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Working from home and housing demand during the pandemic

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We explore the impact of working from home on housing demand during the pandemic. We find that the rise in remote working exerted upward pressure on housing demand, and consequently, property prices. The study is based on microdata from Statistics Denmark's Labour Force Survey, which has been combined with other data from Statistics Denmark's registers.

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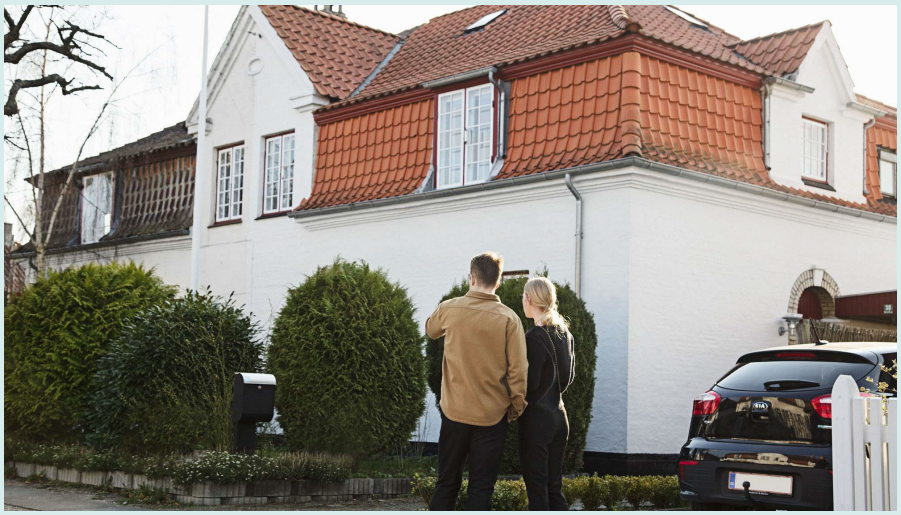


Abstract

We use rich microdata from Denmark to study the effects of increased remote working on housing demand and property prices during the pandemic. We find that the rise in remote working exerted upward pressure on housing demand, and consequently, property prices. The analysis shows that people who frequently worked from home were more likely to buy a home during the 2020-21 pandemic. There was also a tendency for younger people who frequently worked from home to buy larger homes than they had before the pandemic. We estimate that the increased tendency to work from home contributed to a rise in property prices by up to around 3-11 percentage points during the pandemic.

Keywords

Housing market

Labour market

1. Introduction

In the wake of the covid-19 pandemic, the frequency of remote working has increased significantly (Dingel and Neiman, 2020; Barrero, Bloom and Davis, 2021; Bick, Blandin and Mertens, 2023; Van Nieuwerburgh, 2023). At the same time, property prices have risen sharply across advanced economies. This has sparked a new research interest in the effects of working from home on housing demand and property prices. However, there is still limited knowledge about the mechanisms and the extent to which increases in remote working at the individual level have influenced property prices at the aggregate level.

Knowledge of how working from home affects housing demand and property prices is important for assessing the impact at both the micro and macro levels. A thorough understanding requires detailed individual-level data on remote working. In this paper, we use rich microdata from Denmark to study the effects of working from home on housing demand and property prices during the pandemic. From Statistics Denmark, we have access to the individual-level responses to the Danish part of the EU-harmonised Labour Force Survey, which includes questions on working from home. The sample period of the survey covers the years 2006-2023 and around 50,000 people are interviewed each year. Since Statistics Denmark knows the identity of the participating individuals, we can link the survey responses to a large range of individual-level register data.

First, we use individual-level evidence from surveyed individuals to consider potential drivers behind the relation between the extent of remote working and property prices during the pandemic. We find that people who frequently worked from home had an increased tendency to buy a home during the pandemic (2020-21) compared to the pre-pandemic years (2017-19). This was especially true for people in the younger working age groups. Furthermore, there was a tendency for the slightly older age group who frequently worked from home to buy larger homes than they had before the pandemic.

Second, we turn to population-level evidence. Since real estate purchases are rare events at the individual level, population-level data allows us to investigate heterogeneous responses at a more granular level. We use the Labour Force Survey to estimate the probability of working from home based on job function and industry for each individual in the Danish working population. We find a clear relation between the probability of working from home and the probability of purchasing real estate. A key potential concern with our baseline empirical approach could be that the pandemic may have affected businesses differently, and particularly that firms with greater capacity for remote work were less directly affected by the pandemic. In such cases, workers in these firms would have been more likely to work from home and at the same time may have had better prospects for the future in terms of e.g. income – a key driver of housing demand. We address this concern by comparing workers at the same firm or workplace who had different options for working from home. By adding firm or workplace fixed effects to our main specification, we absorb any firm-specific variation that could affect housing demand. The results are in line with the results from our main specification, as adding firm or workplace fixed effects has little impact on the results on remote working and property purchases. Focusing

on those households that purchased real estate during the pandemic, we find that individuals with a higher likelihood of working from home saw a larger increase in their commuting distance following their home purchase than homebuyers who were less likely to work from home.

Finally, we evaluate the impact of working from home on property prices using a simple difference-in-differences approach. We compare the increase in property prices in the individual municipalities from 2017-19 to 2020-21 with the increase in the proportion of employed people in the municipality who worked from home. We find a significant positive correlation, indicating that the increase in property prices during the pandemic was partly driven by the increase in remote working. We also use the population-level estimates of the probability of working from home, and here we also find a significant positive correlation with property prices. Overall, our results suggest that the rise in property prices during the pandemic was partly driven by the increase in remote working.

This paper contributes to the recent literature emerging in the wake of the pandemic on the impact of remote working on housing demand. Working from home might increase households' preference for housing. Remote work implies that households spend more time in their own home and could require more space for home office facilities (Stanton and Tiwari, 2021). Several studies indicate that the recent increase in working from home has had a significant impact on property prices on a nationwide level (Mondragon and Wieland, 2022; Kmetz, Mondragon and Wieland, 2022; Gamber, Graham and Yadav, 2023). Furthermore, there might have been a shift in housing demand at the local level. Remote working might have put downward pressure on property prices in city centres due to a shift in housing demand away from city centres towards suburbs (Bloom and Ramani, 2022; Brueckner, Kahn and Lin, 2023; Delventhal, Kwon and Parkhomenko, 2022; Li and Su, 2023). Studies also point to a decline in office rents (Davis, Ghent and Gregory, 2024; Gupta, Mittal and Nieuwerburgh, 2022).

This paper proceeds by describing the data and methodological issues in section 2. Sections 3 and 4 present results based on the survey sample and the full population respectively. Section 5 presents the results for property prices, and section 6 concludes with some final remarks.

2. Data

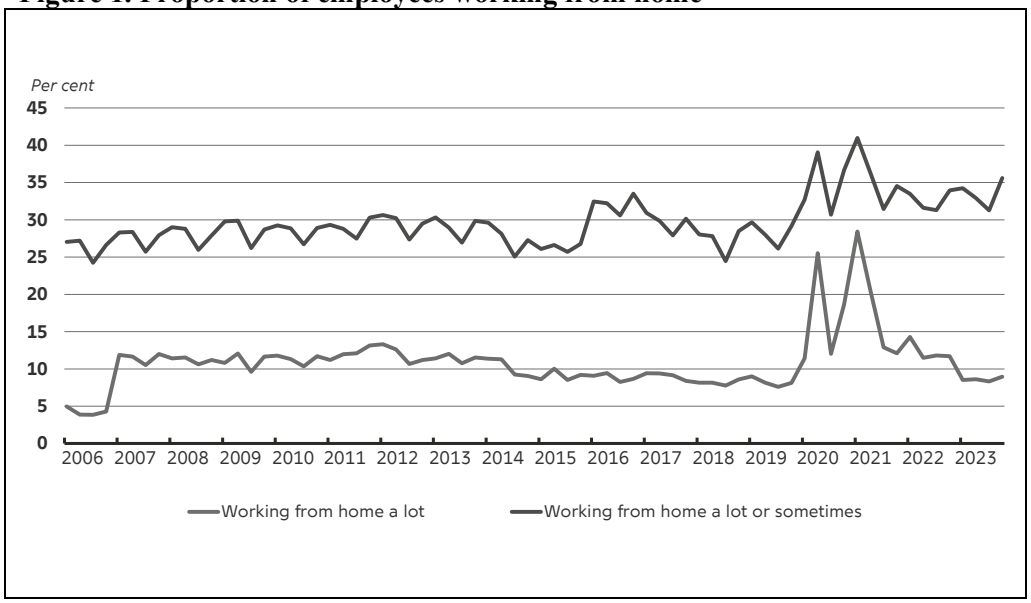
We use the individual-level responses to the Danish part of the EU-harmonised Labour Force Survey, which includes questions about working from home. The survey is conducted by Statistics Denmark, and we have data from 2006 to 2023. Around 50,000 people are interviewed each year. Statistics Denmark knows the identity of the participating individuals, and through their personal registration number, respondents can be linked to a wide range of administrative data, including data on housing transactions, housing characteristics, and links between employees and their workplaces. This data spans most of the sample period, but not all the way to 2023, so for most of the analysis we restrict ourselves to considering the pandemic and pre-pandemic period. Purchase of real estate is a central outcome variable in our micro-data-based exercise. This is measured

as a purchase of a unit of real estate (e.g. a house, a flat or a summer house) through a market-based transaction (e.g. not inheritance etc.), as recorded in the real estate transaction register. The data from this register is merged with the property register to obtain information about the real estate unit, such as location and size.

The survey measures working from home by asking individuals whether they work from home for their main job. For employed individuals, there are three answer categories: "mainly works at home", "sometimes works at home" and "never works at home". People who mainly work from home are defined as those who work at home at least half of the time. Throughout most of the paper, we define individuals to be working from home if they answered that they mainly work at home. The main reason for this is that the answer "sometimes works at home" also includes individuals who work very little from home but whose regular presence at the workplace is required. An example is a doctor who answers emails at home a few days a week after work. We therefore believe that using only the group who work a lot from home provides a cleaner measure of working from home.

Working from home has become more widespread since the covid-19 pandemic. Between 2020 and 2023, around 34 per cent of employees worked from home a lot or sometimes. This was a clear increase compared to the years 2017-19, when the corresponding share was around 28 per cent, see figure 1. During the pandemic, there was a particularly marked increase in the proportion of people who worked from home a lot.

Figure 1. Proportion of employees working from home



Source: Statistics Denmark.

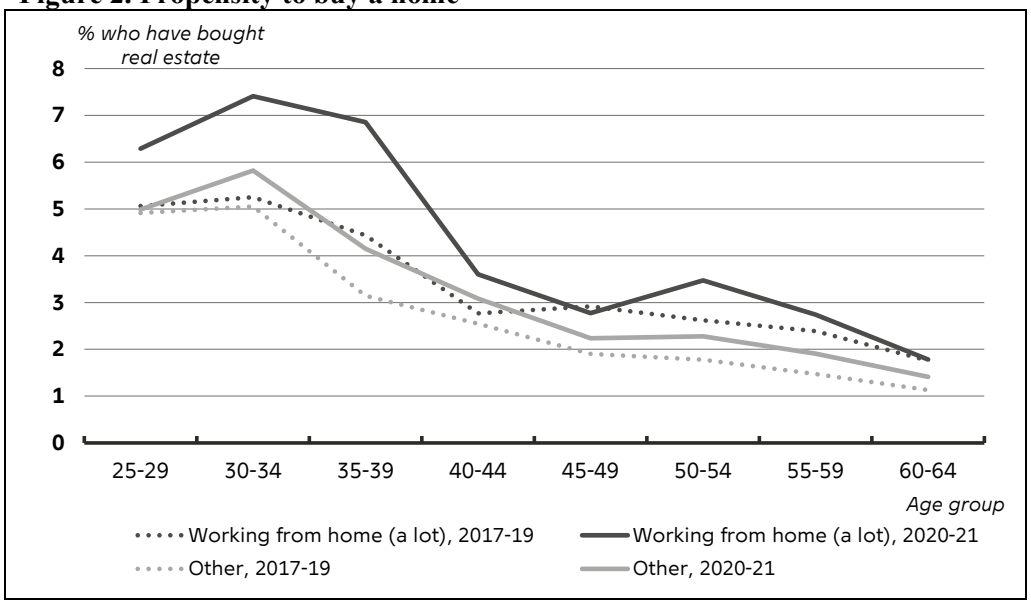
3. Working from home and property price drivers

In this and the following section, we consider potential mechanisms that could imply a relation between the extent of working from home and property prices. Specifically, we explore the association between working

from home and individual housing market outcomes such as real estate purchases and changes in home size when moving to a new home. In this section, we use the survey sample merged with administrative data. In the next section, we extend the analysis to the full population, since it enables further analysis of the behaviour of homebuyers. This is because, in spite of the relatively large sample, real estate purchases are relatively rare events in the survey-based dataset.

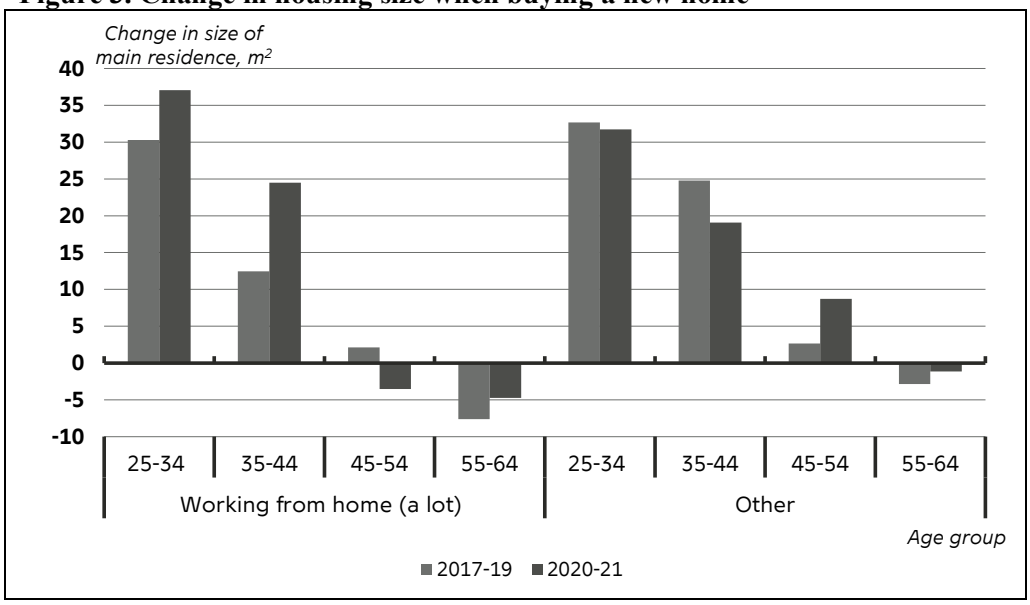
People frequently working from home had an increased tendency to buy a home during the pandemic (2020-21) compared to the pre-pandemic years (2017-19). This was especially true for younger people in the age group 25-39 years, cf. figure 2. There was also a tendency for younger people who worked a lot from home to buy larger homes than they had before the pandemic, cf. figure 3.

Figure 2. Propensity to buy a home



Note: For each group, period and age group, the figure shows the proportion of individuals in the sample who purchased real estate.

Figure 3. Change in housing size when buying a new home



Note: The chart shows the size difference between a homebuyers' new home and their previous home. The previous home could be either owned or rented.

One potential confounder that could play a role for the relations uncovered in figures 2-3 is that the characteristics of individuals working from home may have changed between the two periods. During the pandemic it could be expected that a broader segment of employees was working from home compared to the preceding years. This could mean, for example, that part of the apparent relation between working from home and e.g. probability of real estate purchase could be explained just by the fact that it was a different type of employees working from home during the pandemic than before. Therefore, in table 1 we report the results of a regression where we take background characteristics into account such as income, age and geography.

We find that individuals working from home are 0.5 percentage points more likely to purchase real estate, while the pandemic increased the probability to purchase real estate by 1.1 percentage points (table 1, column 3). However, the interaction between these two variables is also marginally significant, indicating that individuals working from home were an additional 0.5 percentage point more likely to purchase real estate during the pandemic. This indicates that there was a separate effect of the pandemic, and that the increase in housing transactions could not just be ascribed to more employees working from home – there was also a change in behaviour of those already working from home.

The results in column 4 of table 1 illustrate that the increase in the probability of real estate purchase for employees working from home during the pandemic was particularly pronounced among younger working-age groups. In particular, employees between 25 and 34 years, who worked from home, were 1.9 percentage points more likely to purchase real estate than those in the oldest age group (55-64 years) that were working from home during the pandemic. This is consistent with the evidence in figure 2.

The graphical evidence about the change in the size of the main residence, conditional on real estate purchase, is also confirmed by the regression analysis. Working from home during the pandemic was associated with an increase in the size of the household main residence of 6.6 square metres (table 1, column 1). This is an average effect, however. Breaking the effect down by age (table 1, column 2) shows that the effect is mainly driven by employees aged 35-44 years, that were working from home during the pandemic. This group on average added 29 square metres to the size of their main residence, conditional on real estate purchase.

Overall, these results indicate a significant pandemic-related effect of working from home on housing market choices. The younger age groups, typically first-time buyers, were more likely to purchase real estate, and the slightly older age group, who typically have smaller children, were more likely to move to a bigger home during the pandemic than before, if they were working from home.

Table 1: Working from home and housing outcomes

Dependent variable	Δ Size of main residence		Purchased real estate	
	(1)	(2)	(3)	(4)
Age 25-34	34.83***	36.51***	0.0443***	0.0440***
	(2.150)	(3.064)	(0.00159)	(0.00210)
Age 35-44	23.67***	28.13***	0.0180***	0.0159***
	(2.227)	(3.231)	(0.00155)	(0.00209)
Age 45-54	5.337**	5.060	0.00357**	0.00294
	(2.277)	(3.327)	(0.00149)	(0.00201)
WfH	-4.302*	6.067	0.00504**	0.00431
	(2.428)	(7.531)	(0.00208)	(0.00524)
Pandemic	-3.050	0.811	0.0109***	0.0102***
	(1.959)	(4.526)	(0.00166)	(0.00295)
WfH * Pandemic	6.589**	-7.779	0.00500*	-0.000965
	(3.131)	(9.684)	(0.00284)	(0.00705)
Age 25-34 * WfH		-8.732		-0.00510
		(8.787)		(0.00717)
Age 35-44 * WfH		-19.11**		0.000416
		(8.720)		(0.00648)
Age 45-54 * WfH		-6.290		0.00423
		(8.684)		(0.00625)
Age 25-34 * Pandemic		-4.519		-0.00140
		(4.765)		(0.00347)
Age 35-44 * Pandemic		-9.845*		0.00356
		(5.035)		(0.00351)
Age 45-54 * Pandemic		4.321		0.000407
		(5.171)		(0.00335)
Age 25-34 * WfH * Pandemic		17.99		0.0192**
		(11.22)		(0.00952)
Age 35-44 * WfH * Pandemic		28.93**		0.00948
		(11.26)		(0.00887)
Age 45-54 * WfH * Pandemic		-2.401		-0.00169
		(11.39)		(0.00851)
Observations	4,106	4,106	133,977	133,977
R-squared	0.160	0.165	0.013	0.013
Sample	Buyers	Buyers	All	All

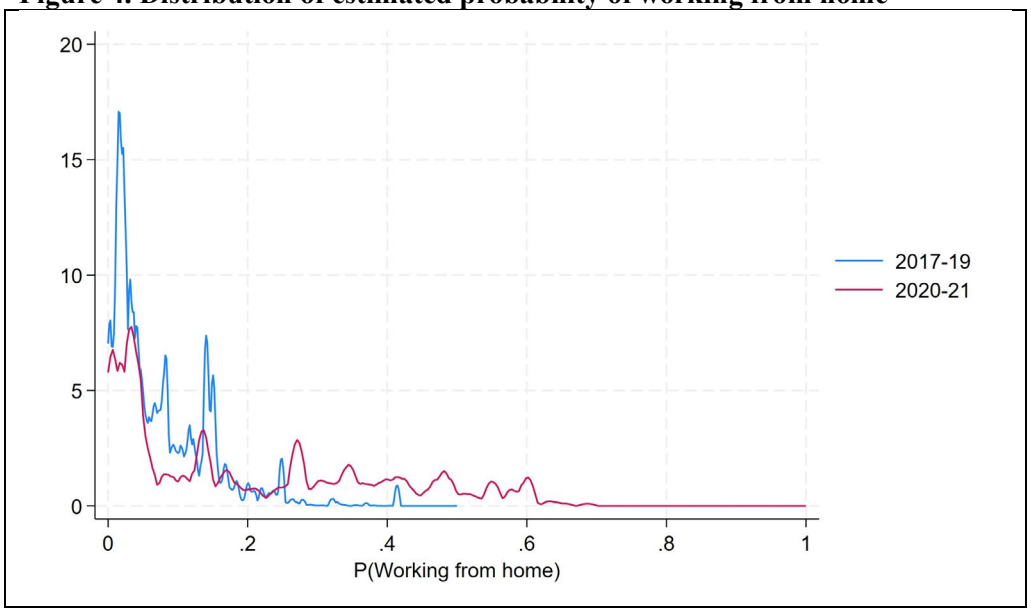
Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses. Control variables: Income, gender, year and municipality fixed effects. WfH denotes working from home (a lot).

4. Population-based evidence

The results presented so far are based on the surveyed sample. In this section, we extend the analysis to cover the full population. There are several reasons for doing this. The main reason is that real estate transactions are relatively rare events at the individual level. The number of individuals who take part in the survey and are involved in a real estate transaction in the same time period is therefore relatively small.

First, we use the survey sample to estimate the probability of working a lot from home based on job function (using the 3-digit DISCO classification) and industry (3-digit). In this linear probability model, we do not control for other factors, and we thereby obtain a measure of the probability that a person with a given job function / industry combination worked from home in the given period. We refrain from including other, e.g. personal, characteristics, as that could potentially contaminate our subsequent estimates due to multicollinearity, for example. We use the coefficients from this regression to estimate the probability of working from home, based on job function and industry, for each employee in the population of Denmark in the given time period. The distribution of this estimated probability of working from home is shown in figure 4. Consistent with the macro results, there is a clear shift towards a higher probability of working from home during the pandemic.

Figure 4. Distribution of estimated probability of working from home



Note: The figure shows a kernel density estimate of the estimated probability of working (a lot) from home for each of the two time periods.

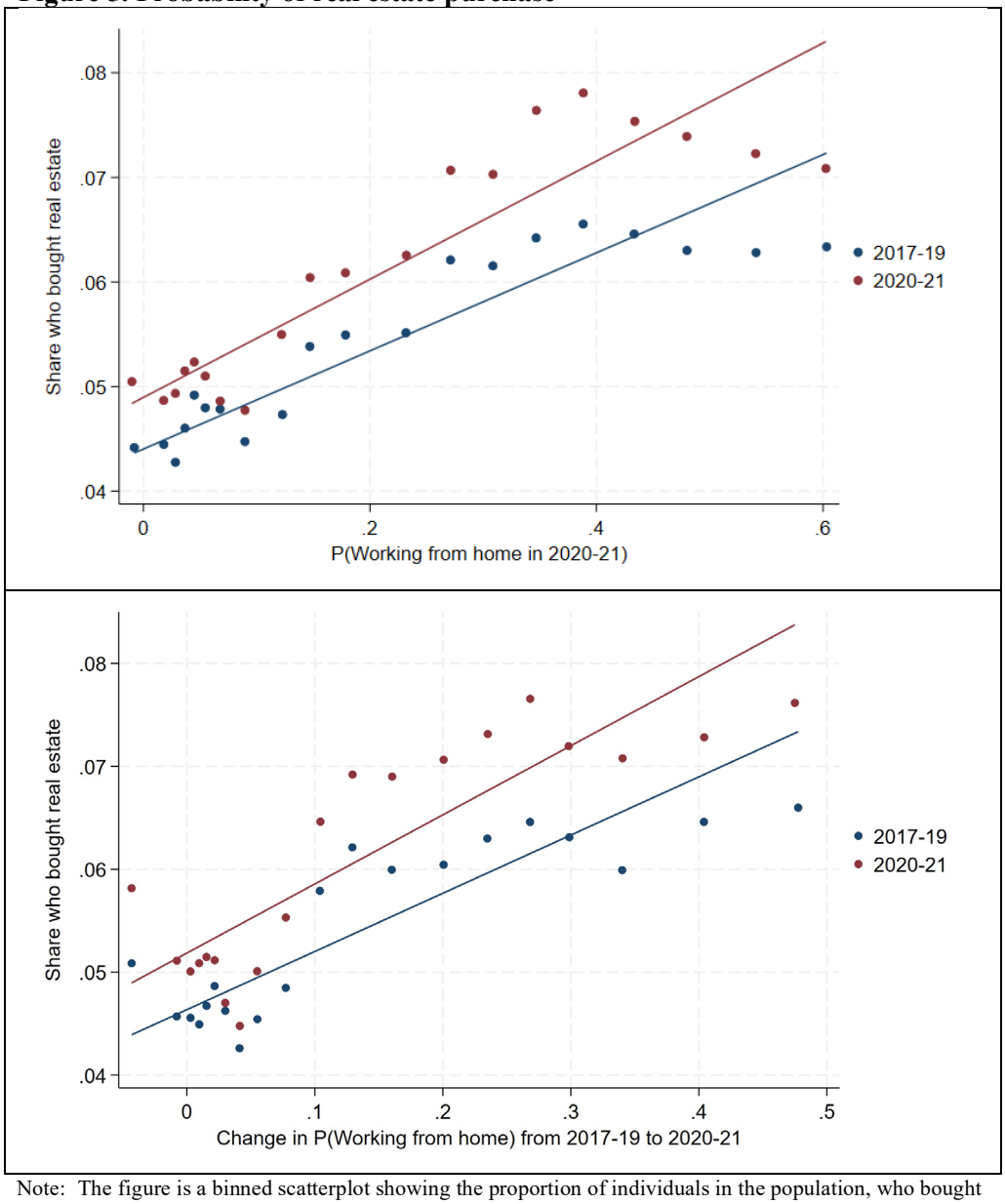
Next, to test whether our sample-based findings also hold for the population, we correlate the estimated probability of working from home to the propensity to purchase real estate. Figure 5, panel A shows the relation between the probability of working from home and the probability of real estate purchase. The regressions

control for income, age and gender dummies, which ensures that lifecycle variation in the propensity to purchase real estate does not impact the estimated relation.

Figure 5, panel A demonstrates a clear relation between the probability of working from home and the probability of real estate purchase. This was the case both before and during the pandemic, but the relation was stronger during the pandemic. In other words, after taking into account the effects of factors like age and income, the increase in housing transactions during the pandemic was particularly driven by individuals with a higher probability of working from home.

In figure 5, panel A we use the probability of working from home during the pandemic on the x-axis. This is implicitly based on an assumption that the pandemic was a shock that revealed the extent to which working from home is possible in a given role. Figure 5, panel B instead uses the change in the probability of working from home from the pre-pandemic to the pandemic years on the x-axis, and the results are similar.

Figure 5. Probability of real estate purchase

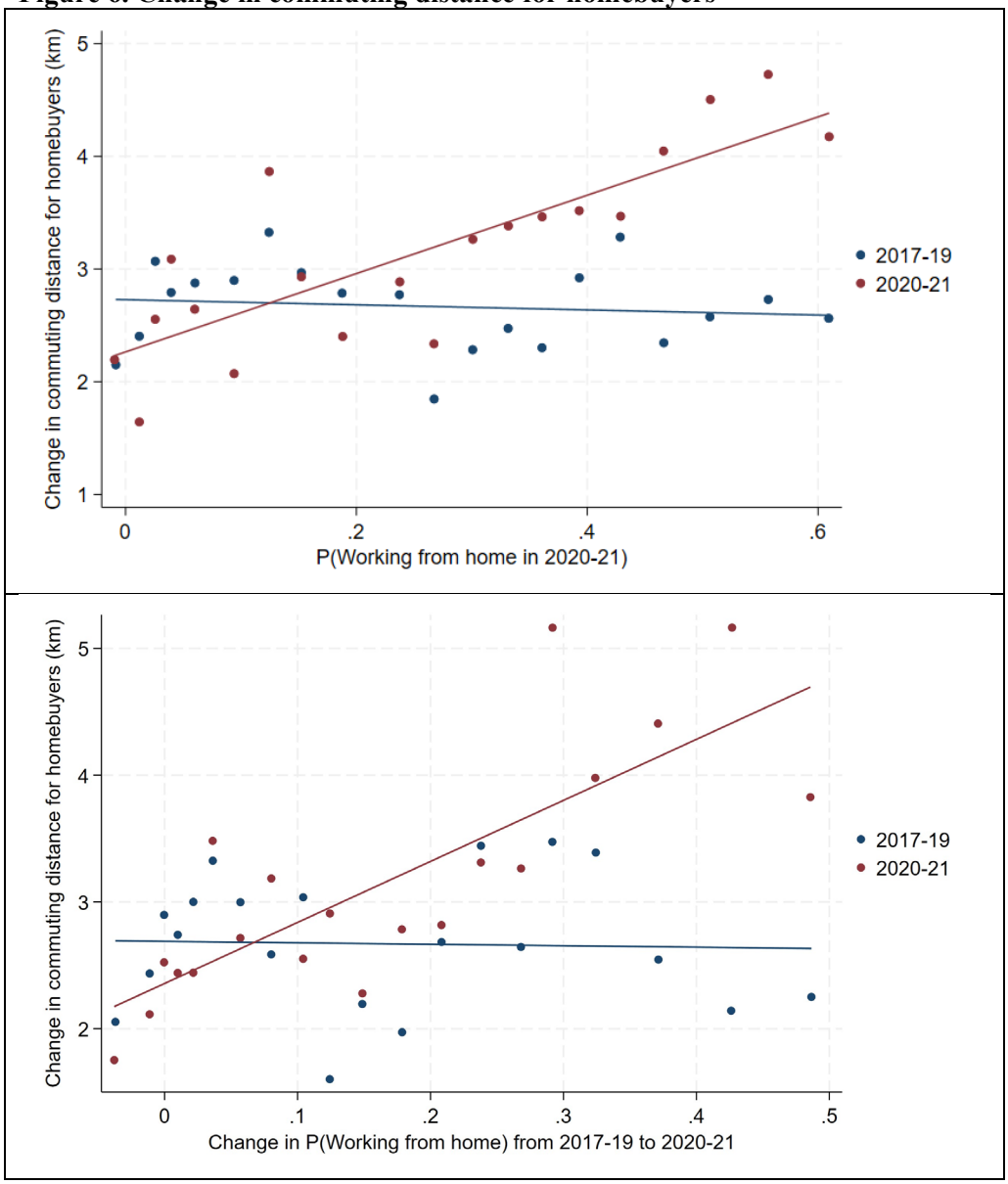


Note: The figure is a binned scatterplot showing the proportion of individuals in the population, who bought real estate, as a function of the probability of working (a lot) from home during the pandemic (panel A) and the change in the probability of working (a lot) from home from before to during the pandemic (panel B). The data includes all working individuals in the Danish population for whom information is available. The control variables are income, gender and age (1-year intervals) fixed effects.

Another factor that could potentially be important for housing demand, and that we can test in the population data, is whether the pandemic-induced increase in working from home impacted commuting distance for those who bought real estate. One hypothesis is that the increased technical opportunities for remote work, as well as a change in the culture and social acceptability of working from home during the pandemic, led households to believe that they would work from home more often in the future. Fewer commuting days may have led households to consider purchasing real estate further away from their workplace than they would have before

the pandemic. In figure 6, we do indeed see that in particular individuals with a higher probability of working from home saw an increase in their commuting distance after purchasing property during the pandemic. For commuting distance conditional on real estate purchases, we find that the effect seems to be present only during the pandemic. This contrast with the results for property purchases, where we also find an effect before the pandemic. This might reflect that it was only during the pandemic that frequent remote work really became an option in practice.

Figure 6. Change in commuting distance for homebuyers



Note: The figure is a binned scatterplot showing the change in commuting distance for those individuals in the population, who bought real estate, as a function of the probability of working (a lot) from home during the pandemic (panel A) and the change in the probability of working (a lot) from home from before to during the pandemic (panel B). The data includes all working individuals in the Danish population for whom information is available. Control variables: Income, gender and age (1-year intervals) fixed effects.

Table 2: Probability of real estate purchase (population level)

	(1)	(2)	(3)	(4)	(5)	(6)
P(WfH)	0.0553***	0.0289***	0.0671***	0.0427***	0.0754***	0.0513***
	(0.00128)	(0.00141)	(0.00121)	(0.00180)	(0.00186)	(0.00187)
P(WfH) * Pandemic	0.0201***	0.000709	0.0196***	2.02e-05	0.0192***	-0.000171
	(0.00132)	(0.00141)	(0.00117)	(0.00175)	(0.00123)	(0.00157)
Pandemic	0.00363***	0.00371***	0.00354***	0.00360***	0.00355***	0.00360***
	(0.000145)	(0.000162)	(0.000168)	(0.000149)	(0.000168)	(0.000158)
P(WfH) * Age 25-34		0.0619***		0.0613***		0.0599***
		(0.00250)		(0.00226)		(0.00194)
P(WfH) * Age 35-44		0.0387***		0.0398***		0.0390***
		(0.00223)		(0.00158)		(0.00171)
P(WfH) * Age 45-54		0.0143***		0.0132***		0.0117***
		(0.00159)		(0.00148)		(0.00153)
P(WfH) * Age 25-34 * Pandemic		0.0385***		0.0384***		0.0381***
		(0.00306)		(0.00265)		(0.00243)
P(WfH) * Age 35-44 * Pandemic		0.0270***		0.0277***		0.0274***
		(0.00263)		(0.00218)		(0.00206)
P(WfH) * Age 45-54 * Pandemic		0.0128***		0.0145***		0.0146***
		(0.00238)		(0.00204)		(0.00183)
Observations	11,888,840	11,888,840	11,844,627	11,844,627	11,839,861	11,839,861
R-squared	0.014	0.014	0.027	0.028	0.031	0.032
Fixed effects	No	No	Firm	Firm	Workplace	Workplace

Note: *** p<0.01, ** p<0.05, * p<0.1. Dependent variable: Indicator for an individual having purchased real estate. Control variables: Income, gender and age fixed effects (as well as age group fixed effects in models 2, 4 and 6). Standard errors in parentheses are derived by a joint bootstrap procedure (50 replications, sampling with replacement), where both the probability of remote work and the outcome equation are estimated for each replication.

We test these relations more formally by estimating corresponding econometric specifications, see table 2 and 3. First, in table 2, column 1, we see that the link between working from home and the probability of real estate purchase found previously based on the sample also holds in the population data. For each 10 percentage point increase in the probability of working from home, the likelihood of purchasing real estate rises by 0.6 percentage points. For comparison, the average probability of real estate purchase in our sample was 2.8 per cent, so the effect of remote work is sizeable. During the pandemic, another 0.2 percentage points was added to the effect, which again confirms that the impact of remote work on the probability of real estate purchase was larger during the pandemic than before. Splitting the effect by age, in table 2, column 2, we see that the effect of working from home on the probability of real estate purchase is particularly significant among the 25-44 year olds, which are generally also the age groups where house purchase is most common. The increase in the effect during the pandemic was also largest in these age groups.

A key potential concern with our main specification is that the pandemic may have affected businesses in different ways that correlate with the ability of employees to work from home. In particular, firms that could more easily operate remotely may have been less directly affected by the pandemic, and workers in those firms

may have been more likely to work from home while also having better future prospects, such as higher income – a key driver of housing demand (Bro and Eriksen, 2025). If this is the case, it could challenge the validity of our estimates. We address this concern by introducing an empirical model that compares outcomes for colleagues in the same workplace who had different options for remote working. We do so by adding firm or workplace fixed effects to our main specification, which completely absorbs any firm- or workplace-specific variation that could affect housing demand. We can do this because we use data from the full population, allowing us to compare individuals within the same firms who had different probabilities of working from home. In the subsequent columns of table 2, we first include firm fixed effects in columns 3 and 4 and then workplace fixed effects in columns 5 and 6. These data are available for most of the working population in Statistics Denmark's administrative records. The inclusion of these fixed effects also ensures that our results are not driven by, for example, different propensities to work from home across industries that were impacted differently by the pandemic. Including firm fixed effects means we are comparing individuals within the same company who are more or less likely to work from home. For larger companies with multiple workplaces (e.g. supermarket chains), it may be more relevant to consider the workplace level instead of the firm level. However, considering the workplace level comes at the cost of fewer individuals per fixed effect unit, which could be an issue when considering relatively rare events such as home purchases.

We find that results based on specifications including firm or workplace fixed effects are similar to those without fixed effects but with the cost of slightly lower precision of the estimated coefficients. The robustness of the results strengthens our confidence in the main specification.

Table 3: Homebuyers' preferences

Dep. Var	Δ Commuting distance		Δ Size of main residence	
	(1)	(2)	(3)	(4)
P(WfH)	-1.246*	-3.454**	9.230***	-2.581
	(0.680)	(1.508)	(1.145)	(2.782)
P(WfH) * Pandemic	5.536***	2.017	-2.413	-5.123
	(1.008)	(1.548)	(1.741)	(3.717)
Pandemic	-0.238	-0.258	1.818***	1.810***
	(0.175)	(0.163)	(0.337)	(0.297)
P(WfH) * Age 25-34		3.445*		15.61***
		(2.012)		(3.432)
P(WfH) * Age 35-44		2.455		20.44***
		(1.762)		(3.763)
P(WfH) * Age 45-54		1.230		0.848
		(1.673)		(3.541)
P(WfH) * Age 25-34 * Pandemic		5.044**		0.834
		(2.196)		(3.106)
P(WfH) * Age 35-44 * Pandemic		5.006**		1.181
		(1.973)		(3.935)
P(WfH) * Age 45-54 * Pandemic		1.696		10.41**
		(1.949)		(4.075)
Observations	326,807	326,807	397,246	397,246
R-squared	0.001	0.001	0.082	0.082
Sample	Homebuyers	Homebuyers	Homebuyers	Homebuyers

Note: *** p<0.01, ** p<0.05, * p<0.1. Control variables: Income, gender and age fixed effects. Standard errors in parentheses are derived by a joint bootstrap procedure (50 replications), where both the probability of remote work and the outcome equation are estimated in the same round. Commuting distance is measured in kilometres, and the size of the main residence is measured in square metres.

Next, we consider people who purchased real estate specifically. There are substantially fewer homebuyers in our sample period compared to the general population. In fact, there are about as many homebuyers in our sample as there are firms in Denmark.[1] Therefore, we continue use the main specification without firm or workplace fixed effects when looking into the conditional outcomes of homebuyers. The results in column 1 of table 3 show that during the pandemic, there was a clear tendency for those with a higher probability of being able to work from home, who purchased real estate, to move further away from their workplace. On average, commuting distance increased by 550 metres more for each 10 percentage points increase in the probability of working from home. For context, the average homebuyer increased their commuting distance by around 3 kilometres when they purchased real estate during the pandemic. Note that, consistent with the graphical evidence, the effect of remote work on commuting distance was only present during the pandemic, not before. Splitting the effect by age, we see that the effect is driven by younger individuals aged 25-44 years, cf. column 2 in table 3.

[1] According to Statistics Denmark, there were 417,137 firms in Denmark in 2022.

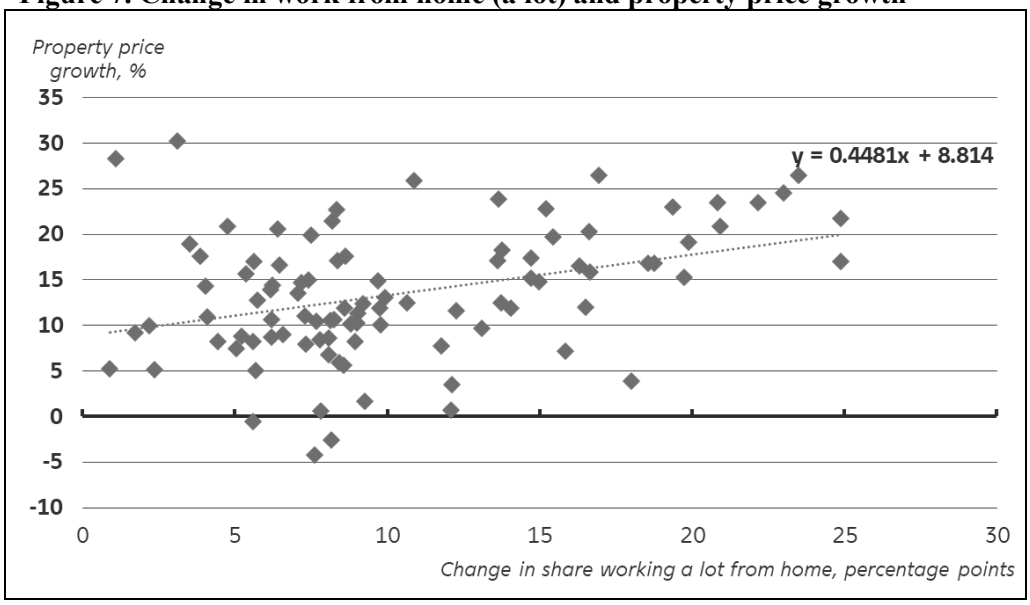
Finally, we use the population data to check our previous results regarding the effect of working from home on the demand for additional space, as shown in columns 3 and 4 of table 3. We find that the higher the probability of working from home, the larger the increase in square metres when purchasing real estate. Overall, this effect does not seem to be related to the pandemic. However, when breaking effects down by age groups, we see that there was a pandemic-related additional effect for the middle-aged households (45-54 year olds).

5. The impact of working from home on property prices

The results presented so far indicate that the increase in working from home during the pandemic, and the prospects of increased use of remote work in the future, has had an impact on central factors related to housing demand. However, the impact on property prices is more difficult to assess precisely, since many other factors besides working from home affect property prices. In addition, to move from drivers of individual housing transactions to developments in market prices, we need to consider a more aggregated level than individual transactions. Therefore, we zoom out to the municipal level.

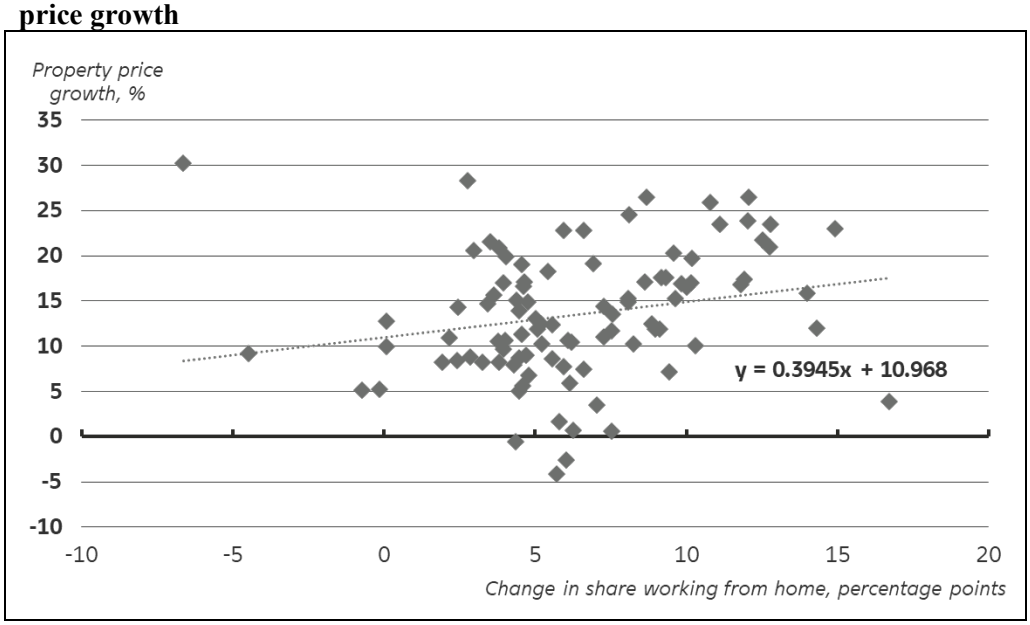
To obtain an indication of the impact of working from home on property prices, we use a simple difference-in-differences approach, as shown in figure 7 and 8. We compare the increase in property prices in the individual municipalities from 2017-19 to 2020-21 with the increase in the proportion of employees in the municipality who worked at home. We find a significant positive correlation, indicating that the increase in property prices during the pandemic was partly driven by the increase in remote working.

Figure 7. Change in work from home (a lot) and property price growth



Note: The x-axis shows the change from 2017-19 to 2020-21 in the proportion of employees in the municipality who worked from home (a lot). The y-axis shows the change in housing prices in the municipality from the second half of 2019 to the second half of 2021. The slope coefficient of the regression line is significantly different from zero at a significance level of 1 per cent.

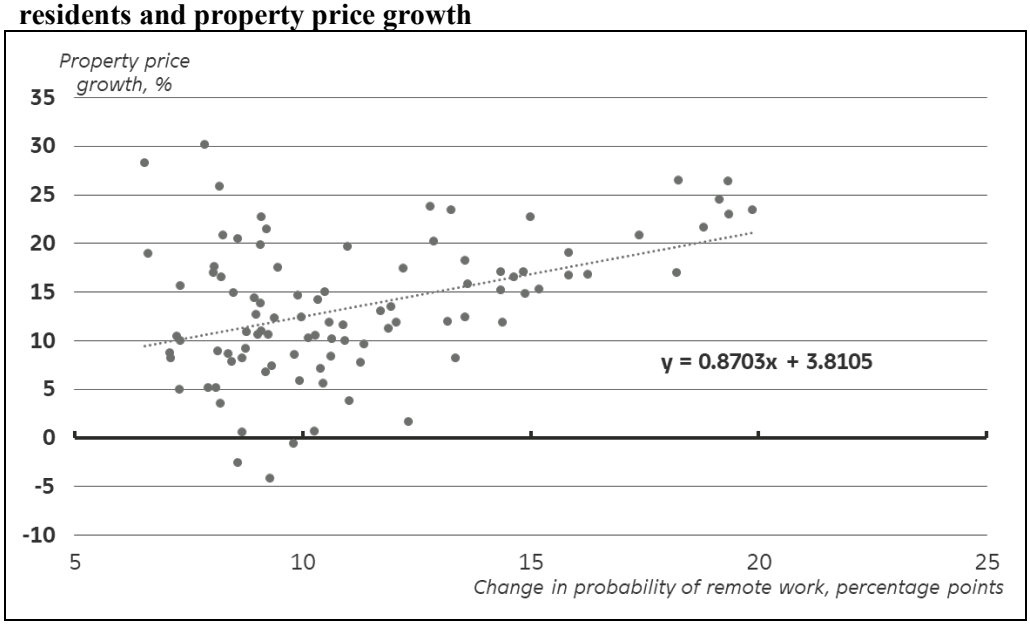
Figure 8. Change in working from home (a lot or sometimes) and property price growth



Note: The x-axis shows the change from 2017-19 to 2020-21 in the proportion of employees in the municipality who worked from home (a lot or sometimes). The y-axis shows the change in housing prices in the municipality from the second half of 2019 to the second half of 2021. The slope coefficient of the regression line is significantly different from zero at a significance level of 5 per cent.

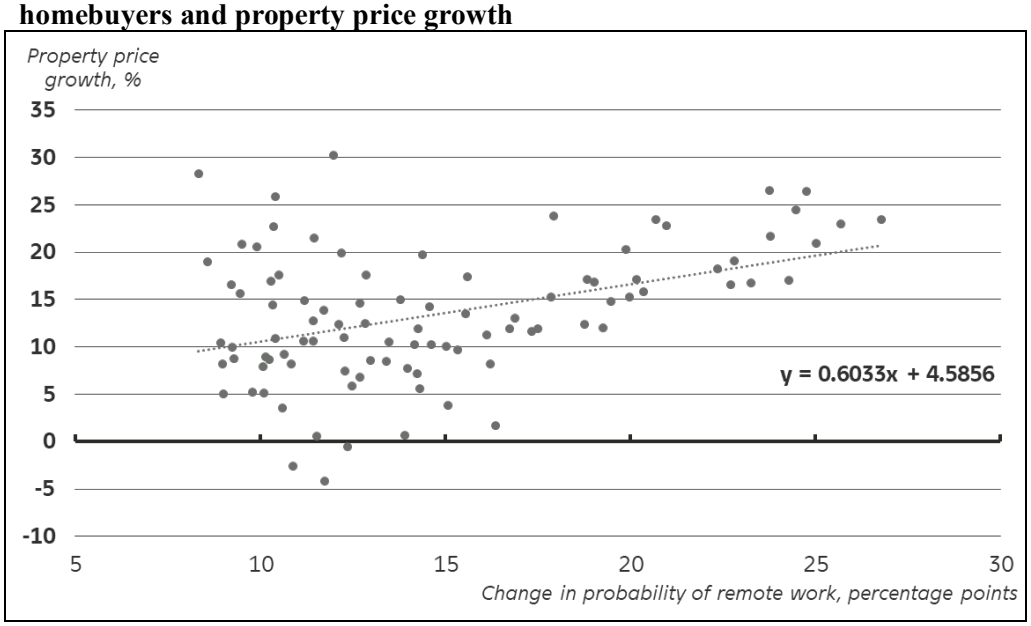
We cross-check this finding by using the population-level data instead of the sample, see figure 9. Our preferred measure of housing demand changes stemming from remote working is the change in the probability of employees in a given municipality to work from home measured from 2017-2019 to 2020-2021. While homebuyers play an active role in housing demand, other homeowners are also crucial for total demand. For example, the option to work from home may have led some homeowners to postpone an exit from the housing market or to downsize. The population-level evidence also points to a positive relation between increasing incidence of remote work and property prices. Taken at face value, the estimate in figure 9 shows that a 1 percentage point increase in the average probability of working from home in a municipality is associated with a 0.9 percentage point increase in property prices. The average increase in the probability of working from home in the population dataset is 12.3 percentage points, indicating that the increase in working from home potentially increased property prices by around 10.7 percentage points from 2019 to 2021. This is a very substantial effect, since the overall increase in property prices during the pandemic was around 18 per cent. Substantial effects on property prices from increased working from home have also been found in US data. The studies by Mondragon and Wieland (2022) and Kmetz, Mondragon and Wieland (2022) found that the increased working from home during the pandemic resulted in property prices rising by around 15 per cent from late 2019 to late 2021, which constituted more than half of overall property price growth during the pandemic.

Figure 9. Change in probability of working from home among municipal residents and property price growth



Note: The x-axis shows the change from 2017-19 to 2020-21 in the average probability of working from home in each municipality. The probability is estimated based on the model introduced in section 4. The y-axis shows the change in housing prices in the municipality from the second half of 2019 to the second half of 2021. The slope coefficient of the regression line is significantly different from zero at a significance level of 1 per cent.

Figure 10. Change in probability of working from home among municipal homebuyers and property price growth



Note: The x-axis shows the change from 2017-19 to 2020-21 in the average probability of working from home among homebuyers in each municipality. The probability is estimated based on the model introduced in section 4. The y-axis shows the change in housing prices in the municipality from the second half of 2019 to the second half of 2021. The slope coefficient of the regression line is significantly different from zero at a significance level of 1 per cent.

As a further robustness check, we change our measure of remote working from all employees in each municipality to only cover the change in the probability of working from home among homebuyers, see figure 10. It could be argued that the homebuyers better represent marginal housing demand in contrast to all homeowners and therefore that their impact on housing prices may be more significant. Additionally, focusing on homebuyers might better capture the potential effects of remote working on housing location, as indicated by the estimated change in commuting distance in section 4. Based on homebuyers only, we find that working from home increased property prices by 10.1 percentage points during the pandemic, as the increase in the average propensity of homebuyers to work from home was 16.8 percentage points.

However, the survey-sample based evidence points to a smaller effect. The trend line in figure 8 indicates that a 1 percentage point increase in the proportion of people working from home (a lot or sometimes) has resulted in property price growth of around 0.4 per cent. The proportion of people working from home increased by around 7 percentage points on average from 2017-19 to 2020-21. This suggests that the increase in remote work could explain an increase in property prices during the pandemic of around 3 per cent. A similar calculation based on those working a lot from home in figure 7 suggests that the increase in remote work could explain an increase in property prices during the pandemic of around 4 per cent.

Therefore, a likely ballpark estimate of the size of the effect of working from home on property prices during the pandemic is 3-11 percentage points. This estimate may be subject to omitted variable bias because the

cross-municipality regressions do not include control variables. As most candidates for control variables could be correlated with the effect of working from home on property prices in non-trivial ways, and the dataset on municipal-level changes is very small (there are 98 municipalities in Denmark), we prefer not to include control variables for this exercise. However, we perform a robustness check where we include two control variables: population density (to account for housing supply constraints) and income growth (to control for heterogeneity in demand). The effect of remote working on property prices is still statistically significant in this robustness check, except when we consider the change in the proportion of people working a lot or somewhat from home, cf. table 4. This is consistent with our assumption that defining remote working individuals as those who work a lot from home provides a clearer signal than including all individuals working from home, regardless of their frequency of remote work. The population-based results with control variables are remarkably similar to those without controls. Along with the evidence at the individual level in sections 3 and 5 it serves as an indication that working from home had material effects on macro-level outcomes during the pandemic, though the exact size of the effect is uncertain.

Table 4: Property price regressions based on municipality-level data

	Sample		Population	
Independent variable	Change in share WfH a lot	Change in share WfH	Change in p(WfH), residents	Change in p(WfH), homebuyers
	(1)	(2)	(3)	(4)
No controls	0.448***	0.394**	0.870***	0.603***
	(0.118)	(0.181)	(0.199)	(0.137)
With controls	0.370***	0.245	0.875***	0.623***
	(0.140)	(0.198)	(0.255)	(0.180)

Note: Each cell shows the coefficient from a regression of the property price growth on the independent variable given in the column header. The sample size is 95 municipalities. Control variables: Population density and growth in income, 2019-2021. *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.

6. Final remarks

In summary, our analysis indicates that the increase in remote working put upward pressure on housing demand, and consequently, on property prices during the pandemic.

As shown in figure 1, the proportion of people working from home has remained fairly constant over the past few years at a level significantly above pre-pandemic levels. It is therefore reasonable to interpret the increase in remote working during the pandemic as a one-off adjustment that provided a lasting boost to housing demand and contributed to an increase in property prices. In the longer term, the housing supply could be expected to adapt to the increase in housing demand due to remote working.

However, the proportion of employees frequently working from home has returned to pre-pandemic levels. Additionally, it cannot be ruled out that part of the effect on housing demand during the pandemic stemmed

from individuals who worked from home more frequently having more time to search for new homes. Part of the effect on housing demand from increased working from home during the pandemic might therefore have been temporary.

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