                      | 0.76                      | 0.76                        | 0.76                                | 0.76                 | 0.76                     |
| Observations near open space      | 9845                      | 18,999                    | 33,574                      | 3586                                | 6642                 | 1720                     |
| Observations sold during SAH      | 3065                      | 3065                      | 3065                        | 3065                                | 3065                 | 3065                     |
| Observations in interaction group | 538                       | 1003                      | 1681                        | 233                                 | 233                  | 93                       |
| Observations                      | 64,510                    | 64,510                    | 64,510                      | 64,510                              | 64,510               | 64,510                   |

Notes: These estimation results provide a robustness check for the open space proximity results by modifying the SAH closing restriction from our original assumption of a 30-day closing period to a 60-day closing period for all housing transactions. ***p < .01, **p < .05, *p < .1. Robust standard errors shown in parenthesis are clustered at the block group level.

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