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Abstract

A defining economic outcome from the Covid-19 pandemic is the unprecedented shift towards remote working from home. The extent and duration of this shift will have important consequences for local economies and especially the retail and hospitality sectors which depend on business around the workplace. Using a new bespoke, nationally representative survey of UK working age adults we analyse their ability and willingness to work remotely, and the consequences for spending on food, beverages, retail and entertainment around the workplace. We establish five key facts. (i) The post-pandemic change will be large: the fraction of work done from home will increase by 20 percentage points over its pre-pandemic level. (ii) The Dingel-Neiman (2020) assessment of remote working potential by occupation are reasonably predictive of what workers and employers expect to do, with a correlation coefficient of over 0.7. (iii) Relocation will be higher for better paid professional occupations, which will skew spending toward the most socio-economically affluent geographical areas. (iv) The corresponding geographical shift in annual retail and hospitality spending will be £3.0 billion with more remote working shifting demand away from urban areas. (v) On average, a 1% change in neighbourhood workforce changes local spending by 0.25%.

Keywords: Covid-19, work-from-home, local labour markets
JEL Classifications: R12, J01, H12

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1 Introduction

The Covid-19 pandemic has had a dramatic impact on the way we work. At its peak approximately 40% of all work done across England and Wales was done from home (Kent-Smith, 2020). As homeworking mandates are relaxed, there is uncertainty about how much work will be done remotely in the medium term, by whom, and where. Firms have invested in capital and developed patterns of working that may cause remote working (RW) to persist beyond the point when it is necessary or required for public-health reasons. These choices will affect other workers and business who are not party to them, and in particular those who provide locally-consumed services (LS) such as retail and hospitality to workers who will now be working elsewhere.

This paper uses information from a new bespoke, nationally representative survey of UK workers to quantify their expectations of how much they will work in the office and how much remotely in 2022 and thereafter. We combine this with information about their occupation and geographic location, along with their reported pre-pandemic work-related expenditure on LS analyse to calculate occupation- and location-specific spending and shares of work done from home, to which we apply the methodology described in De Fraja et al. (2021) to estimate geographic shifts in work and spending due to RW across England and Wales. We use this to establish five facts about RW and its geographic and industrial impact.

First, respondents report that the post-pandemic increase in RW will be large: the fraction of work done remotely will increase by 20 percentage points over pre-pandemic levels. This is similar to the estimated increase in the U.S. Barrero et al. (2021) and prior estimates for the UK Casey (2021).

Second, the pattern of WFH across occupations turns out to be broadly consistent with the predictions made in Dingel and Neiman (2020): the correlation across our 25 occupational groupings is 0.73. Workers expect to RW slightly more than thought possible in low-RW occupations according to Dingel and Neiman (2020), and slightly less in high-RW occupations. Our data provide an additional and complementary source for researchers who need to quantify occupations by their ability to RW.

Third, the incidence and impact of RW will vary a great deal across geographic areas. For

example, the increase in RW will affect city centres especially hard and most of all Central London. There are a number of factors driving this pattern. A key factor is that where people work is more geographically concentrated than where people live. This is especially true for jobs that can potentially be done from home which tend to cluster in dense city centres. We also show that workers who can work from home are likely to be relatively well-paid, resulting in a skewing of work done from home towards more affluent neighbourhoods. Another important factor, as our survey shows for the first time, workers' propensity to work from home within given occupations depends on where they live. For example, workers business management or professional occupations who live in smaller cities and towns anticipate less RW in the future than their counterparts who live in London or other large cities in England and Wales.

Fourth, we estimate that around £3.0 billion in annual retail and hospitality spending (1.5% of total spending[1]) may relocate away from urban centres to residential areas. By changing where we spend our time, RW also changes where our spending on locally consumed services—such as coffee shops, restaurants, and retail—takes place. The local impact of this change will vary a great deal, with spending falling by as much 32.5% in the City of London, but potentially increasing by more than 50% in many residential neighbourhoods. This shift in spending is important; we estimate approximately 77,000 jobs in retail and hospitality will either need to similarly relocate or be lost all together.

Fifth and finally, we use these estimates to calculate the elasticity of retail and hospitality spending with respect to a change in the neighbourhood workforce. On average, we find that a 1% increase in person-days spent RW in a neighbourhood will lead to a 0.25% change in spending. This estimate is consistent across different neighbourhoods in England and Wales, but notably higher in a few neighbourhoods, such as the City of London or Canary Wharf, where worker spending is a very large portion of overall spending on local services.

This paper builds on a emerging literature studying the dramatic increase in RW during, and after, the pandemic. Relative to this literature, our paper makes contributions in four broad broad areas. First, we complement the early judgement-based assessments (Dingel and Neiman, 2020) and surveys (Adams-Prassl et al., 2020) of different occupations' suitability for

[1]Percentage is based on total spending for industries working in hospitality, retail, and wholesale.

RW, with workers' own expectations for the future based on their experiences over 9-18 months of the pandemic. Second, we show that there are systematic differences in these metrics by geography as well as occupation. Third, our estimates of where work will be done across the UK update De Fraja et al. (2021) for the UK and complement Ramani and Bloom (2021), Althoff et al. (2021) and Brueckner et al. (2021) for the US. Fourth, we assess the externalities these moves will have for LS in the UK, a country with a very different economic and human geography to the US (Barrero et al., 2021).

The remainder of the paper is structured as follows. Section 2 provides the details on how we quantify neighbourhood-level changes in work and spending. This section also provide details on the data sources used in this study. Section 3 presents the main results of this study on post-pandemic remote working, retail and hospitality spending, and the implied elasticity of local services spending with respect to remote working. Section 4 we discuss some of the consequences of these changes for the broader economy and policy recommendations. Section 5 concludes with some implications that these results have for post-pandemic recovery policy.

2 Quantifying the geographic effect of RW

This section proceeds as follows. First, in section 2.1 we introduce and describe our survey data on historic and expected RW and individuals' expenditure when at work. Then, we use it to assess differences in actual RW patterns from those predicted at the beginning of the pandemic. Next, we study geographical regularities in RW and expenditure patterns vary by location. Section 2.2 describes the method by which we combine the survey data with Census data to compute, for each neighbourhood, changes in RW and retail and hospitality spending.

2.1 The Work From Home Survey

Our primary data source is the novel UK Work From Home Survey. The survey has been collected monthly from January 2021, providing a sample of approximately 2,500 completed surveys in each month. We work with data collected from March 2021—when data on 2019 work patterns were first collected—up to and inclusive of November of 2021, for a total of 22,554

Table 1: Work From Home Survey descriptive statistics

	Unweighted		Weighted		
Variables	Mean	SD	Mean	SD	N
Female (%)	62.64	48.38	57.64	49.41	22,554
University education (%)	63.73	48.08	39.39	48.86	22,554
Work income in 2019 (£'000s)†	29.57	19.54	28.06	18.93	22,554
Days per week worked from home in 2019	0.49	1.18	0.48	1.18	22,554
Did not work in reference week (%)	11.76	32.22	14.14	34.84	22,554
Full days worked in reference week	3.92	1.70	3.79	1.79	22,554
Days worked from home in reference week⋆	2.91	2.05	2.64	2.10	19,901

Notes: This table reports summary statistics for the Work From Home Survey (March–November 2021). Column SD reports standard deviations for the sample. Weighted estimates are weighted by age, sex and education to match the *Quarterly Labour Force Survey*.
†Income groups reported, mean is calculated based on the midpoint for each group.
⋆Days worked from home are conditional on working in the reference week.

observations. The survey samples UK residents, age 20–65 who earned at least £10,000 in 2019, roughly corresponding to the population of adults in full-time employment. The Work From Home Survey includes a number of results about individuals' RW preferences, their ability to do so, and the impact upon their productivity of pandemic induced additional RW.[2]. We report selected summary statistics in Table 1. For the period covered by the survey, the average worker was working 2.64 full days per week at home (of an average 3.79 days worked in total), compared to an average of 0.46 days per week in 2019.

In this study we are interested in estimating the permanent shift in work done from home, once firms and or government are no longer mandating or permitting RW for public health reasons. For this purpose we focus on information about survey respondents' belief about their employers plans for future working arrangements to estimate working from home moving forward. Specifically we look at the answer to the following survey question:

> *Q1: After COVID, in 2022 and later, how often is your employer planning for you to work full days at home?*

In the case of respondents who are self-employed (10% of the sample), we use the question

> *Q2: After COVID, in 2022 and later, how often would you like to have paid workdays at home?*

[2]Productivity and preference results for earlier waves of the survey are reported in Taneja et al. (2021)

Table 2: Remote working and spending by occupation

	Work done from home (%)		Spending (£)	N
	in 2019	2022 over 2019	at work 2019	
Armed forces	11.71	3.13	38.15	48
	(3.53)	(4.89)	(7.83)	
Construction and extraction	3.77	10.64	38.16	161
	(1.20)	(2.05)	(3.97)	
Farming, fishing, and forestry	13.71	5.50	55.18	65
	(3.80)	(3.29)	(11.38)	
Management, business and financial	15.82	31.03	36.00	2,043
	(0.68)	(0.82)	(0.99)	
Office and administrative support	11.38	25.34	23.98	2,593
	(0.56)	(0.75)	(0.60)	
Production	5.05	10.88	27.24	331
	(1.04)	(1.48)	(1.92)	
Professional and related	24.78	25.70	31.52	1,165
	(1.10)	(1.15)	(1.30)	
Sales and related	15.53	13.36	30.83	1,258
	(0.95)	(0.97)	(1.11)	
Service occupations	10.40	11.40	28.87	622
	(1.16)	(1.34)	(1.49)	
Transportation and material moving	3.02	6.20	17.89	381
	(0.76)	(1.24)	(1.51)	
Education, training and library	7.59	9.23	19.98	1,939
	(0.53)	(0.69)	(0.79)	
Public sector	8.42	24.53	22.55	1,142
	(0.64)	(1.00)	(0.85)	
Computer and mathematical	22.88	36.90	29.97	863
	(1.25)	(1.38)	(1.49)	
Architecture and engineering	9.26	24.98	26.34	199
	(1.80)	(2.35)	(2.54)	
Physical and social science	10.38	17.06	24.84	122
	(2.30)	(3.29)	(2.39)	
Community and social service	12.73	23.49	26.16	253
	(1.91)	(2.49)	(2.34)	
Legal	12.27	31.98	41.52	238
	(1.76)	(2.40)	(3.09)	
Arts, design, entertainment, sports, and media	36.17	20.41	31.03	738
	(1.64)	(1.57)	(1.70)	
Healthcare practitioner and technical	6.12	12.04	27.99	642
	(0.73)	(1.09)	(1.82)	
Healthcare support	5.63	8.87	25.81	493
	(0.91)	(1.28)	(1.49)	
Protective service	1.18	11.35	32.97	71
	(0.63)	(3.31)	(4.52)	
Food preparation and serving	3.72	7.61	30.87	252
	(1.11)	(1.45)	(2.47)	
Cleaning and maintenance of buildings and grounds	4.59	12.28	16.18	90
	(1.87)	(2.88)	(2.52)	
Personal care and service	14.59	10.53	25.67	149
	(2.83)	(2.68)	(2.91)	
Installation, maintenance and repair	8.49	14.08	18.92	122
	(2.35)	(3.07)	(2.18)	

Notes: This table reports remote work and retail and hospitality spending in 2019 and 2022 by occupation, calculated from the Work From Home Survey. Standard error of mean values reported in parenthesis.

The answers to these questions are given in days, beginning with a) Never, b) About once or twice per month, c) 1 day per week,..., g) 5 or more days per week. We transform responses to each of these questions are into a share of a 5-day work week. For example, if a respondent chooses *About once or twice per month*, then they are doing 10% of work from home each week; if a respondent chooses *5+ days per week*, then doing 100% of work from home each week.

To be conservative we rely on estimates using respondents' beliefs about their employer's preferences for RW rather than their own. The average respondent reports (for *Q2*) that they would prefer to work from home 50% of the time—considerably higher than the average 33% reported for *Q1* above. Notice that both of these reported values are considerably larger than the average 12% of work done from home reported for 2019.[3]

The Work From Home Survey also provides information on the reported amount of spending on retail and hospitality that workers did while working at the office pre-pandemic. This is based on the answer to three questions:

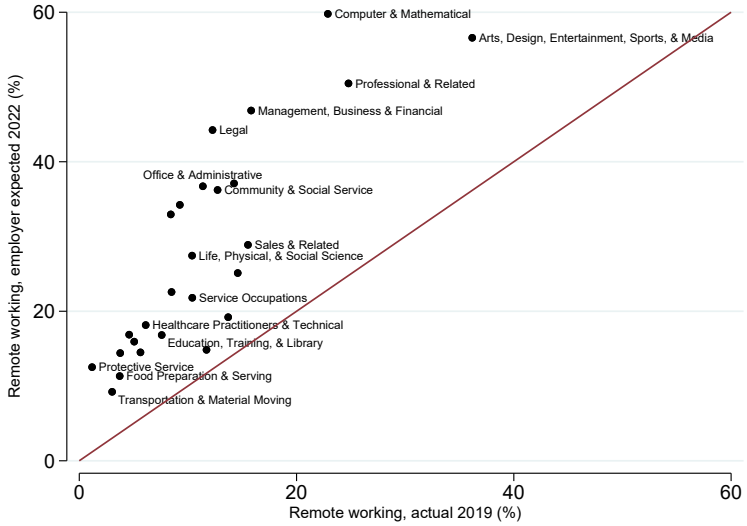
> *Q3: In 2019, when you worked at your employer's business premises, roughly how much money (in pounds) did you spend during a typical working week on food and drinks (e.g. lunch, coffee, snacks, etc.)?*
> *Q4: In 2019, when you worked at your employer's business premises, roughly how much money (in pounds) did you spend during a typical working week on shopping near work (e.g. gifts or clothes shopping during your lunch break of after work.)?*
> *Q5: In 2019, when you worked at your employer's business premises, roughly how much money (in pounds) did you spend during a typical working week on bars, restaurants, and other entertainment venues that are near your workplace?*

The answers for each of these questions are reported in pounds.

In Table 2 we report estimates of RW and spending while at work across the twenty-five occupation categories recorded in the survey. As we would expect, there are considerable differences in expected future RW. For example, office and administrative support workers are expected to do 25 percentage points more work from home in 2022 than the 11% done in 2019. Work in education, on the other hand, is expected to do only 9 percentage points more work

[3]The proportion of work done from home in 2019 is a derived measure. See Appendix A for details.

Figure 1:
Remote working, 2019 and 2022



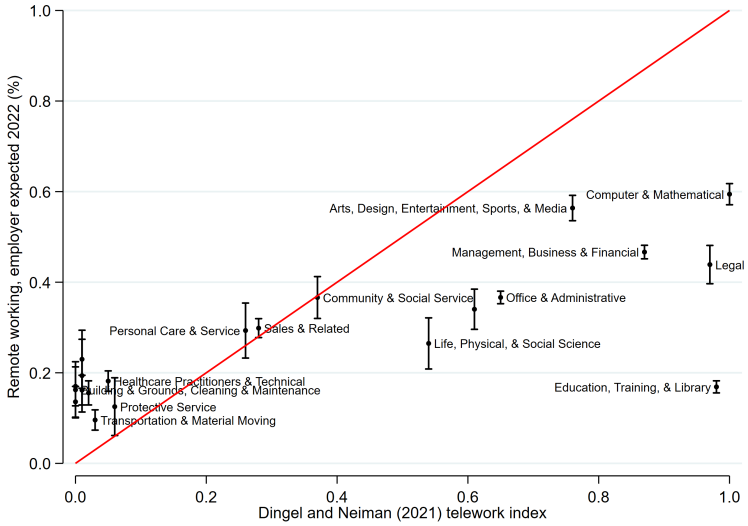
Notes: This figure plots the expected percent of work done at home in 2022 against the average percent of work done at home in 2019. The 45° line is shown in red.

from home in 2022 than the 7.5% done in 2019. A general pattern emerges where occupations that had higher RW rates before the pandemic both have higher RW rates after the pandemic and have a larger incremental increase (see Figure 1)

This variation in RW is likely driven, in part, by occupational differences in how amenable jobs are to teleworking. We examine this by looking at the correlation between the change in post-pandemic RW and the teleworking index reported in (Dingel and Neiman, 2020) for the same occupations[4]. We show a scatter plot of the correlation in Figure 2. The correlation of 0.78 is substantial, consistent with the teleworking index being a good predictor of future working from home. Moreover, the differences between predicted RW and actual RW are themselves revealing. Dingel and Neiman (2020) underestimates the potential for RW at the bottom of the RW distribution, in occupations such as transportation or healthcare, and overestimated it at the top-end in occupations like legal services. This highlights a key difference in these two

[4]In Appendix A we do the same analysis using the (De Fraja et al., 2021) adaptation of the (Dingel and Neiman, 2020) teleworking index for UK SOC codes.

Figure 2:
2022 remote working rates versus teleworking index



Notes: This figure show a scatter plot of work from home rates by occupation as predicted by the Work From Home Survey against work from home indices reported in Dingle and Neiman (2021)— the correlation coefficient is 0.78. Vertical bars show 95% confidence intervals for the survey estimates. The 45° line is shown in red.

measures, the index reflects how much work *can* be done from home, while we estimate how much work *will* be done from home. An occupation where we see a stark difference between the teleworking index and WFH prediction is education. This fits with the anecdotal experience throughout 2020 and 2021; although children can be educated remotely, there is a strong preference (both from parents and teachers) to continue this work face-to-face. Likewise, while it seemed logical that healthcare needs to be done in person innovation and adoption of new technologies have enabled a substantial proportion of care to be done remotely.

We now turn to our data on spending while at work. We also see considerable variation in working from home and spending across different geographic areas. We consider four levels of geography: *Outer London*, *Central London*[5], *Other large cities*, *All other cities and towns*. We

[5]We define Central London to be the local authorities of Camden, Islington, Kensington and Chelsea, Lambeth, Southwark, Westminster, City of London, Greenwich, Hackney, Hammersmith and Fulham, Lewisham, Tower Hamlets, and Wandsworth.

Table 3: Remote working and spending by work location

	Work done from home (%)		Spending	N
	in 2019	2022 over 2019	at work 2019	
Other towns and cities	12.79	17.48	24.82	11,782
	(0.27)	(0.33)	(0.34)	
Large cities (top 15 by population)	10.41	26.68	30.39	2,574
	(0.50)	(0.70)	(0.73)	
Central London	10.37	28.43	51.24	1,160
	(0.72)	(0.93)	(1.52)	
Outer London	25.24	30.00	42.17	552
	(1.57)	(1.51)	(2.07)	

Notes: This table reports work from home and retail and hospitality spending in 2019 and 2022 by location of work (in 2019). Standard error of mean values reported in parenthesis.

define *Other large cities* as the fifteen largest local authorities outsides the Greater London area. Aggregate statistics for working from home and spending are reported in Table 3. We see that the change in working from home is considerably larger in central and outer London than in cities and towns outside the London area. Further, weekly spending while at work is twice as high in central London (£51.24 per week) than in smaller towns and cities (£24.82 per week).

Within several occupations we see large and significant RW variation across the different geographic regions (see Table A1 in Appendix A). For example, a worker in office and administrative support is expected to increase their RW by 26.8 percentage points if they are in a small local authority, compared to to 39.7 percentage points in central London. Workers in professional occupations are expected to increase their RW by 21.0 percentage points in a small local authorities, but 36.9 percentage points in Central London. We see similarly large geographic differences in management, legal, and healthcare. For most occupations in which there is a large overall change in working from home, the change is expected to be largest in the London area (an interesting exception to this is computer and mathematical occupations where we see lower incremental RW in London versus other parts of England and Wales).

2.2 Calculating the geographic shift in working and spending

To measure how RW will affect the geography of productive activities and the resulting demand for local services, we build on the work of De Fraja et al. (2021). They introduce what they term as a *zoomshock*, the geographic change in economic activity due to the shift towards RW during the Covid-19 pandemic. The zoomshock reflects the difference between the number of workers who live in a neighbourhood, and can work remotely, and the number of workers who work in a neighbourhood, and can work remotely:

$$\begin{pmatrix} \text{Number of workers who } \textit{live} \\ \text{in neighbourhood } z \text{ and} \\ \text{can work remotely} \end{pmatrix} - \begin{pmatrix} \text{Number of workers who } \textit{work} \\ \text{in neighbourhood } z \text{ and} \\ \text{can work remotely} \end{pmatrix} \tag{1}$$

In this paper we modify this measure to reflect the amount of post-pandemic RW that we expect to be done from home over what was done pre-pandemic. Specifically, we will compare expectations of the amount of work that will be remote in 2022 to estimates of the amount of RW in 2019. That is, we estimate the change in the amount of work done in a neighbourhood z as:

$$\Delta E_z = \sum_o [(RW_{o,z}^{2022} - RW_{o,z}^{2019}) E_{o,z}^R - (RW_{o,z}^{2022} - RW_{o,z}^{2019}) E_{o,z}^W], \tag{2}$$

where $RW_{o,z}^{2022}$ is the expected proportion of RW in 2022, for occupation o and neighbourhood z; $RW_{o,z}^{2019}$ is the proportion of RW in 2019, for occupation o and neighbourhood z; $E_{o,z}^R$ and $E_{o,z}^W$ are the number of workers with jobs in occupation o who live and work in neighbourhood z (pre-pandemic).

By changing where workers are spending their time, the increase in RW will also lead to a geographic change in where workers do their work-related spending on locally consumed services, particularly retail and hospitality. The demand for coffees, drinks, sandwiches and retail shopping during lunch breaks, will be shifted from neighbourhoods in which workers work to neighbourhoods in which workers live.

We calculate this expected change in local retail and hospitality spending by weighting the geographic movement of work across different occupations by the average spending in each

occupation and location. Formally the change in retail and hospitality spending in a given neighbourhood, ΔS_z, is calculated as:

$$\Delta S_z = \sum_o [(RW_{o,z}^{2022} - RW_{o,z}^{2019}) Spend_{o,z}^{2019} E_{o,z}^R - (RW_{o,z}^{2022} - RW_{o,z}^{2019}) Spend_{o,z}^{2019} E_{o,z}^W] \quad (3)$$

$Spend_{o,z}^{2019}$ is the average spending, while at work, by workers in occupation o working in neighbourhood z before the pandemic.

We use the information from the Work From Home Survey, described above, to estimate values for $RW_{o,z}^{2022}$, $RW_{o,z}^{2019}$, and $Spend_{o,z}^{2019}$ in Equation (3). For each of the twenty-five survey occupation categories and four location described above, we calculate the average increase in WFH for 2022 over 2019, and the average work-related spending on retail and hospitality.

The 2011 population Census, published by Office for National Statistics, provides us with the pre-pandemic distribution of residents and workers by occupation and location, $E_{o,z}^R$ and $E_{o,z}^W$. These data provide, for every middle super output area (MSOA)[6], a count of the number of employees working in the MSOA by three-digit Standard Occupational Classification (SOC), and a count of the number of employees living in the MSOA by four-digit SOC. To match with the survey information, each SOC code is allocated to one of the 25 occupations (see data appendix for more details), average values of $RW_{o,z}^{2022}$, $RW_{o,z}^{2019}$, and $Spend_{o,z}^{2019}$ are assumed to be constant across MSOAs (z) within each of the four geographic regions we consider above. This means that cross MSOA variation in average spending and RW within one of the four geographic regions will be driven by variation in occupation composition.

We express both eq. (2) and eq. (3) as percentage changes. For eq. (2) this is done by dividing by the total pre-pandemic number of jobs done in neighbourhood z. For eq. (3) we divide by the total retail and hospitality spending for neighbourhood z. We calculate total spending for a neighbourhood z as the total employment in retail and hospitality done (by workers and all other forms of spending) in the neighbourhood multiplied by the output per worker. Full details of calculations and data sources are available in Appendix A.

There are three assumptions underlying eq. (3) that are worth highlighting. First, this

[6] An MSOA is an official geographic unit used in England and Wales. Each unit defines a geographic area in which approximately 8,254 people reside. There are 7,201 MSOAs across England and Wales

measure reflects the change in spending that will occur in each neighbourhood when workers spending in 2019 is reallocated to different neighbourhoods. While a decrease in spending is likely to be realised when workers leave city centres, where many local services are available, the corresponding increase may not be realised in residential neighbourhoods if relatively few of such services are available (discussed in more detail in Section 4). For this reason, we interpret ΔS_z as the geographic shift in *desired* retail and hospitality spending by workers.

Second, we assume that desired spending on retail and hospitality does not change when workers work remotely as opposed to working in an office. It is plausible that when workers work from home, with access to a full kitchen, desired spending on food and beverages decreases. However, it could also be that desired spending increases, as coffee shops and restaurants provide a valuable respite from the social isolation of home working. Likewise, some may prefer to work remotely from cafes or hotels. For this reason, our results reflect the conservative assumption that desired spending is independent of where work takes place. This means that local spending will not be affected by the place of work for workers who work and live in the same neighbourhood. If this is violated it will likely lead us to under-estimate any aggregate decline in spending due to RW.

Third, we assume that spending is spread evenly throughout the week. This means that working from home two days a week will result in two days' worth of spending that does not take place in the city centre. This may lead us to over or under-estimate the effect of home working on spending if spending is concentrated around certain days of the week. This is unlikely to apply to spending that is done on a daily basis, such as coffee and sandwiches, but may be important for spending that is concentrated, as may be the case with Friday evening drinks or retail shopping.

3 Results

In this section we present our results quantifying the geographic shift in where work is done and the corresponding shift in desired retail and hospitality spending. We then use these results to calculate the elasticity of spending (LS-elasticity) with respect to a neighbourhood's change

in work.

3.1 The geography of remote work

Computing eq. (2) for England and Wales as a whole suggests that an additional fifth (18%) of all work will be worked remotely in 2022 compared to 2019. However, this overall figure masks considerable variation. Figure 3 plots the estimated increase in RW by local authority as a percentage of the total local authority workforce. Looking at the map it is clear that the change is largest in Central London, and more generally in the remainder of South East England. We can also see that a similar pattern is evident for other large cities, with Birmingham, Cardiff, Leeds, and Manchester all discernible as darker patches of the map. Likewise, areas far from major cities such as the majority of Wales, are paler reflecting lower rates of RW.

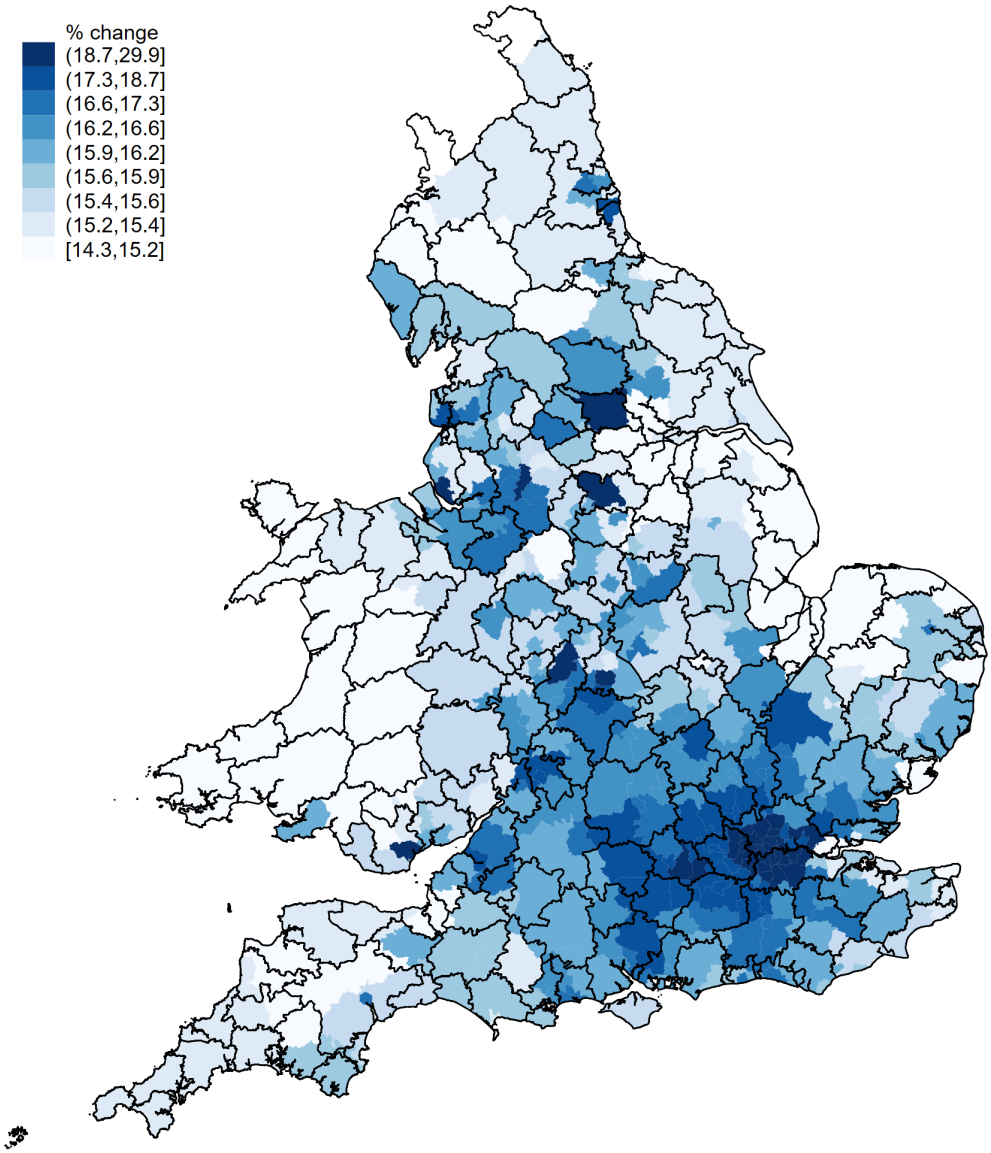
Looking at the quantile definitions in the legend makes clear another important feature of the change in RW. The distribution of changes is heavily right-skewed. At the local authority level the minimum increase in RW is 14.3% (Richmondshire District in North Yorkshire). But, across the country the minimum increase in RW is still nearly an additional day per week suggesting that RW is not merely an urban or suburban phenomenon. The largest increases, 29.9% for the City of London/Westminster and 29.0% for Tower Hamlets, are consistent with an average increase of 1.5 days per week working from home.

While the average increase in RW in all London Boroughs is large, there is considerable variation at the neighbourhood level. Figure 4 plots the estimated increase in RW at the neighbourhood (MSOA) level for Greater London.[7] As should be expected the average increase for London is higher than for England and Wales as a whole. Again, the increase is right-skewed—every London neighbourhood will see an increase in RW of at least 15.6%.

More loosely, there is evidence of a 'doughnut' type pattern with increases in RW highest in central MSOAs but with higher rates in the outermost neighbourhoods than those in between. There are many exceptions to this (e.g. the prosperous areas of West London along the river Thames have higher rates than those further West), reflecting the complexity of London's eco-

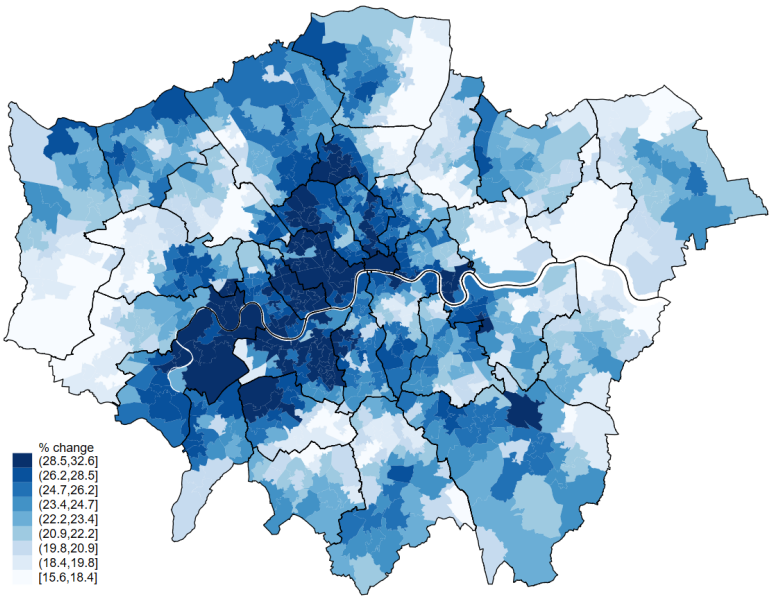
[7]This figure plots the changes in RW for residents living in each MSOA. Figure B6 in the Appendix additionally plots the increases as a percentage of those working in each MSOA. While there are some interesting differences, the overall implications are the same.

Figure 3:
Change in remote working, England and Wales



Notes: This figure shows the change in working from home in 2022 over 2019, as a percent of total local authority workforce. Boarders denote travel to work areas.

Figure 4: Change in remote working, Greater London



Notes: This figure shows the change in the number of residents working remotely in 2022 over 2019, as a percentage of total neighbourhood (MSOA) workforce. Boarders denote local authorities.

nomic geography. Nevertheless, excepting these nibbles, overall the doughnut pattern is clear. Of course, this pattern is not a coincidence but reflects differences in affluence, workers living in more affluent neighbourhoods are more likely to have jobs that allow for hybrid working. This doughnut pattern is similar in spirit, if not detail, to the 'donut effect' identified by Ramani and Bloom (2021).[8]

3.2 Change in retail and hospitality spending

We now turn to the change in spending. Calculating eq. (3) for the entirety of England and Wales suggests an aggregate geographic reallocation of desired retail and hospitality spending, as a result of the post-pandemic increase in RW, of £3.0 billion. This is approximately 1.5% of

[8]Ramani and Bloom (2021) provide evidence of a migration amongst those able to RW from the centre of major US cities to their suburbs, and a consequent change in rents. There the donut refers to the suburbs with the central business district the hole, here, the doughnut refers to an inner ring of suburbs between Central and Outer London.

2019 spending[9] in England and Wales. Assuming that a percentage change in spending means a percentage change in employment, this translates to approximately 77,000 retail and hospitality jobs which will either be lost or relocated.[10]

[9]Percentage is based on total spending for industries working in hospitality, retail, and wholesale.

[10]The number of retail and hospitality jobs assumes a 1:1 relationship between spending and employment. This is a conservative assumption, as fixed costs mean small changes in revenues may lead to a disproportionate number of firms or establishments closing.

Table 4: Largest negative and positive spending changes by neighbourhood, Greater London

Local authority	Neighbourhood	Spending change annual £'000s {%}		Employment change number of jobs {%}		Change in R&H jobs
City of London	City of London	-349,349	{-31.6}	-114,490	{-32.1}	-7,981
Westminster	Strand, St James & Mayfair	-124,615	{-10.3}	-43,024	{-27.8}	-3,029
Westminster	Fitzrovia West & Soho	-107,441	{-6.0}	-36,157	{-27.6}	-2,276
Tower Hamlets	Canary Wharf	-101,880	{-34.7}	-33,064	{-31.8}	-2,333
Westminster	Central Westminster	-67,312	{-18.4}	-24,455	{-28.1}	-1,486
Camden	Holborn, St Giles & Bloomsbury South	-55,470	{-16.4}	-18,926	{-27.5}	-1,310
Southwark	Borough & Southwark Street	-43,564	{-22.3}	-14,750	{-26.5}	-1,058
Westminster	Marylebone & Park Lane	-35,981	{-5.9}	-12,159	{-24.4}	-781
Camden	Fitzrovia East & Bloomsbury West	-30,496	{-14.0}	-10,650	{-26.0}	-707
Islington	Old Street & St Luke's	-29,736	{-23.4}	-9,909	{-27.4}	-650
Wandsworth	Tooting Bec Common	5,056	{57.8}	1,730	{115.8}	110
Tower Hamlets	Millwall South	4,458	{57.0}	1,488	{105.2}	105
Wandsworth	Clapham Common West	4,375	{39.9}	1,464	{90.2}	94
Lambeth	Acre Lane	4,356	{20.2}	1,539	{71.8}	95
Wandsworth	Southfields North	3,469	{26.2}	1,179	{57.4}	75
Southwark	Rotherhithe	3,467	{28.4}	1,159	{64.9}	87
Westminster	Little Venice	3,459	{15.5}	1,134	{45.3}	78
Lambeth	Clapham Park West	3,451	{32.5}	1,181	{64.4}	74
Wandsworth	Earlsfield North	3,424	{18.6}	1,158	{46.3}	73
Camden	South Hampstead	3,407	{68.1}	1,140	{89.0}	73

Notes: This table reports the ten largest negative and positive spending changes for neighbourhoods in the Greater London Authority. *Spending change* refers to the annual change in LS (measured as retail and hospitality spending) as a result of post-pandemic RW. (Equation (2)). Percent change, in braces, is this spending change as a percent of total 2019 retail and hospitality spending in the same neighbourhood. *Employment change* refers to the change work done in the neighbourhood due to post-pandemic working from home. This values reflects the net number of jobs (Equation (1)). Percent change, in braces, is this employment change as a percent of total number of jobs done in the same neighbourhood pre-pandemic. *Change in R&H jobs* is the total change in the number of retail and hospitality jobs as a result of post-pandemic working from home. This value is calculated assuming a 1% change in spending leads to a 1% change in employment.

Table 5: Largest negative and positive spending changes by neighbourhood, not including Greater London

Local authority	Neighbourhood	Spending change annual £'000s {%}		Employment change number of jobs {%}		Change in R&H jobs
Leeds	Leeds City Centre	-35,045	{-5.9}	-20,736	{-25.1}	-1,074
Birmingham	Central	-24,077	{-8.0}	-14,148	{-26.9}	-721
Manchester	City Centre North & Collyhurst	-22,181	{-4.3}	-12,847	{-25.1}	-661
Cardiff	Cathays South & Bute Park	-13,397	{-4.0}	-8,012	{-21.6}	-479
Liverpool	Pier Head	-12,558	{-12.9}	-7,631	{-26.8}	-398
Newcastle upon Tyne	City Centre & Arthur's Hill	-12,109	{-3.3}	-8,855	{-16.2}	-453
Birmingham	North Central & Dartmouth Circus	-11,949	{-8.0}	-7,302	{-21.3}	-329
Bristol, City of	Bristol City Centre	-11,603	{-6.0}	-8,429	{-16.9}	-403
Manchester	Piccadilly & Ancoats	-11,558	{-7.3}	-6,835	{-22.5}	-389
Manchester	Castlefield & Deansgate	-9,022	{-13.0}	-5,252	{-25.4}	-326
Stockton-on-Tees	Ingleby Barwick West	1,448	{11.6}	1,067	{52.6}	50
Sheffield	Mosborough & Halfway	1,368	{14.2}	826	{60.3}	44
Birmingham	Little Sutton & Roughley	1,294	{12.1}	760	{51.8}	41
Leeds	Primley Park & Wigton Moor	1,242	{19.6}	738	{67.8}	37
Sheffield	Walkley	1,215	{16.7}	764	{44.5}	38
Manchester	Didsbury Village	1,212	{6.0}	734	{25.0}	40
Leeds	Robin Hood, Lofthouse & Middleton Lane	1,208	{12.8}	726	{43.6}	34
Coventry	Stivichall & Finham	1,194	{19.3}	723	{73.7}	34
Sheffield	High Green & Burncross	1,187	{16.1}	720	{45.9}	36
Swindon	Mouldon Hill & Oakhurst	1,169	{23.1}	856	{67.2}	37

Notes: This table reports the ten largest negative and positive spending changes for neighbourhoods in England and Wales which are outside the Greater London Authority. *Spending change* refers to the annual change in retail and hospitality spending as a result of post-pandemic working from home (Equation (2)). Percent change, in braces, is this spending change as a percent of total 2019 retail and hospitality spending in the same neighbourhood. *Employment change* refers to the change work done in the neighbourhood due to post-pandemic working from home. This values reflects the net number of jobs (Equation (1)). Percent change, in braces, is this employment change as a percent of total number of jobs done in the same neighbourhood pre-pandemic. *Change in R&H jobs* is the total change in the number of retail and hospitality jobs as a result of post-pandemic working from home. This value is calculated assuming a 1% change in spending leads to a 1% change in employment.

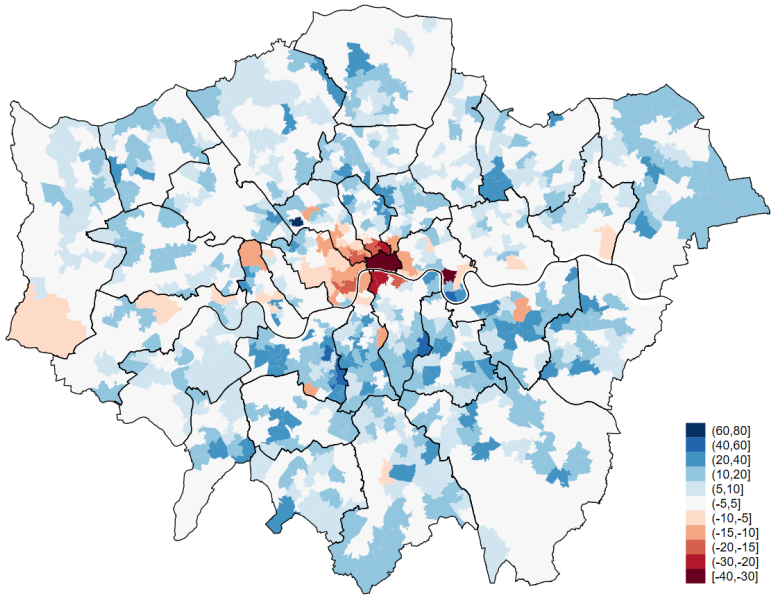
This shift in desired spending is highly uneven across England and Wales. We report the ten neighbourhoods with the largest changes in desired spending (positive and negative) for Greater London and all neighbourhoods outside London in tables 4 and 5. Several patterns quickly emerge. First, while demand reductions are concentrated in a few neighbourhoods, demand increases are spread across many neighbourhoods. For example, in Greater London the aggregate reduction in spending for the ten worst-affected neighbourhoods is estimated to be £945 million annually, whereas the ten largest positive shock neighbourhoods can expect an increase in desired spending of £39 million annually; the losses are 24 times larger than the gains. We see a similar story outside of London, with the worst affected neighbourhoods experiencing a £163 million annual reduction in desired spending and the ten with the largest increases predicted a aggregate £12 million annual increase in desired spending; losses are 14 times larger than gains.

To get a sense of how important are the concentration of losses relative to gains in LS demand, consider the aggregate changes across the entire Greater London area. RW will reallocate £1.5 billion in spending, primarily away from the neighbourhoods of central London. However, only 62% of this spending (£0.9 billion) is expected to remain in the Greater London area. The remainder will be allocated across the many towns and villages in which London commuters live. The geographic shifts in LS demand that we estimates can be of a non-trivial distance.

The greater concentration of reductions in anticipated LS spending reflects the fact that while RW is relatively uniformly distributed, incomes and consumption are not. Thus, it is unsurprising that the City of London with its high number of well-paid commuters has the largest loss, it is also unsurprising that the largest gains are in affluent suburbs such as Hampsted. Figure 5 displays the percentage changes in LS demand for London neighbourhoods. The decline can be seen to be heavily concentrated in the City of London and Westminster and other parts of Central London, while increases are much more evenly spread.

One way in which the comparative concentration of spending changes can be seen is to compare the largest values in tables 4 and 5. The predicted loss of LS jobs in the City of London is around eight times as large as that anywhere outside of London. Likewise the 10th largest loss in London (in Old Street, Islington) is similar to that of the largest loss in Manchester (and the third largest outside London). On the other hand, while the largest gains are also biggest in

Figure 5:
Local service demand shocks, Greater London Authority



Notes: This figure shows the percentage change in demand for retail and hospitality spending for each Greater London MSOA. Boarders denote local authorities.

London, the discrepancy is now only a factor of two. This comparatively uniform distribution reflects that commuting by its nature funnels people from many different residential areas into a small number of city centres.

3.3 Retail and hospitality elasticity

The two quantities in eq. (2) and eq. (3) can be used to measure the responsiveness of LS spending to a change in the amount of work done in a neighbourhood. To do this we calculate a local service elasticity (LS-elasticity), reflecting the percentage change in retail and hospitality spending given a percentage change in work done in neighbourhood z:

$$\epsilon_z = \frac{\%\Delta S_z}{\%\Delta E_z} \tag{4}$$

where $\%\Delta S_z$ and $\%\Delta E_z$ are eq. (3) and eq. (2) expressed as a percentage of total spending and work.

The LS-elasticity measure is important. It reflects the direct effect on local service spending of a change in where employment takes place. It therefore applies beyond the case of the pandemic, and can be used to quantify spillovers that will arise form place-based employment policies more generally.

The average LS-elasticity for England and Wales, as reported in table 6, is one quarter; a percentage change in an MSOA's workforce leads to a 0.250% change in desired spending.[11]

Table 6: Elasticity of RW on R&H Spending

	Elasticity	Confidence interval (95%)	N
All MSOAs	0.250	[0.221, 0.278]	7,201
MSOAs with a spending decrease	0.285	[0.240, 0.329]	1,884
MSOAs with a spending increase	0.208	[0.187, 0.228]	5,317

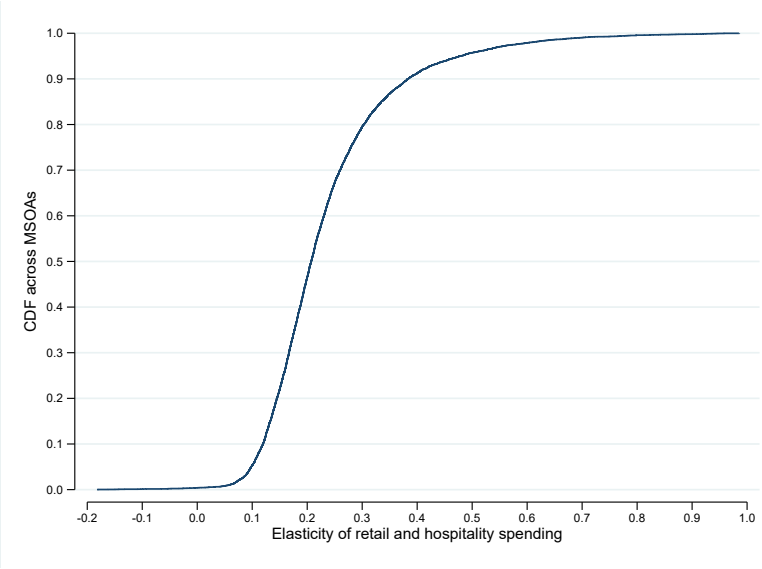
Notes: This table reports the mean percentage change in desired MSOA retail and hospitality spending following a 1% change in work done in the MSOA. Estimates reflect the mean elasticity weighted by the share of pre-pandemic jobs done in each MSOA.

These estimates are relatively precise. The 95% confidence interval suggests that we would not expect the true parameter to be below 0.22 or above 0.28. Moreover, the individual ϵ_z for each MSOA are relatively stable across MSOAs. More than 95% of MSOAs have an elasticity between 0.1 and 1.0. This can be seen by looking at fig. 6 which plots the empirical cumulative distribution function of ϵ_z. More than 95% of MSOAs have an elasticity which lies between 0.1 and 0.5; 67% of MSOAs have an elasticity between 0.15 and 0.35. Moreover, excepting a few outliers, the estimated elasticities are always in the range $[0, 1]$ as our intuition leads us to expect.[12]

[11] Average elasticity is computed weighting each MSOA by its share of the total workforce working in the area. The unweighted results are qualitatively and quantitatively very similar.

[12] The highest estimate is for Canary Wharf, London, with an estimated elasticity of 1.03. This estimate is not significantly different from 1 and likely reflects the extremely large number of daily commuters working in financial services. There are 52 MSOAs with negative estimated elasticities. This will reflect rare cases where working from home leads to changes in spending and the working population that go in opposite directions, as would be the case when worker spending in the area is relatively high.

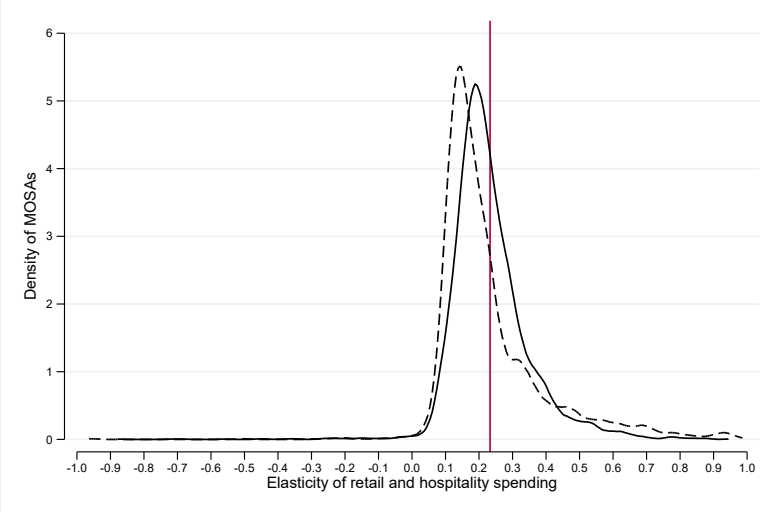
Figure 6:
Cumulative density of LS-elasticity



Notes: This figure plots the empirical cumulative distribution function for MSOA-specific elasticity estimates, ϵ_z as defined in eq. (4).

Figure 7 provides kernel density estimates of the distribution of ϵ_z disaggregated by whether or not there will be an expected increase or decrease in demand. This allows us to understand whether there are systematic differences in the spending plans of those living in areas where expenditure is planned to rise due to RW such as affluent suburbs and those where it is expected to fall such as city centres. Corresponding numerical estimates are provided in table 6. The results suggest that ϵ_z is lower in areas with an anticipated reduction in demand but not substantially with a mean of 0.21 compared to 0.29 in areas with an anticipated increase. Moreover, the two distributions have similar supports. Interestingly, there is more mass in the right-tail of the distribution of ϵ_z in MSOAs seeing a decrease in demand. This might reflect areas in which LS services for commuters are a particularly large share of activity. We discuss this further in section 4.

Figure 7:
Distribution of LS-elasticity



Notes: This figure shows the distribution of elasticity. Elasticity measures the percent change in desired retail and hospitality spending following a 1% change in work done in each MSOA do to working from home. Red line shows the overall mean value, 0.250.

4 Consequences

The change in how much work is done remotely has broader consequences for local economies. We provide evidence of two important effects here. First, these changes will disproportionately benefit already affluent neighbourhoods. Second, these changes have implications for the density of economic activity and the need for office space.

Inequality across neighbourhoods

Information from the Work From Home survey indicates that the largest changes in RW will take place in occupations in which workers have the highest incomes (see Figure A1 in Appendix A). This consistent with the finding of Dingel and Neiman (2020) which shows that higher income occupations are more likkely to be able to remote work.

This pattern in terms of geography in turn will reflect systematic differences in the occupations of those living in neighbourhoods with greater increases in RW. Figure 1 plots for broad

occupation groups the amount of RW in 2019 and the intended amount in 2022. We can see that that the increase is largest in the Arts, IT, and Professional Services, and Finance. The increase is smallest in Protective Services and Transportation. Moreover, given the nature of the occupations closest to the x-axis we should expect that increases in RW in those occupations will likely be accounted for by those in managerial roles.

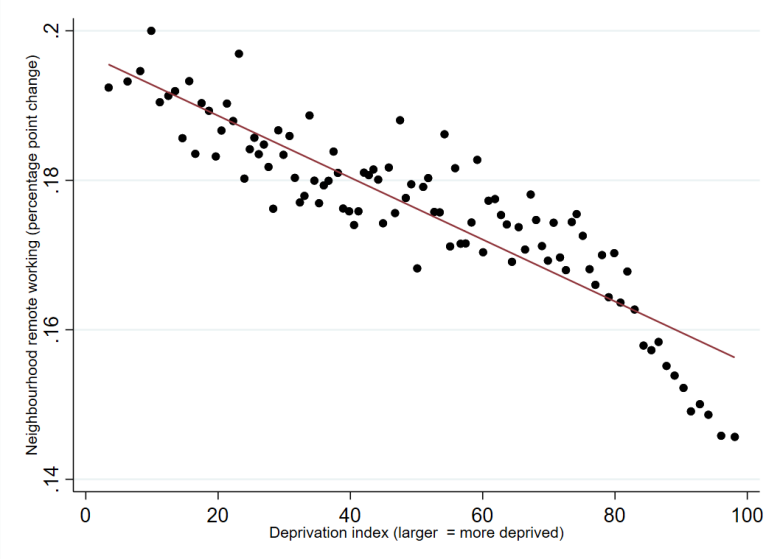
This difference in increased RW is arguably a source of inequality in itself. The concentration of the reductions in the costs, in terms of time and money, on a subset of relatively well-paid occupations perhaps increases differences in effective compensation. Moving from occupations to communities, we can see in fig. 8 that the largest increases in RW are in the most-affluent neighbourhoods. In particular, the binscatter plot makes clear that this negative relationship is most pronounced amongst the most deprived neighbourhoods with a difference in expected increase of nearly 2pp (or 10%) between neighbourhoods at the 80th and 98th percentiles. This might suggest that while the most affluent neighbourhoods expect to benefit from reduced costs of commuting and greater freedom in terms of work location, the least affluent will see much less benefit further exacerbating differences.

Changing employment density

In this section we analyse the potential consequences of RW for the demand for office space. A substantial prior literature has highlighted the role of positive agglomeration externalities associated with the high-density of economic activity found in city centres, and particularly in the centres of the largest cities (Glaeser and Gottlieb, 2009; Duranton and Puga, 2020; Eeckhout et al., 2014; Ahlfeldt et al., 2015).

By changing where work is done, the shift to working from home will impact the density (or agglomeration) of employment. We estimate this change at the MSOA and local authority level decomposing changes into those along the intensive margin (the reallocation of work within an area) and those along the extensive margin (the movement of work outsides an area). Following Glaeser and Kahn (2004) we calculate employment density in a given MSOA as the number of workers per hectare, and employment density in a local authority as the employment share

Figure 8:
Change in work done from home by neighbourhood deprivation



Notes: This binscatter plots the percentage point increase in the percent of work expected done from home in 2022 over 2019 for workers living in each neighbourhood.

weighted average of these MSOA densities.[13]

Looking at Figure 9 we can see the anticipated change in the density of employment between 2019 and 2022 in each London Borough (left-hand panel) and local authority outside of London (right-hand panel). We note that authorities with lower initial employment densities are likely to see an increase (and thus be above the 45° line) while those with high initial densities such as the City of London and Camden, or Birmingham and Manchester, tend to be below. This is to be expected given that workers normally commute from lower-density to higher-density areas. However, the scale of the change is substantial with a predicted reduction of nearly 400 workers per hectare in the City of London. For comparison this reduction is roughly equal to the difference in total employment density between Camden and Cornwall. A number

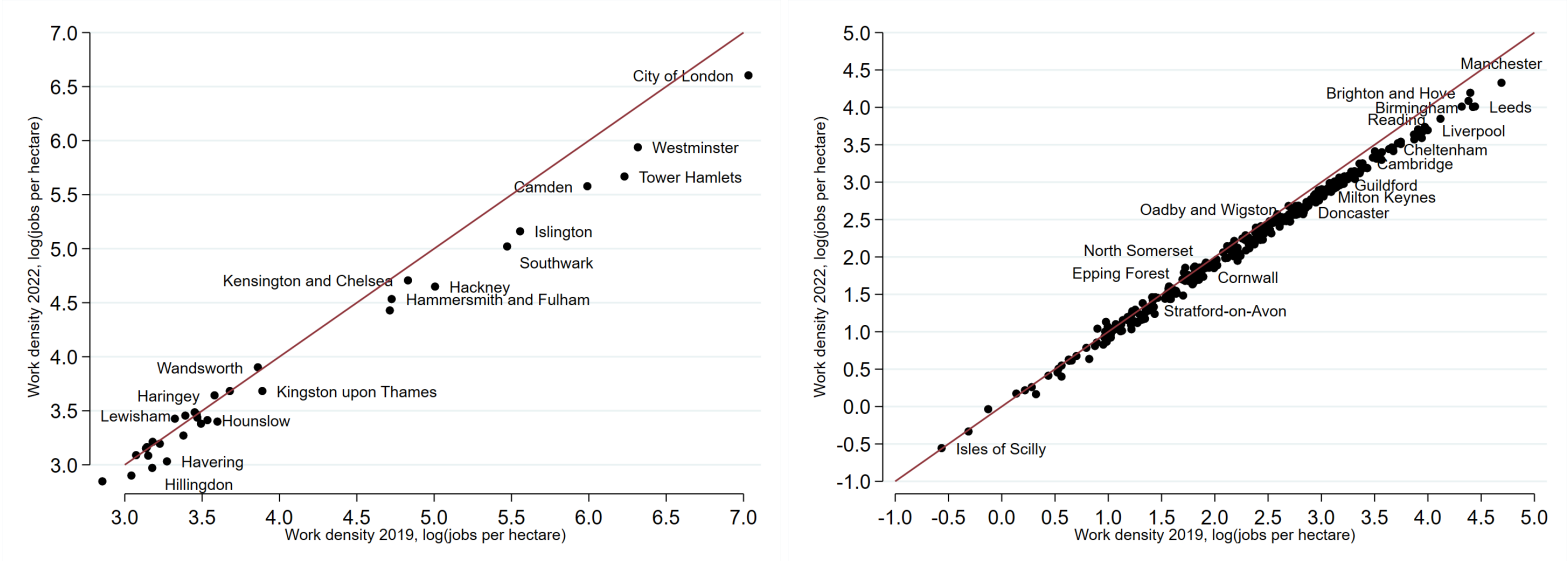
[13]That is as:

$$Den_A = \sum_{z \in A} \left(\frac{E_z}{E_A} \frac{E_z}{Area_z} \right) \tag{5}$$

Where E_z is employment in neighbourhood z, E_A is employment in local authority A and $Area_z$ is the size in hectares of z.

of authorities outside of London will see smaller, but still substantial, declines. This includes Manchester, which will experience a decline of about thirty workers per hectare, or Cardiff, Leicester, and Liverpool which experience reductions of between ten and twenty workers per hectare.

Figure 9:
Change in job density due to working-from-home



Notes: This figure plots, by local authority, the number of workers per hectare (logs) in 2019 against the estimated number of workers per hectare (logs) in 2022. The figure to the left includes only local authorities in Greater London. The figure to the left includes only local authorities outside the Greater London Area.

The shift from working in the office to working at home will potentially lead to a significant reduction in the demand for office space. We can get a sense of this by looking at the change in ratio of workers to commercial space available in each neighbourhood. Figure 10 displays the distribution of commercial space density for England and Wales [14].

Given that most workers anticipate working from home only some of the time to calculate the potential impact of RW on the demand for commercial space, we must make an assumption about how such hybrid working will affect office space demand. This will of course vary from firm to firm, but it is reasonable to expect that firms in which most workers RW three days a week will seek to find efficiency savings on rent, and to a greater extent than those in which workers RW two days a week. For simplicity we assume that the ratio of days worked to the demand for office space will remain constant. Thus, for example, a move to working from home one day a week will lead to a reduction in office space demand of 20%. This is clearly a strong assumption but a necessary one given we are not aware of any suitable data. [15]

Comparing the post-pandemic distribution plotted with the dashed line in fig. 10 with the pre-pandemic distribution plotted as the solid line makes clear that the decline in office space will be largest in those neighbourhoods where density is highest. This is as expected since such neighbourhoods tend to be in city centres and office-parks where teleworkable occupations are most common.

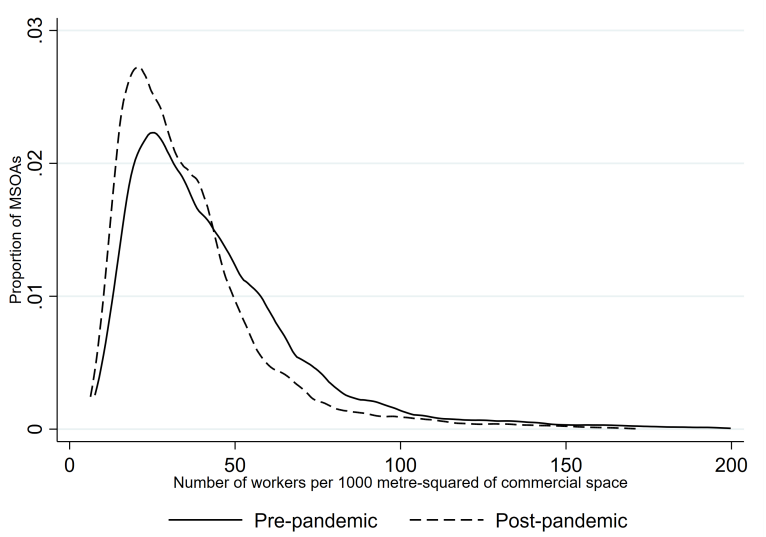
Alternative evidence of the disproportionate impact of RW on those areas where density is highest is provided in fig. 11. This binscatter plot illustrates the relationship between the rateable value (and thus tax-rate) of floorspace and the percentage of work that is expected to be done from home. Notably, there is a clear jump in the percentage of work expected to be done from home in the 2% of areas where rents are highest.

One implication then is that there maybe a consequent surplus of available office space in

[14] We include in this figure only neighbourhoods in which the density is less than 200 workers per $100m^2$ of commercial space (pre-pandemic). This captures 90% of neighbourhoods in England and Wales, and 93% of employment. The neighbourhoods excluded are largely those with very little commercial space, such as farming communities.

[15] It may be that this assumption will lead us to overstate the potential reduction in the demand for commercial space. For example, when a business executive does 20% more work from home, it is unlikely that they require 20% less office space. On the other hand competitive forces are likely to prevent firms maintaining large but empty offices for very long.

Figure 10:
Commercial floorspace density, 2019 and 2022



Notes: This figure displays kernel density plots of the distribution of the number of workers per $1000m^2$ of commercial building space. The solid like shows the distribution before the pandemic, the dashed line shows the distribution post pandemic. Estimates are weighted by the availability of commercial space in each neighbourhood.

city centres, etc. This is important to note as on one hand it suggests that RW may reduce the importance of agglomeration externalities that have driven the concentration of economic activity in cities (Glaeser and Gottlieb, 2009; Duranton and Puga, 2020). On the other hand, the reduction in the space a firm of a given size needs may mean that agglomeration in fact increases further as more firms are able to locate close to each other. Thus, as firms are able to undertake only some of their activities in the office the impetus to locate in city centres close to others is strengthened.

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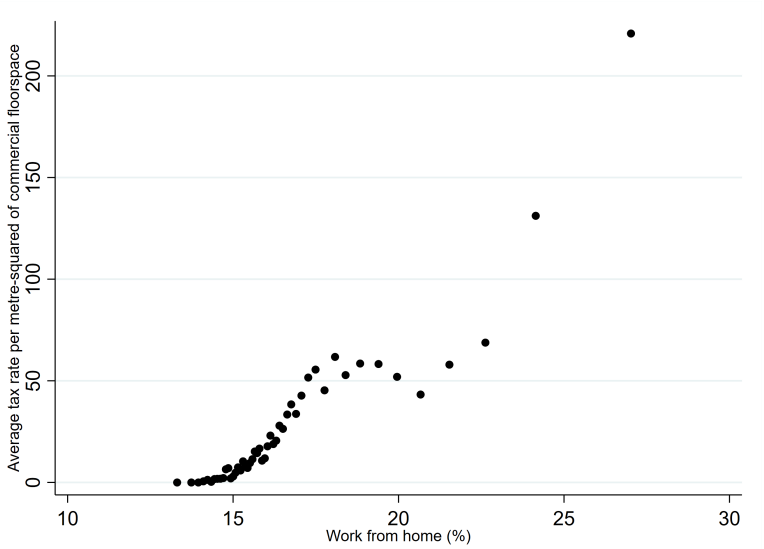
Figure 11:
Tax rate of floorspace and working-from-home



Notes: This binscatter plots working from home rates for jobs done in each MSOA (50 bins) against the average tax rate (£s) per meter-squared of commercial floorspace. Tax rate reflects the average non-domestic rate as reported by the Valuation Office Agency.

5 Conclusions

Our data suggest that, the unprecedented shift in how much work is done from home versus the office during the Covid-19 pandemic will, in part, persist beyond it. We find that remote working will increase 20 percentage points over pre-pandemic levels across all jobs. This means that in future approximately 30% of all work will be done remotely. One consequence of this change will be a shift in where retail and hospitality services are demanded due to reductions in commuting.

This will result in a shift of £3.0 billion in annual spending (1.5% of the total) for LS. These changes have the potential to exacerbate existing inequalities. Largely from city centres to residential neighbourhoods. Firstly, the shift in where work is done implies that approximately 77,000 jobs in retail and hospitality will need to relocate to affluent residential neighbourhoods

or be lost altogether. Secondly, jobs that cannot be done from home including LS jobs are disproportionately concentrated in the most deprived neighbourhoods. Amongst these neighbourhoods it is those in large cities with a high number of residents in LS roles in city-centres that stand to lose the most. Thus, the consequences of of increased RW are uneven.

Thus, given both the scale and concentration of LS job losses one implication is that policymakers should seek to ensure that those jobs can be replaced with new jobs in suburban areas. This will require both improved and reorganised transport links. For example, in many cities bus routes tend to go from the periphery in and vice-versa. Perhaps, there may now be increased demand for routes that connect neighbourhoods with high rates of RW with those where many LS workers live. However, making it possible for LS workers to commute to such neighbourhoods is by itself insufficient. It may be that there are insufficient extant premises to allow firms to meet the increased demand. Local authorities may wish to consider how additional floor-space can be made available. Perhaps, for example, via an accelerated change of use process for business premises.

Policymakers responsible for city-centres will face a similar challenge. Our results suggest not only substantial declines in the demand for LS services and associated job losses, but also a related, and similarly substantial, decline in the demand for office-space. The precise extent of this decline will depend on how firms adapt their use of space given increased RW, but it is clear that it will be substantial. On one hand, this may represent an opportunity to increase the effective density of economic activity and thus agglomeration externalities. On the other, the ability to RW or indeed work from anywhere may reduce these externalities exerting a centripetal force on the demand for office space. Regardless, the substantial reductions in aggregate office-space demand we estimate imply a surplus of space that may need to be re-purposed.

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A Data

In this appendix we provide additional details on the data used in our analysis as well as some additional summary statistics.

Assignment of occupation

The Work From Home Survey asks respondents to choose from a list of 25 occupational categories plus "other", the occupation which best describes their job. Approximately 15% of survey respondents choose the "other" category and entered in a description of their job. In these cases we used our judgement to allocate their written response to the most appropriate occupation category.

To match survey occupations to UK Standard Occupation Classification codes we assign three digit, and four digit, SOC codes to each of the 25 occupation categories.

Pre-pandemic (2019) working from home

The survey does not directly ask how much work was done from home before the pandemic. Instead, we use information form two questions:

> *Q9: In 2019 (before COVID) approximately how many hours a week did you work when employed?*
>
> *Q57: Prior to the Covid-19 pandemic, how many full days were you commuting to work?*

Assuming an eight-hour work day, the number of days worked from home is calculated as

$$WFH_{i,o,z}^{2019} = \frac{\frac{Q9_{i,o,z}}{8} - Q57}{5} \tag{A1}$$

We then use these individual values to take the mean by occupation and location:

$$WFH_{o,z}^{2019} = \frac{1}{n_{o,z}} \Sigma_i WFH_{i,o,z}^{2019} \tag{A2}$$

where $n_{o,z}$ is the number of survey respondents in occupation o and area z.

Work and residential populations

The count of residents and workers by occupation and location, $E^R_{o,z}$ and $E^W_{o,z}$, comes from the 2011 national census, published by Office for National Statistics. These data provide, for every MSOA, a count of the number of employees working in the MSOA by three-digit SOC code, and a count of the number of employees living in the MSOA by four-digit SOC code. All data can be downloaded from Office for National Statistics NOMIS website.

Neighbourhood retail and hospitality output

For Equation (3), we calculate the total spending on retail and hospitality for each MSOA as the total number of workers in the area multiplied by the average output per worker in each of the nine ITL1 regions, plus Wales. Data for output per worker is downloaded from the Office for National Statistics website.

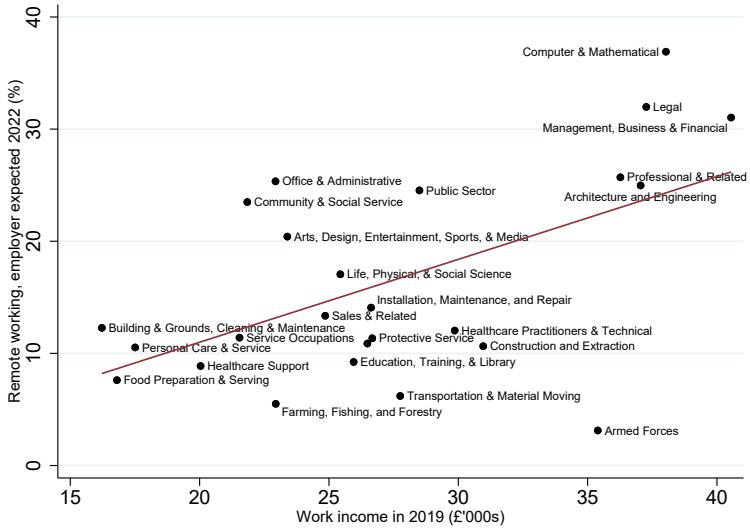
How the shift from working in the office to working from home will impact coffee shops, retail and other locally consumed services depends on the importance of spending by workers as opposed to other sources. For example, the City of Westminster and the City of London look similar in terms of the number of workers, but due to its considerable attraction to tourists, Westminster spending overall is much less dependent on the local workforce than the City of London. Therefore, a 20% decrease in office workers will have different implications in Westminster than it will in City of London.

More broadly, the extent to which LS are consumed by commuters versus residents varies across MSOA not just due to the number and type of commuters and the number and type of residents but also idiosyncratic factors such as tourism, transport links, etc. In fig. A2, we show the distribution of spending shares across MSOAs. We can see that in most MSOAs commuters account for 15–40% of LS expenditure.

Business rates and floorspace

Business rates and commerical floorspace data are reported by the Valuation Office Agency. All analysis reported in the main paper reflects 2019 values.

Figure A1:
Change in working from home and income



Notes: This figures show a scatter plot of increase in RW rates by occupation against income earned in 2019. All values are estimated from the Work From Home Survey.

Table A1: Working from home, 2022 over 2019, by occupation and region

Occupation	Smaller LAs	Large LAs	Central London	Outer London	*p-value*
Construction and extraction	12.16	6.19	7.59	7.23†	0.69
	(2.56)	(5.62)	(3.43)	(3.09)	
Farming, fishing, and forestry	6.38	-5.36			0.35
	(3.51)	(7.37)			
Management, business and financial	26.83	40.65	39.70	39.25	0.00
	(1.03)	(1.88)	(2.07)	(3.30)	
Office and administrative support	22.68	34.35	33.35	32.78	0.00
	(0.89)	(1.69)	(2.23)	(3.67)	
Production	10.78	5.22	33.58	31.13	0.04
	(1.63)	(3.68)	(8.47)	(11.72)	
Professional and related	20.96	39.16	36.94	34.34	0.00
	(1.40)	(2.88)	(2.51)	(5.00)	
Sales and related	13.09	12.50	17.00	20.10	0.59
	(1.12)	(2.40)	(3.43)	(5.16)	
Service	9.78	19.98	8.20	18.59	0.05
	(1.52)	(3.50)	(5.52)	(7.31)	
Transportation and material moving	5.67	10.49	9.12	0.81	0.59
	(1.36)	(3.27)	(12.30)	(1.02)	
Education	8.22	13.98	13.01	17.21	0.02
	(0.77)	(1.90)	(2.90)	(6.80)	
Public sector	22.46	31.33	34.45	22.65	0.00
	(1.22)	(1.97)	(3.51)	(4.38)	
Computer and mathematical	37.10	40.84	28.55	36.93	0.19
	(1.77)	(3.07)	(3.55)	(4.54)	
Architecture and engineering	22.59	40.69	26.95	32.87†	0.08
	(2.62)	(5.84)	(14.13)	(10.09)	
Physical and social science	19.38	14.39	36.47	6.64†	0.10
	(4.15)	(6.36)	(12.85)	(10.69)	
Community and social service	21.50	32.05	39.58	29.18†	0.22
	(2.82)	(6.52)	(7.00)	(8.39)	

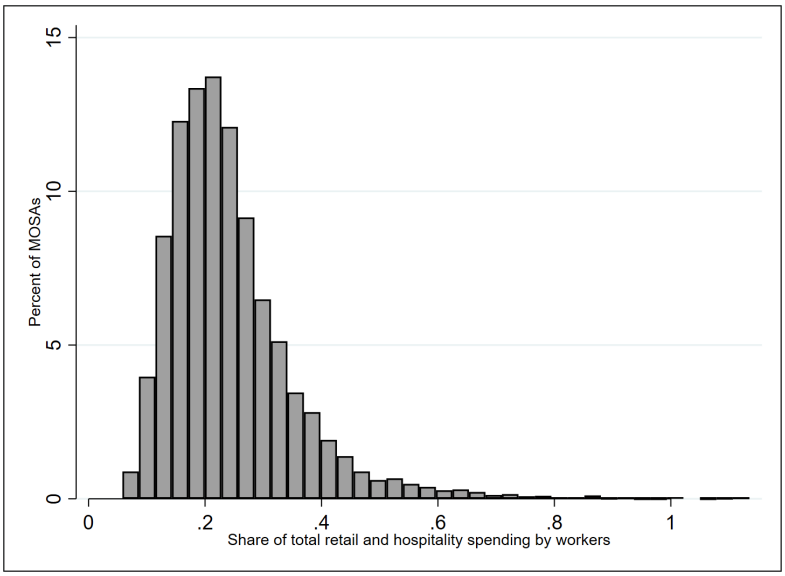
continued...

Table A1 continued...

Occupation	Smaller LAs	Large LAs	Central London	Outer London	*p-value*
Legal	26.48	42.30	31.71	37.54	0.04
	(3.21)	(4.92)	(5.53)	(9.06)	
Arts, design, entertainment, sports, and	16.72	24.56	31.80	53.25	0.00
	(1.95)	(3.59)	(4.04)	(6.82)	
Healthcare practitioner and technical	13.34	4.63	23.42	3.59	0.00
	(1.29)	(2.18)	(3.77)	(10.68)	
Healthcare support	8.17	10.98	22.60	9.91	0.28
	(1.42)	(3.27)	(6.05)	(14.40)	
Protective service	12.36	6.44	5.94†	5.94†	0.85
	(4.09)	(5.58)	(6.36)	(6.36)	
Food preparation and serving	8.51	2.28	3.58	3.42†	0.54
	(1.69)	(1.36)	(3.61)	(3.37)	
Cleaning and maintenance of buildings and grounds	14.87	0.00	2.21	2.21†	0.16
	(3.48)	(0.00)	(2.80)	(2.80)	
Personal care and service	11.14	2.60	4.43	3.62†	0.89
	(2.92)	(9.35)	(4.15)	(3.44)	
Installation, maintenance and repair	15.87	7.51	0.00	2.94†	0.61
	(3.60)	(6.50)	(0.00)	(2.68)	
Correlation with telework index⋆	0.75	0.78	0.58	0.59	
R^2 of telework index	0.56	0.61	0.34	0.35	

Notes: This table reports working from home rates by occupation and location of job (in 2019). *Smaller LAs* refers to all local authorities outside the Greater London area which are not in the top 15 cities by population size. *Large LA* reflects the top 15 largest local authorities by 2019 population size. Mean standard errors are reported in parenthesis. Column labelled *p-value* reports the p-value corresponding to a test of the hypothesis that work from home rates are the same across areas.
†Cells for which $n < 5$ have been replaced with averages for Greater London.
⋆Occupation telework index as calculated in Dingel and Neiman (2020)

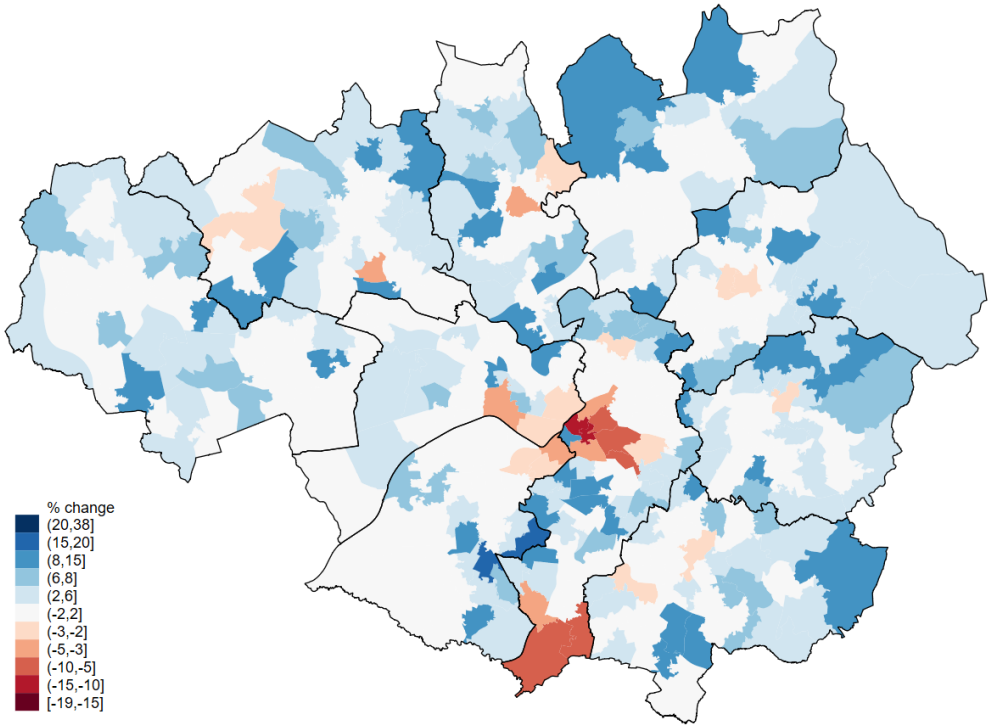
Figure A2:
Share of total retail and hospitality spending due to workers at work



Notes: This histogram shows the distribution of neighbourhoods according to the share of total spending that is attributable to workers working in the MSOA.

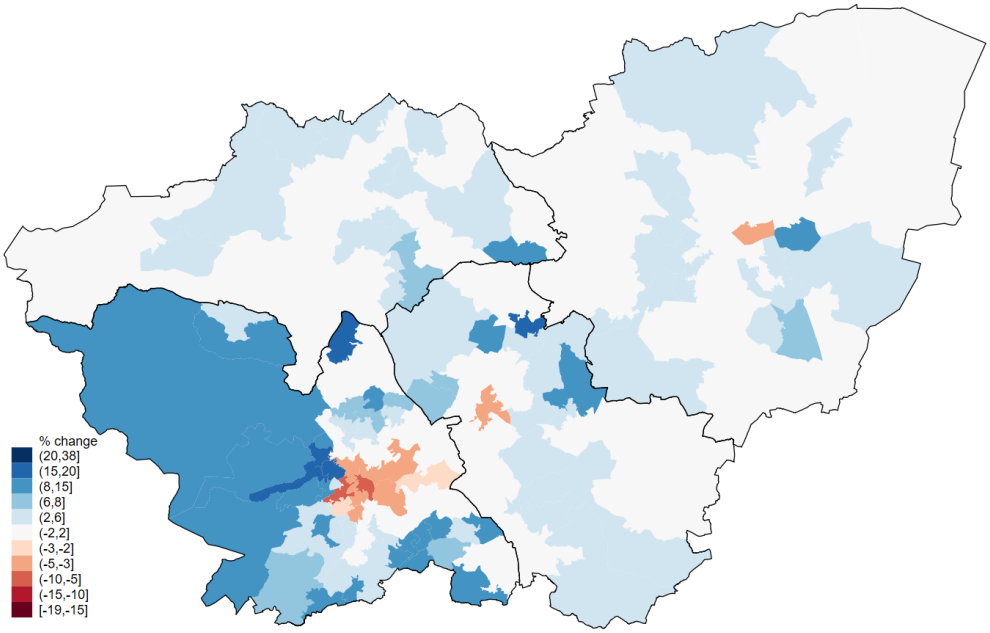
B Additional Figures

Figure B1:
Change retail and hospitality spending, Greater Manchester



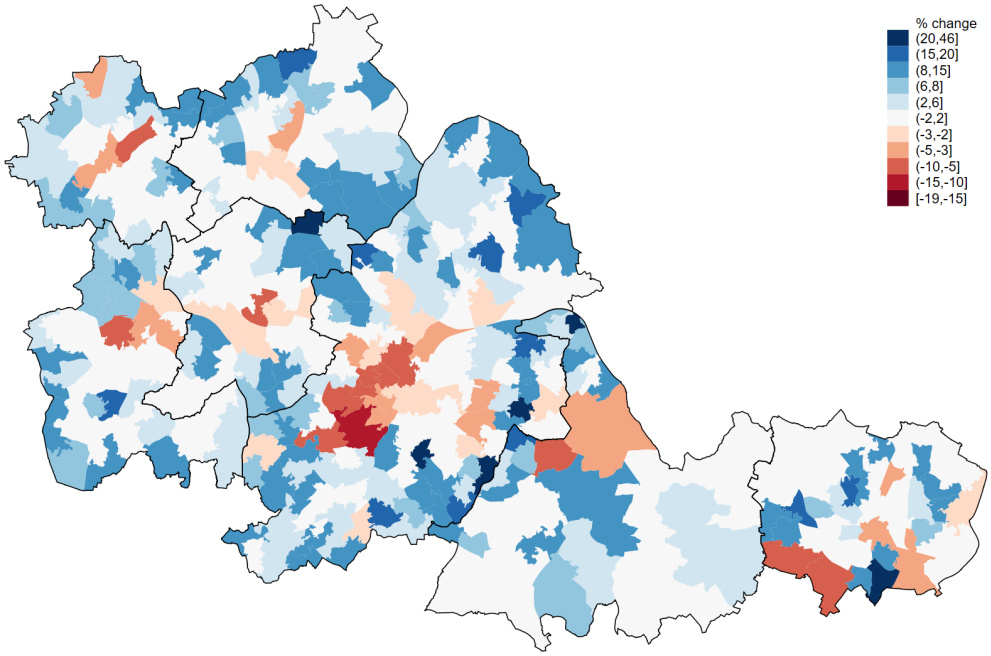
Note: This figure shows the percentage change in demand for retail and hospitality spending for each MSOA within the Greater Manchester Area. Boarders denote local authorities.

Figure B2:
Change retail and hospitality spending, South Yorkshire



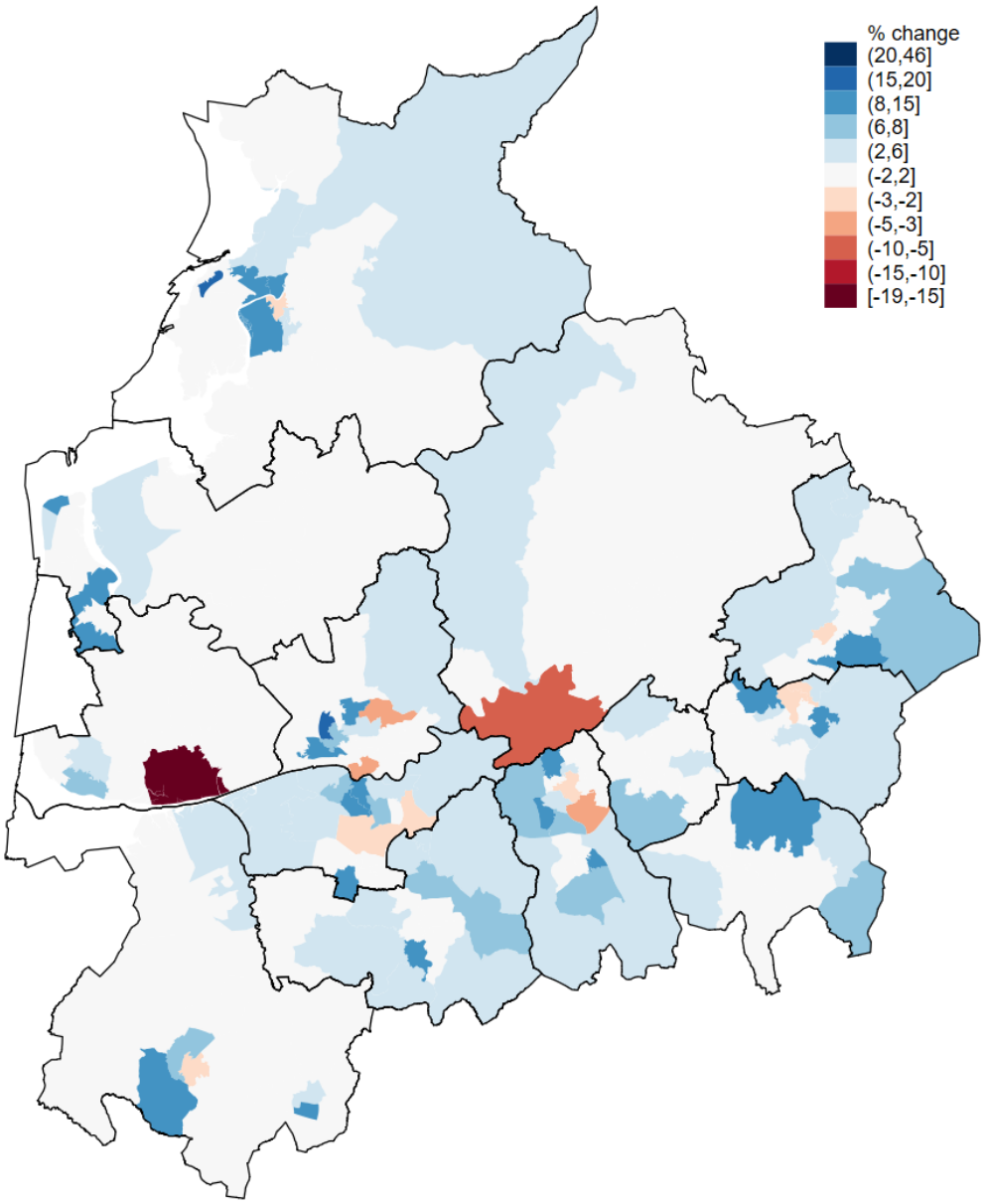
Note: This figure shows the percentage change in demand for retail and hospitality spending for each MSOA within the South Yorkshire area. Boarders denote local authorities.

Figure B3:
Change retail and hospitality spending, West Midlands



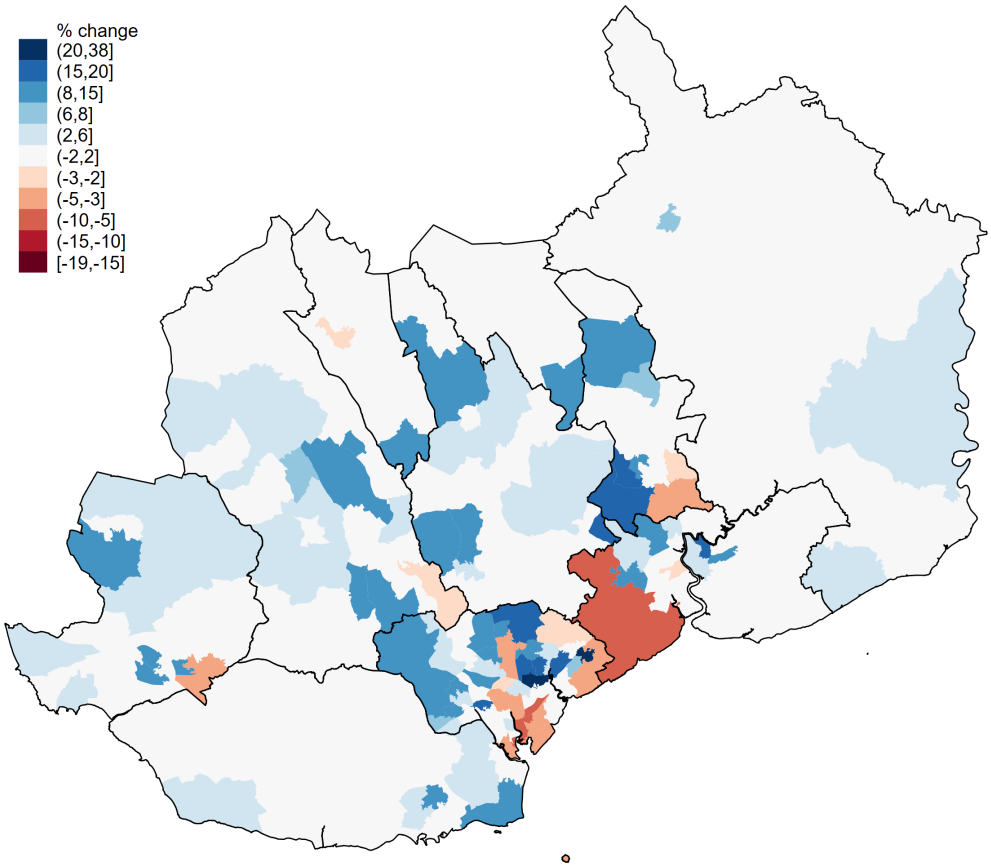
Note: This figure shows the percentage change in demand for retail and hospitality spending for each MSOA within the West Midlands area. Boarders denote local authorities.

Figure B4:
Change retail and hospitality spending, West Lancashire



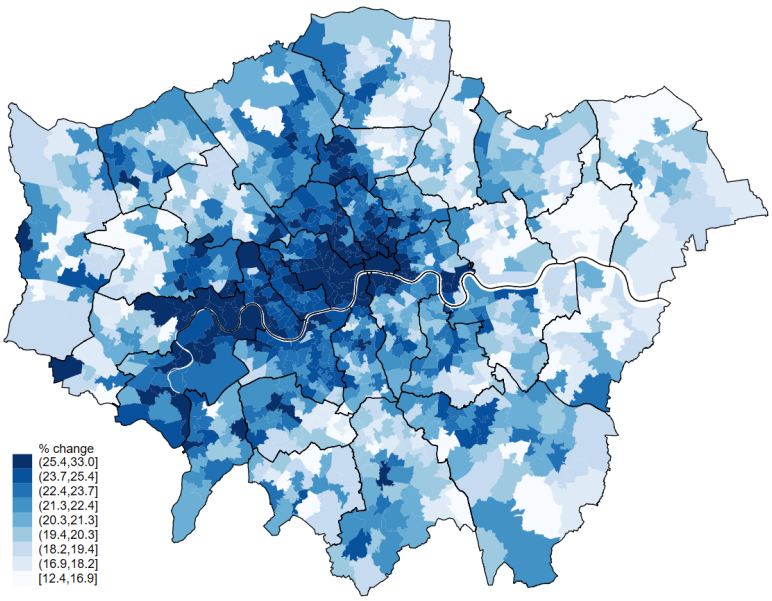
Note: This figure shows the percentage change in demand for retail and hospitality spending for each MSOA within the West Lancashire area. Boarders denote local authorities.

Figure B5:
Change retail and hospitality spending, Cardiff Capital Region



Note: This figure shows the percentage change in demand for retail and hospitality spending for each MSOA within the Cardiff Capital Region. Boarders denote local authorities.

Figure B6:
Change in work done from home, Greater London Authority



Note: This figure shows the change in working from home in 2022 over 2019, for workers working in each MSOA, as a percent of total employment in the MSOA. Boarders denote local authorities.