

How work-from-home changes housing demand: evidence from online search

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Online Appendix

A The impact of work-from-home on housing demand: quantitative analysis

To quantify the causal impact of work-from-home (WFH) on the changes in housing demand we exploit both the time series and the cross-sectional variation in WFH adoption, proceeding in two steps. First, we estimate the following pooled OLS regression:

$$(1) \quad y_{i,k,j,t} = \alpha_{k,t} + \beta_{q,j} M_{q,j} X_i + \delta \mathbf{Z}_{i,t} + \varepsilon_{i,k,j,t}$$

where i denotes the single listing, k the local housing market (neighborhood), j the province and t is a month-year tuple. The dependent variable $y_{i,k,j,t}$ is equal to 1 when listing i has been contacted by a potential buyer at least once during period t ; $\alpha_{k,t}$ are location-time fixed effects, $M_{q,j}$ is a set of quarterly dummy variables at the provincial level, \mathbf{X}_i is a characteristic of interest (eg. being a single-family home), and $\mathbf{Z}_{i,t}$ include other controls (eg. floor area, elevator, distance from the centroid of the commuting zone, asking price, time on market etc.). For each of the 8 post-Covid quarters considered in the analysis (from 2020Q1 until 2021Q4) and for each province j we estimate a separate regression including data only for the selected province and the selected quarter along with its corresponding period in 2018 and 2019. For instance, to estimate $\beta_{2020Q1,j}$ we estimate model (1) on the subset of the data including listings located in province j and appearing on the platform either in 2018Q1, in 2019Q1 or in 2020Q1. Therefore $\beta_{2020Q1,j}$ is a dummy taking value of 1 in 2020Q1 and denoting changes in demand compared to the pre-Covid respective quarters. This procedure allows us to net out seasonal factors that may affect the

infra-annual demand for specific housing characteristics.¹ The outcome of the first estimation step is a collection of quarterly series of “demand change measures” $\beta_{q,j}$ for each characteristic of interest (e.g. single-family home) and each province j , that capture how the preference for that characteristic has changed compared to the pre-Covid period.

In the second step we regress the “demand change measures” onto the changes in high and low-intensity WFH ($\Delta WFH_{q,j}^h$ and $\Delta WFH_{q,j}^l$, respectively):

$$(2) \quad \beta_{q,j} = \kappa^h \Delta WFH_{q,j}^h + \kappa^l \Delta WFH_{q,j}^l + \gamma \Omega_{q,j} + \alpha_q + \varepsilon_{q,j},$$

where $\Omega_{q,j}$ denote controls at the province level – such as Covid-19 hospitalization rates and changes in employment – and α_q are quarterly fixed effects.

OLS estimates, however, may be biased possibly due to omitted variables correlated with both WFH and changes in housing demand. To address this issue, we adopt an instrumental variable (IV) approach based on a shift-share instrument for high-intensity WFH.² The share component of the instrument is based on the sectoral specialization of the provinces, which proxies the pre-Covid exposure to potential remote working: the first stage reveals that the share of workers in ICT and financial sectors is a strong predictor of WFH adoption in 2020 and 2021 (Figure B.4). The exclusion restriction assumes that the sectoral composition does not predict changes in housing demand other than through WFH adoption. The shift component of the instrument is the variation in WFH at the national level excluding the province of interest. Hence we instrument $\Delta WFH_{q,j}^h$ with $Z_{jq} = ICT_FIN_j * \Delta WFH_{q,-j}^h$, where ICT_FIN_j is the average share of ICT and financial workers in province j in 2018-19 and $\Delta WFH_{q,-j}^h$ is the variation in high-intensity WFH in quarter q (compared to the corresponding period in 2019) computed at the national level but excluding the province of interest.

¹For instance, houses endowed with outward spaces are generally more requested in summer.

²In the IV estimation we neglect low-intensity WFH as its impact turns out to be mostly insignificant.

B Additional Figures and Tables

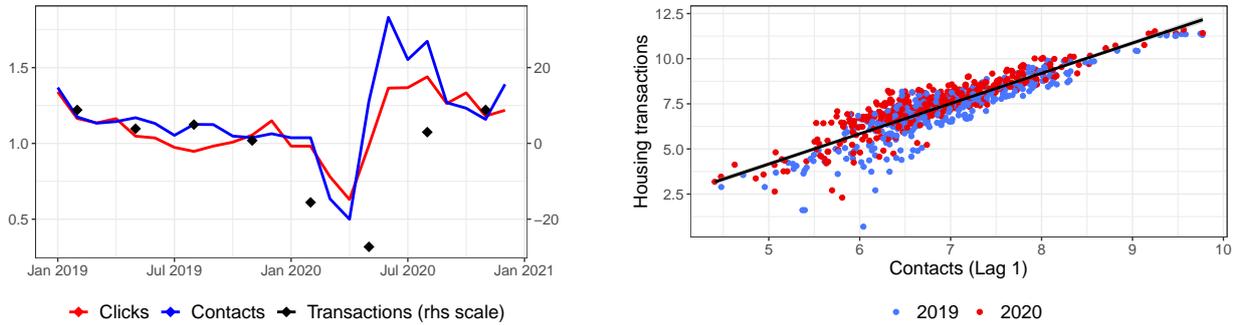


FIGURE B.1: CONTACTS AND HOUSE SALES

Notes: The left-hand panel reports contacts, web page views, and house sales. For contacts and web page views we show the ratio with respect to the same period of the previous year; for house sales we report the year-on-year growth rates (right-hand axis). In the right-hand panel the log of house sales (y-axis) and the log of contacts (lagged by one quarter; x-axis) in each province.

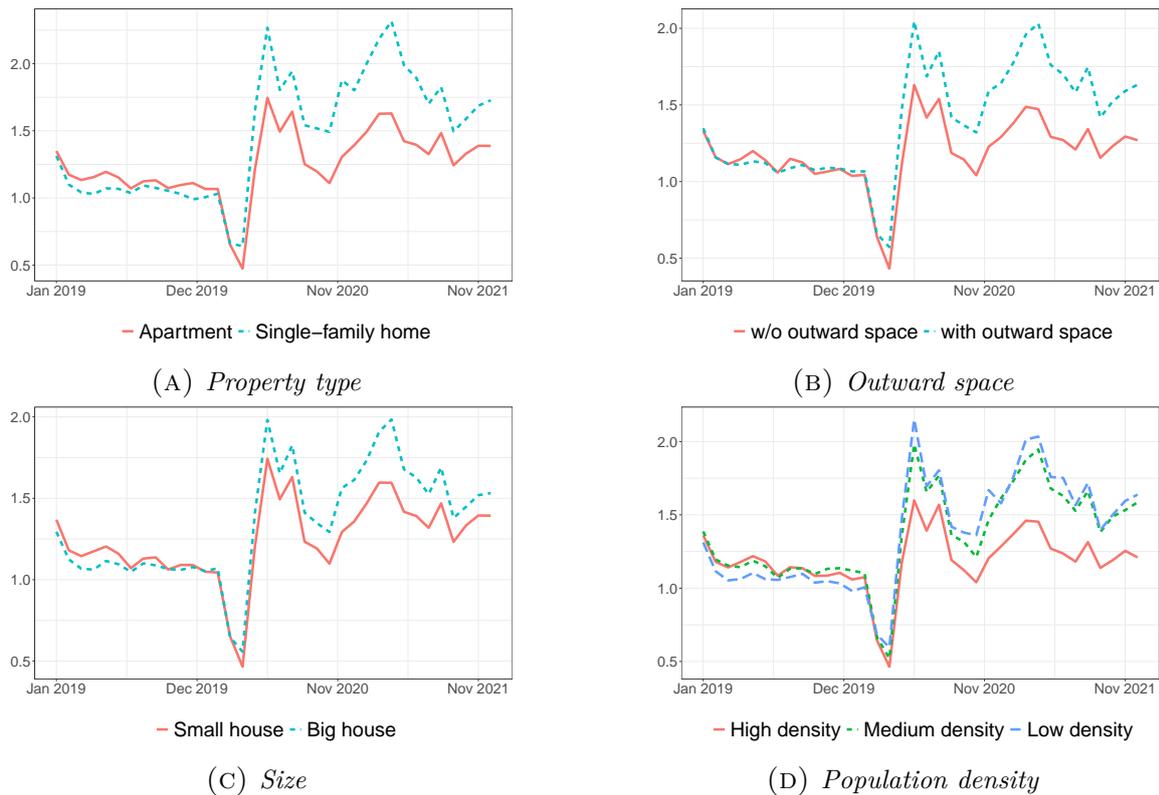


FIGURE B.2: TRENDS IN HOUSING DEMAND

Notes: Daily *contacts* per listing: ratio with respect to the previous year (for 2021, ratio with respect to same month in 2019).

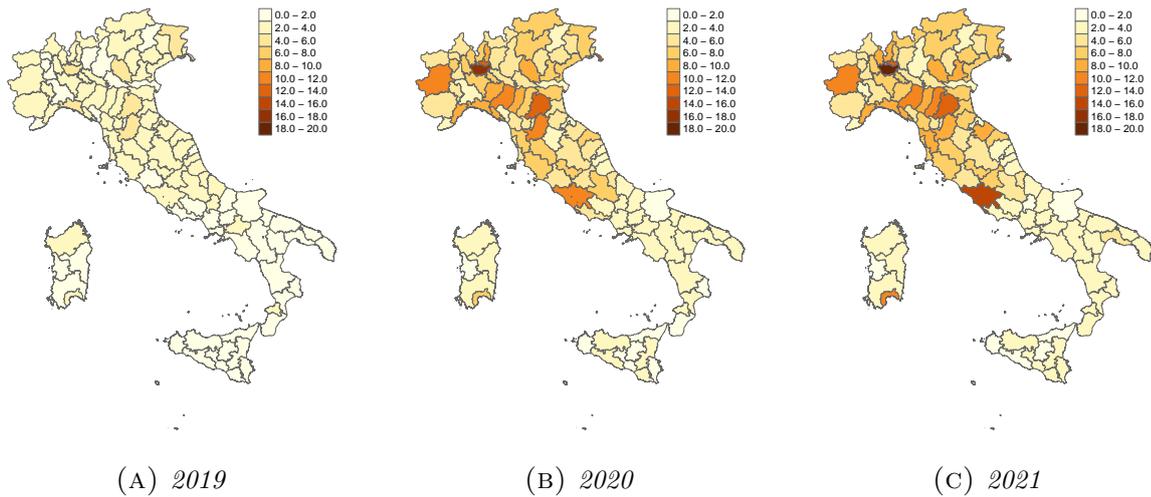


FIGURE B.3: SHARE OF REMOTE WORKERS

Notes: Data drawn from the Italian Labour Force Survey (ISTAT). Share of employees in the private sector that declared having worked from home in the previous month.

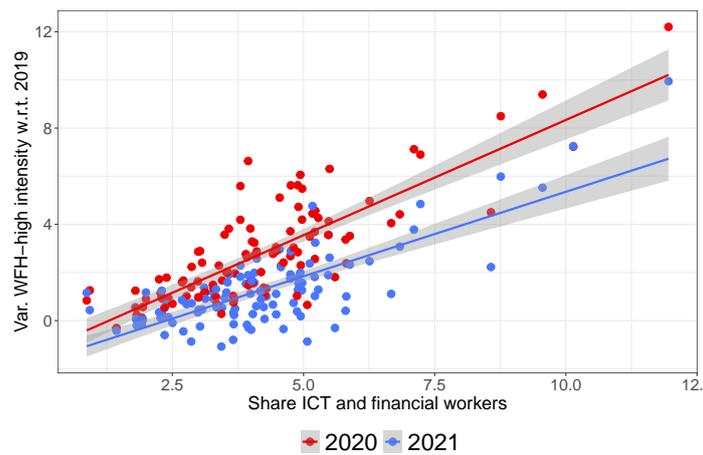


FIGURE B.4: INTENSE WFH ADOPTION AND SHARE OF ICT AND FINANCIAL WORKERS

Notes: On the x-axis, average share of workers employed in the ICT or in the financial sector in 2018-19. On the y-axis, share of employees in the private sector that declared having worked from home more than half of their working time in the previous month.

TABLE B.1: ESTIMATED POST-PANDEMIC CHANGES IN HOUSING DEMAND

	(1)	(2)	$P(\text{Contacts} \geq 0)$		(5)	(6)
			(3)	(4)		
Single-family	0.029*** (0.004)	0.018*** (0.003)	0.029*** (0.004)	0.029*** (0.004)	0.020*** (0.004)	0.011*** (0.004)
Outward space	0.043*** (0.005)	0.044*** (0.005)	0.033*** (0.004)	0.044*** (0.004)	0.020*** (0.003)	0.009*** (0.003)
Large house	-0.043*** (0.006)	-0.045*** (0.006)	-0.045*** (0.006)	-0.050*** (0.007)	-0.020*** (0.004)	-0.019*** (0.004)
Population density					0.006*** (0.001)	0.005*** (0.001)
Covid-19	0.080*** (0.005)					
Covid-19 × Single-family		0.021*** (0.004)				0.019*** (0.003)
Covid-19 × Outward space			0.022*** (0.003)			0.024*** (0.002)
Covid-19 × Large house				0.011** (0.004)		-0.003 (0.003)
Covid-19 × Population density					-0.006*** (0.0007)	-0.003*** (0.0007)
Observations	20,081,906	20,081,906	20,081,906	20,081,906	19,882,635	19,882,635
Neighborhood × Month FE	✓					
Neighborhood × Time FE		✓	✓	✓		
Province × Time FE					✓	✓

Notes: Estimates based on the linear probability model (1) in the main text.