Towards Estimating the Carbon Footprint of Retail: Do English Planning Policies Make Shops More Accessible?

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Abstract:

Town Centre First Policies (TCFP) were introduced in England with real rigour in 1996. They restricted new retail development to traditional 'town centres' with the declared aim of making cities more 'sustainable' and retaining access to shops to those without cars. TCFP were introduced without evidence to support these claims and to date have not been subject to any rigorous analysis of their actual impacts on travel patterns for shopping. This paper provides the first clear evidence of their impact on travel for shopping trips. We use novel data on local shopping travel for 1998 and 2008 and use a difference-in-difference approach to exploit the fact that shoppers in England were affected differentially by TCFP depending on their precise location within a city. We consider consumers as treated more strongly if their potential shopping area contains a larger share of post-1997 stores and if they reside closer to the centre of town. Using these sources of geographical variation we examine the effect of TCFP on consumers' travel costs. Our results indicate that TCFP increased average distance and travel time, so made cities less rather than more 'sustainable'. The estimated effects are economically meaningful: doubling the treatment increases average travel times 25%, 46% of a standard deviation of average travel times.

Keywords: Retail Sector, Planning, Great Britain

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1. *Introduction*

According to the OECD, by 2050, 70% of the world's population – and 86% in OECD countries – will live in urban areas. This rapid urbanisation (and suburbanisation) process, combined with threats of global warming, high energy prices and tight government budgets make a convincing argument for better city planning' (OECD, 2012). In particular, to many observers the continuing growth of urban populations calls for a policy response that optimises land resources.

Cities contribute an estimated 70% of the world's energy-related greenhouse gases (GHG) (The World Bank, 2012)[2]. In the last few years we have witnessed a growing literature discussing the potential contribution of cities and their built form to solving environmental problems and reducing GHG emissions. In British planning thinking, and increasingly elsewhere, the idea of 'sustainable' cities has gained great attraction. Such sustainable cities are usually equated with 'compact' cities. Urban economists have contributed to the debate on cities and urban growth in the context of Green Cities (for example Kahn, 2006). Compact cities (defined as cities that are dense, well linked by transport and with high accessibility to services and jobs) have been said to be the way to reduce the carbon footprint of urban settlements (Glaeser, 2011, OECD, 2012) and 'carbon footprint' has been suggested as an adequate measure to capture the emissions of cities (Wright *et al*, 2011)[3].

Most of the recommendations to tackle carbon-emissions in cities have focused on improving the efficiency of transport systems (low-carbon vehicles), reducing household and industry emissions, improving the efficiency of buildings, promoting consumption of low-carbon goods and reducing resource waste (The World Bank, 2012) or even increasing the density of population (Glaeser, 2011). However, much less attention has been paid to another of the aspects of compact cities: access to and location of local services and jobs. The physical form of and layout of specific activities within the built environment has figured often explicitly, if generally, in current policy analysis (for example in the literature on the 'new urbanism' or the 'sustainable city') but much more frequently it figures in the debates only implicitly. Moreover the 'evidence' called on by advocates of the 'new urbanism' and compact cities has never been rigorously empirical: rather arguments for the sustainability of compact cities tend to be asserted on the basis of 'common sense' or call as evidence very simple aggregative correlations such as Newman and Kenworthy (1989).

The interactions between the built environment (urban form), technological possibilities (information and communication technology, infrastructure, transport costs) and socio-economic factors (demographic changes, consumption patterns, economic spatial disparities) are almost certainly highly complex and require detailed investigation before we can hope to understand their effects on emissions associated with the retail sector (and other urban activities); or devise policies resting on modifying the form of the built environment that might hope effectively to reduce emissions. These emissions include not only GHG but also other toxins that could have significant effects on air pollution and population health outcomes.

This paper aims to provide evidence on these effects by investigating the impact that a specific British – specifically English - planning policy has had on the *length* and *duration* of shopping patterns. In particular we analyse the impacts of Town Centre First policies introduced in their full rigour in 1996. This planning policy directly affected urban form by regulating the location and size of shops. For a given location of households, Town Centre First policies (TCFP) had a direct impact on their 'choice set of shops' (accessibility to shops) and thus might have affected the length and frequency of their shopping trips.

[2] However, the contribution of cities to global GDP exceeds 70% so in proportion terms the contribution of cities to total emissions/GDP is not that large.

[3] Although other emissions such as particulates may have detrimental effects on health and, like GHG, are likely to be externalities.

We use novel data on a commercial survey of shopping patterns (the National Survey of Local Shopping Patterns – NSLSP – provided by CBRE) to calculate average and total travel costs incurred by household when travelling to buy grocery goods. We aggregate the measures at the smallest geographical unit available, the postal sector[4]. We have data for two years, 1998 and 2008. Even if the policies were introduced in 1996, we can consider 1998 as pre-policy given that – as discussed in section 5.5 – retailers reacted to the policy with some time lag. Because TCFP were only introduced in England, in a first step we use data on shopping trips and destinations for England compared to Scotland to assess the impact the policy had on the accessibility of shop locations[5]. On a second step, we compare the extent to which small English areas (postal sectors) where affected by the policy to estimate the impact of the policy.

Even if we do not find that travel costs in England reacted differently to the introduction of the policy than those in Scotland, we find evidence that TCFP increased shopping travel costs (distances and time) in areas that were treated to a larger extent. Other things equal, increased travelling for shopping as a result of planning policy would result in an increased carbon footprint for the retail sector.

The rest of the paper is organised as follows. In Section 2 we describe Town Centre First Policies and discussed the related literature. In Section 3 we describe the aim of this research and the specific research questions of this paper. In Section 4 we explain the construction of the shopping travel costs. In section 5 we describe the construction of the treatment and control variables. In sections 6 we describe the empirical strategy and in section 7 we discuss the results. Finally, section 7 concludes.

2. *Town Centre First Policies and related literature*

The British system of land use planning has explicitly aimed to 'contain' urban areas since 1947 (Cheshire et al, 2012a). It imposes direct restrictions on the supply of land for each, legally defined, category of use. This increases the cost of space in all categories of development: notably residential, commercial, wholesale, industrial and retail. Obviously the greater is demand for land for a particular use in a particular location, the greater will be the price this fiat-determined supply of land commands. Over the past 20 years a literature has developed analysing the economic effects of these restrictions. Most of this work has related to the residential sector (Cheshire and Sheppard, 2002; Ball, 2011; Hilber and Vermeulen, 2012) but more recently studies have begun to analyse the costs in other sectors.

There are significant differences, both in the form and the timing of the application, between the planning policies affecting the retail sector in the different countries of the United Kingdom (see Cheshire *et al* 2012a for more details). In particular, in this paper we focus on the differences between England and Scotland[6]. The policy for retail development in England is very restrictive. As noted above there has been containment since 1947 when the Town and Country Planning Act was introduced. This has set the basis for land use planning in the UK ever since. From the 1960s the construction of the motorway (highway) system, growth of car ownership and use and the associated residential decentralisation, created strong forces favouring the

[4] Postal sector areas are derived from postcodes. British postcodes define very small geographies and generally correspond to a few residential blocks. On average they contain 16 addresses. Postal sectors are obtained by "removing" the last two letters of the postcodes. At the end of 2008 there were 10769 postal sectors in Great Britain, with contained an average of 158 postcodes, their average area was 21 square kilometres and had an average of 2410 residential addresses. Of these, 9062 were in England, 1112 in Scotland and 595 in Wales. Postal sector boundaries and codes change over time due to postcode changes and updates, and for these reason, we lose a small number of units when constructing a common sample of areas for 1998 and 2008.

[5] The final aim of this project is to estimate the impact that TCFP had on the carbon footprint of the retail sector. Due to data limitations, our first step is to estimate if this policy increased 'shopping travel costs' in the areas in which it was more rigorously implemented. Assuming that longer trips imply more emissions, this is a first approximation to the 'environmental' impact of the policy. In later stages we will analyse the impact on energy use in stores and in the retail logistics chain.

[6] Wales has generally followed England with respect to policy.

development of out-of-town, large format supermarkets and shopping centres. These forces were reinforced by the replacement of rail by large lorries (trucks) for long distance haulage giving a strong competitive advantage to our-of-town large format retail. Policy makers responded specifically to restrict such developments in England from 1988. Retail planning policy changed in that year to introduce controls on 'out-of-town': such development would only be permitted to regenerate brownfield sites ('regeneration sites'). After a slight relaxation of policy in 1993, it really tightened in 1996 with 'Town Centre First Policy' (TCFP). This policy dropped the aim of supporting a 'competitive retail sector' and introduced the 'Needs' & 'Sequential' tests.

The *Needs* test required the developer to demonstrate, according to prescribed formulae, that the local community 'needs' more shopping space and that their proposed development would not undermine the viability of other local shopping facilities. It can be argued this erected a barrier to entry into local markets. The *Sequential* test was designed to rule out all 'suitable' sites closer to town centres before allowing an out-of-town site even to be considered for retail development. It required the developer to show that 'suitable' sites nearer the 'town centres' were not available before permission might be granted to develop an edge-of or out-of town site. A site was only defined as 'suitable' if it was identified for retail use in the local plan (*legally* available), not available *de-facto* for the developer (for example, an in-town location owned by a competitor but not developed, would still be considered 'suitable').

Scotland had no specific policy regulating the location and size of retail sites until 1996. In 1996 Scotland introduced some regulation where town centres became 'preferred' locations, but no needs or sequential tests were introduced to enforce this and the policy still aimed to support a competitive retail sector. Scottish policy tightened somewhat in 1998 and firmly tightened more firmly in 2006 to include a form of sequential test (but continued to support a competitive retail sector). In this paper we exploit this difference in 'restrictiveness' and timing of the policy in the two countries. We need to clarify that both countries were 'treated' by restrictive retail planning policies but to a different extent. In that sense, we are not comparing treated versus non-treated but very rigorously and clearly treated from a given date (England) to treated gradually and more moderately at different points in time (Scotland).

Previous work has shown that planning policies have had major impacts on costs of space for economic sectors, for example office space (Cheshire & Hilber, 2008). In the retail sector, there exist a few papers which have evaluated the impact of British planning regulations - especially TCFP - on different outcomes. They find that more restrictive planning have had negative impacts on employment in independent retailers (Sadun, 2008), on multi-store TFP -by decreasing store sizes (Haskel and Sadun, 2011), and they also imposed reductions in the number of big stores in equilibrium (Griffith and Harmgart, 2012). Cheshire, Hilber and co-authors provide further evidence using store level micro-data for a specific supermarket chain (2012a) and a specific clothes retailer (2012b). Their most recent estimated impact on retail output loss in a representative grocery supermarket is 32% from combination of tightening of policy in England from 1988 and Town Centre First Policies (TCFP) in 1996. In a nutshell, empirical evidence is supportive of the fact that planning policies have had substantial economic costs.

Town Centre First policies (TCFP) were introduced in England on the basis that they would increase the sustainability of cities (ODPM, 2004). These policies have shaped the location and the size of the retail estate in England since their introduction in 1996. The reasons why they were expected to increase the sustainability of cities were that they would lead to environmental and distributional gains. This was based on the premise that town centres are the most accessible location for alternative (non-car) means of transport and so, because of 'linked trips', forcing retail (and other 'traditional town centre uses') to locate in town centres would reduce the need to travel. This was expected to reduce the carbon footprint of the retail sector and

help make the distribution of real incomes fairer since access to shops would be preserved for households without cars.

This is not, however, necessarily the case. Households have continued both to decentralise from central cities and continue to use cars for shopping trips (according to the National Travel Survey, around 60% of shopping trips are done by car, while public transport and walk/bike modes each account for around 20%). While there may have been some substitution of public transport for cars, still shopping trips may have become longer and are likely to have become more frequent (stores are smaller; shoppers have to carry their shopping) and more concentrated in congested areas.

3. Aim and research questions

The aim of this paper is to begin to provide evidence of a rigorous kind on the impact of built form on travel and specifically to provide evidence on the alleged benefits of TCFP, e.g. its environmental 'sustainability'. In particular we evaluate if TCFP made shopping more 'accessible' to consumers, and thus shopping for travel more sustainable. Travel 'costs' for shopping (measured as time spent travelling to shops times the number of shopping trips in a given period of time) might have increased as a result of the policy. If a more stringent planning policy forces consumers to travel further to access more convenient stores (bigger, more easily accessed by car and with a larger range of products), this ultimately might result in increased travel-related carbon emissions.

TCFP may also, of course, affect the total carbon footprint of the retail sector via other channels (logistic trips, energy use of the stores) but in this paper we focus only on its effect on shopping trips. By restricting their size and forcing stores to central locations, TCFP could have achieved some substitution towards public transport but it could have also lengthened shopping trips as population decentralised or simply sought to continue to use their cars to go shopping for groceries. Additionally, it could have increased the frequency of shopping trips because of more frequent shopping trips because town-centre stores tend to be smaller or because travelling by public transport and/or foot forces shoppers to carry their purchases so they buy smaller quantities. Even for equally long and frequency trips, it could have negatively affected emissions if shopping trips became concentrated in more congested locations.

As a first step to evaluate the environmental impact of this policy, in this paper we use data on grocery shopping destinations for consumers in England and Scotland in 1998 and 2008. The dataset contains information about the origin of the shopping trips (postal sector) and the destination (grocery store). We aggregated the destination information to postal sector aggregated travel distance and travel time measures. We combine this data with three measures of "being treated" by the policy and assess if TCFP increased or decreased shopping travel costs.

4. Measuring shopping travel costs

4.1. Shopping travel behaviour in Great Britain – some facts

A first step to assess the impact TCFP might have had on access to shops is to explore the changes over time on shopping trip frequency, average travel time spent travelling to shops and the modal choice distribution for shopping trips[7]. To explore this we use information from National Travel Survey (NTS) for the periods 1995-

[7] A comprehensive evaluation of the impact of the policy on travel costs would account for the fact that, by changing the supply and location of stores, not only choice of shop (which affects distance and travel time) but also trip frequency can be affected. Moreover, the policy aimed to affect the transportation mode use for shopping trips towards more sustainable (public) transport. Given NTS data

2002 and 2003-2010. The NTS is produced by NatCen for the Department for Transport (DfT). It follows households for a week during which all the members of the household fill in a 7-day journal with information on all trips undertaken during that period (it is available since 1985). The annual survey samples are small (between 16,000 and 20,000 individuals per year for the whole of Great Britain), so when calculating sub-national area values the survey needs to be appropriately weighted and to have a sufficiently large number of observations and we need to pool several years together. The survey asks a large number of travel behaviour related questions, which allows us to obtain information on the number of trips, average distance traveled and average duration of the trips by purpose, mode and residence of the respondents for different areas.

[FIGURE 1]

Figure 1 provides some descriptive statistics on these variables since 1995, for total shopping and food shopping (only available from 1998). We compare the evolution of the variables from England (in black) and Scotland (in grey), for total shopping (solid lines) and food shopping (dotted lines). In panels 1.A and 1.B we see that the average number of shopping trips per person per year decreased very similarly in both countries, while average duration per trip increased. In order to be able to produce reliable estimates we use three-year moving-averages starting from 1995 to 97, then 1996 to 98 etc[8].

In panel 1.C, when we examine the evolution of annual hours spent travelling for shopping over time, (which is equal to the product of number of trips- fig 1.A- and their average duration –fig 1.B-), we see that it slightly decreased over time, mainly due to the fall in number of trips. The trend is almost flat and very similar in both countries, providing a first insight that TCFP did not have any impact in the country in which the policy was stricter (England) as compared to the other country (Scotland).

In panel 1.D we plot the proportion of (total) shopping trips by different travel modes for both countries, calculated as the means over three years at the beginning (1995/97) and the end (2008/2010) of the period. We see that car/motorbike is the most common mode for shopping, and that this proportion has indeed increased over time. Moreover, the proportions are very similar for both countries, and so are the changes in modal choice. This provides some evidence that the policy did not radically change the modal distribution for shopping differently in the country in which the regulation was more stringent.

Even if informative, these figures do not take into account the different spatial distribution of consumers and stores nor other factors that might have changed over time in the countries and influenced modal choice and shopping trips patterns. To be able to evaluate the impact of the policy more rigorously we our main approach uses regression analysis employing a of Difference-in-Difference approach.

4.2. The National Survey of Local Shopping Patterns (NSLSP)

To estimate area level shopping travel costs we use data on shopping destinations from the 'National Survey of Local Shopping Patterns' (NSLSP), which was provided to us by the commercial real estate services firm CBRE. To the best of our knowledge this data has never before been used for academic research. The NSLSP survey was established in 1995, first published 1996, and has been run yearly since 1998. Approximately one million households a year are asked where they do their main shopping for different goods. For grocery shopping, the survey contains information on which specific shop they consider their 'main' destination and where it is

limitations (small samples), we do not have access to time-varying frequency measures disaggregated by geography, so the frequency information can only be used as a motivational descriptive measure. We however plan to work on better measures in the near future.

[8] This is also how the nationally published figures from NTS were presented before 2002; from when the sample sizes of the survey were substantially increased. For internal consistency, we applied the same methodology (3-year moving average) to all the observations in the period..

located[9]. The dataset makes it possible to construct detailed store catchment areas, as the large sample and detailed geography of the origin and destination of the consumers provides rich information on shopping destinations across the entire Great Britain. We have data for grocery shopping destinations for 1998 and 2008.

The dataset available to us is a 'gravity-type' dataset in which, for each store in the survey, we have the list of postal sectors from which it draws consumers and how many consumers are drawn. These are defined as (origin) postal sector - (destination) store pairs. For each pair we also have the number of shoppers from a given origin postal sector that choose that specific destination (obtained as a product of the penetration rate times the postal sector population).

To obtain travel costs between origin and destinations we geo-located all the stores and the centroid of the postal sectors using the National Statistics Postcode Directory (NSPD). Once we had Easting and Northing[10], we calculated bilateral the travel distances and times for all the store-postal sector pairs. We used three measures of travel costs: crow-fly distance (straight distance between coordinates), driving distance and driving travel time. These last two measures were obtained using Bernhard (2013) TRAVELTIME3 Stata command, which obtains information from Google Maps. As we do not know the mode used by consumers to go shopping, we applied driving mode values to all the pairs (in any case, as shown in Figure 1.D, most shopping trips take place by car). Additionally, in the robustness we used major road network optimal travel times based in the data from Gibbons et al (2012). From both the 1998 and 2008 samples, we drop the observations with the 0.5% top crow-fly distances. We are left with 91,175 origin-destination pairs in 1998 and 107,875 pairs in 2008.

4.3. Summary statistics of travel costs

Tables 1 and 2 provide summary statistics for the number of shoppers and the travel cost measures for both samples and the same statistics for England, Wales and Scotland separately. Focusing on driving time, which is the measure we use in the main analysis, the average driving travel time decreased from 14.7 to 13.3 minutes between 1998 and 2008 (-9%). This decrease was larger in Scotland (-13.9%) than in England (-8.2%), and the dispersion of distances also decreased in both countries, but much less in England. These changes are similar for other travel cost measures. Finally, the average number of consumers per pair was 563 in 1998 and 445 in 2008, a decrease of 20%. This is probably due to the fact that the number of destinations increased substantially over time as the number of stores increased.

[TABLE 1] and [TABLE 2]

Figures 2 and 3 present the distribution of times and distances in both years. Both the histograms and the density distribution remained very similar over time. In both years and for all three measures of costs (crow-fly distance, driving distance and driving time) the distribution is very skewed the median is substantially smaller than the average and the distributions have a long thin tail of large values.

[FIGURE 2] and [FIGURE 3]

To run the regression analysis described in sections 6 and 7, we aggregate this information at the postal sector level using the pairs bilateral cost measures (either distance or time) and the number of consumers. We always exclude the top 0.5% extreme values in the calculation of the area values.

[9] Information on household characteristics (exact address, income, household size) and average weekly spent is also provided in the survey, but not yet available to use so not used in this set of results.

[10] Coordinates in the British National Grid system, which measure the meters from a given reference point in the South-West of the British Isles.

We aggregate the costs at the postal level sector in four ways. We summarise the number of pairs and the costs between origin and destination and obtain the average and standard deviation of the travel costs from each postal sector of consumers origin. On the other hand, using the information on the number of shoppers in a given pair, we also calculated the weighted-by-consumer average, which takes into account the changes in destinations but also on the number of consumers that pick a specific destination over time. Finally, we calculated the sum of distances traveled by consumers from a given postal sector. This measure capture the *total* traveled, and should be a better measure if we aim to measure the total costs. Table 3 provides summary statistics for these four measures for the estimations sample (Scotland and England on the top panel, England only on the bottom panel).

[TABLE 3]

For the two periods (1998 and 2008) the weighted-average number of minutes traveled to grocery stores is around 10, slightly lower in England. The non-weighted average is almost 14 minutes. The mean value of weighted average travel time is thus around 4 minutes smaller than the non-weighted mean, which indicates that a larger proportion of consumers choose shorter shopping trips. The standard deviation of both variables is very similar, and large compared to the mean value. Given that the average number of annual food shopping trips for person per year during the period 2003-2010 (based on NTS) was 98.7, the average consumer spent around 16.5 hours in a year traveling to grocery stores.

5. *Data sources and definitions*

5.1. The shopping areas

Travel costs incurred by consumers in a given postal sector would be affected by the extent to which the policy affects shopping opportunities "around" them. The number of shops (units) and how big these are (employment) would impact the shopping choices they make and thus the average and total travel costs. Between the two years of our analysis, 1998 and 2008, consumers would endogenously choses difference shopping destinations as the location and availability of stores change in their shopping area. For this reason, we cannot measure the effect of the treatment for a small area around the consumer or an area artificially limited by administrative boundaries, but we need to construct a meaningful treatment area that takes into account the geographical extent to which the policy affects consumer shopping for travel behaviour.

To do this, we use the information on the distribution of travel distances in 1998 (Table 1) to define "shopping areas" around the postal sector centroid. We constructed buffers at different distance levels and measure the impact of the treatment and the controls within these shopping areas. Figure 3 provides an illustration of the geographical extent of the shopping distance buffers.

[FIGURE 3]

This figure plots, for a specific postal sector close to Cambridge (CB250), the shape of the postal sector, the location of its centroid and the extent of the shopping areas. We created buffers of different radius based on the distribution of crow-fly distances pre-period (1998) displayed in Table 1. The figure shows the extent of the buffers using the average distance (7.95 kms), the 75% percentile distance (10.88 kms), the 90% percentile distance (18.24 kms) and the 95% percentile distance (23.63 kms). For reasons explained below, this figure also shows the location of the closest main railway station and a 10-kilometre buffer around the station.

Each shopping area is postal-sector specific and therefore the different shopping areas overlap as we move over the geography. We calculated the policy variables (explained in the next section) for each postal sector

aggregating the information from the postal sectors included within its shopping area. This way the treatment varies smoothly over space and it is not constrained to specific administrative boundaries. For the main results, we use the 95% percentile buffer (p95) as we believe this captures the observations of those consumers that are willing to travel longer distances for their shopping. In the robustness checks we also use the average, p75 and p90 buffers.

5.3. The definition of the policy treatment

We use three facts to guide the construction of the policy treatment variables. The first one is that the TCFP was implemented in England before than in Scotland and it was stricter. This defines the first approach (section 5.4). The second one is that, in England, different locations were treated to different extents depending on their characteristics. We use this for the definition of the second approach (section 5.5). Locations closer to town centres were more treated as the policy restricted new retail openings to central places. At the same time, the local planning authorities (which in most cases correspond to local districts) implemented the policy at their discretion and, as a result, different shopping areas experienced different changes in grocery shopping "supply" over time. As new grocery stores were built over time in different areas, the share of pre-policy stores (those constructed before TCFP were put into place) change for different locations depending on the extent to which the local planning authorities complied with the policy.

To identify what the policy refers to as "Town Centres" we use the location of the major rail station in England and Scotland (Cheshire et al, 2012a). We used 66 rail stations (58 in England and 8 in Scotland) and calculated the distance from the postal sector centroid to the closest rail station. As shown in Table 3, on average a postal sector is within 18.3 kilometres of a main rail station, and this distance is one kilometre shorter in England. The extent to which a postal sector is treated is defined by the distance to the station. The larger the distance, the less the location is treated.

To compute the changes in grocery stores supply between 1998 and 2008 we used the Annual Business Inquiry (ABI) data from the Office for National Statistics[11]. The ABI is a business survey which collects both employment and financial information for the universe of private-sector businesses in the UK. It is the Census of Production and collects information for all trading business paying VAT/PAYE. We used the workplace analysis series with the new 1997 methodology. We collected data at the postal sector level and aggregated it at the shopping area level by adding the values of postal sectors located within the different distance bands of each postal sector centroid[12]. To identify grocery stores we use observations corresponding to the 52.1.1 sector (SIC 1992 definition "Retail: non-specialised food stores etc"). For robustness, we followed Haskel and Sadun (2011) and used sector 52.1 (" Retail sale in non-specialised stores"). The results using this classification are virtually the same, so we do not report them. We calculate both the number of units (establishments) and employment in the sector. We calculated the values in 1998 and 2008[13].

We also used the ABI data to compute the amount of other retail supply area (sector 52 excluding sector 5211) and the amount of employment or establishments in all sectors (excluding 5211 and other retail) within the shopping area. These variables are used in the regressions as controls. Supply of other retail could affect travel costs as consumers might travel further to non-grocery shops and use that trip to buy groceries. At the same time, the location of other retail directly affects the location of grocery retail, for example when retail parks or

[11] Confidential version accessed via NOMIS, with notice NTC/BRES12-P0320.

[12] In practice this means we constructed a matrix that had the bilateral distance between each postal sector and any other postal sector within 50 kilometres. We added the ABI data and collapse by different distance bands levels the values of the own plus the neighbouring locations within the band.

[13] ABI values are dated in April and refer to the previous financial year, so the 1998 values correspond to the April 1997-April 2008 period.

shopping centres are opened. Establishments or employment in all sectors capture the aggregate level of economic activity in the area.

Table 3 presents descriptive statistics for the establishments and employment variables, for the whole sample and for the only England sample for the p95 shopping area. Within 23.6 kms of any postal sector centroid there is an average of 1150 grocery stores. This might seem as a large number, but these are large areas (1754 square kilometres). On average, the 5211 sector establishments correspond to around 15% of total retail, and 1.8% of total sectors. In terms of employments, it concentrates 35% of all retail and 3% of all activity.

5.4. Control variables

We used additional data sources to construct other area shopping controls that might affect the treatment and the outcome variables at the same time. We used Ordnance Survey Strategy information to calculate the number of road kilometres and the number of road junctions within the shopping area. Infrastructure is directly related the shopping travel behaviour and can affect the opening decisions of the retailers. We used Census 2001 small geography statistics data (aggregated from very small output areas to shopping areas), the NSPD and OS Codepoint Postcode Dataset to construct additional time invariant area controls. These are:

- Density and urbanity: log of population, log of area, percentage of urban addresses over total addresses;
- Socio-economic: unemployment rate, share of non-white population; share of population with no qualifications, with level 1 or 2 qualifications, with level 3, with level 4 or 5 qualifications (highest); share of households that own their home, share of households that are social renters, share of households that are private renters; average household size, share of populations who are students, share of population who is retired.
- Travel behaviour: average commuting distance, share of employed that do not commute, share of employees that commute by private motor, share of employees that commute using public transport, share of employed that commute by foot or bike (exclude category is private motor).

Finally, we compiled time-varying data on unemployment using the Claimant Count information available in NOMIS. This reports the number of Job Seekers Allowance (unemployment benefits) claimants in each area by month. We calculated mid-year to mid-year averages (e.g. 1998 values is July 1997 to June 1998 average).

5.5. Evidence on the timing and effects of TCFP from a representative supermarket chain

When defining pre and post treatment periods in our empirical exercise below, we use data for 1998 to capture the effect of the policy before it came about. This might seem problematic as in theory the policy was introduced in 1996 in England. However, in practice we would expect that retailers need some time to internalise the policy so the location of new retail units was not affected until a few periods after the 1996.

To check this we use a dataset for a one of the largest British supermarket chain which had a large number of stores in both England and Scotland before and in 1998 of after. For this chain we have information on the opening dates and the surface of its stores for the stock of stores in March 2012. We present this information in Table 4.

[TABLE 4]

Due to confidentiality, this table does not provide the exact number of stores, but presents the proportion of “big” (supermarket) and “small” (convenience) stores over the total number of stores in England and Scotland

opened either before 1998 or opened in 1998 or after. TCFP forced retailers to open smaller stores in town centres (Cheshire et al, 2012a). We expect this to have an effect on the type of stores that the chain opened and on the size of these stores, and these effects to be different for England and Scotland. This table fully supports this fact, and shows that this chain did not have any convenience stores before 1998. After this date, the chain mostly opened convenience stores, and this was more the case in England than in Scotland. In fact, over the total number of stores, the weights of supermarkets stores over the total number of stores decreased over time in England while it increased in Scotland. Moreover, in the last two columns of Table 4 we see that the stores opened in 1998 or after were on average smaller than the stores open prior to 1998 and on average they were smaller in England.

These results show that one of the largest and representative supermarket chain substantially changed its expansion strategy after the policy was implemented in England, and that it was not until 1998 that these changes effectively took place. Even if retailers did know about the policy from 1996, they did not start opening new story complying with the new planning regulations until two years later. This results support the fact that using 1998 as pre-policy year is a valid approach. To assess the effect of the policy on travel behaviour, we now move to the regression analysis of the travel behaviour response.

6. *Empirical strategy*

6.1. General considerations

Postal sectors fall within what we defined as shopping areas, and these can be quite large. In the main results, we use the shopping areas defined with radius 23.63 kms, which corresponds to the 95% percentile value of distance traveled in 1998 (see Table 1). Close to the border between England and Scotland, these areas will include locations in both countries, and thus, will be subject to different planning conditions in different parts of the shopping area. For this reason, for the estimations below we only use postal sectors for which the shopping area is completely contained in one of the countries (either England or Scotland). We apply the same criteria when in the robustness we use shopping areas defined with smaller radiuses.

Secondly, we cluster the standard errors at the Local Planning Authority (LPAs). LPAs are in charge of the application of the policies at the local level *de facto*. The planning authorities, which roughly correspond to Local Authority Districts (LADs), are in charge of approving the planning applications for new retail openings. Officials in different LPAs would be subject to different local conditions and have heterogeneous preferences on the application of the national planning law. We account for this by allowing the unobserved shocks of postal sectors that belong to the same LAP to be correlated across space. This also reduces any inefficiency in the calculation of the standard errors due to spatial autocorrelation of the small spatial units. Additionally, the standard errors are robust to heteroskedasticity.

The main results are obtained using the natural logarithm of the average weighted by consumers travel time from an origin postal sector. In the robustness, we examine for effect on other travel cost aggregations (non-weigthed average, sum, standard deviation) and for other travel cost definitions (crow-fly distance, driving distance). The policy variables are either a dummy variable (section 6.2) or a continuous treatment in natural logarithms (section 6.3). Therefore the magnitude of coefficient of interest can be interpreted as the effect of the policy in percentage changes (elasticity).

Finally, we only kept observations for those postal sectors for which we had travel cost data in both years. This means we lose some observations as some postal sectors exist in 1998 and not in 2008 and vice versa. In the main sample we have 7,813 postal sectors, of which 6,951 are in England and the rest in Scotland.

6.2. First approach: comparing England and Scotland

In the first approach use all the postal sector units in England and Scotland and compare the effect of being treated versus non-being treated. As explained above, England imposed TCFP in 1996 and its application was more stringent than in Scotland. We use a differences-in-differences approach (DiD) and compare the log average weighted travel costs in postal sectors in England and Scotland pre (1998) and post (2008) policy. The specification we estimate is:

$$\log_waver_trav_cost_{p,t} = \beta_0 + \boldsymbol{\beta_1}(dEngland_p * d2008_t) + \beta_2(dEngland_p) + \beta_3(d2008_t) + \Gamma(sh_area_controls_{p,t}) + \varepsilon_{p,t} \quad (1)$$

Where "*p*" denotes postal sectors and "*t*" denotes time periods (1998 or 2008); $dEngland_p$ is a dummy that indicates if the postal sector (and its shopping area) its located in England (versus Scotland), $d2008_t$ is a dummy that indicates that the observation corresponds to year 2008 (post-treatment) and $sh_area_controls_{p,t}$ is a matrix of shopping area controls (time invariant and time varying) as defined in section 5.4. Our coefficient of interest is β_1, which captures the effect of being in the treated group (England) post-treatment (2008) on the average postal sector travel costs.

This approach estimates the effect of the policy by simply comparing aggregated travel behaviour (postal sector travel costs) in the country where the policy was implemented before and to a larger extent. However, this approach might not have enough power to identify the effects if the average changes in travel costs in England and Scotland are not sufficiently different conditional on controls. Moreover, most of the postal sectors are located in England (90% of them), so the control group is relatively very small. For this reason, we adopted a second approach in which we exploit the spatial variations in the application of the policy.

6.3. Second approach: exploiting spatial variation within England

In England, the country where TCFP was applied to its full extent, there were marked spatial differences in the compliance of the policy. TCFP affected the internal configuration of retail supply within the shopping areas by changing the location of new stores and by changing the number of new openings.

How the policy was implemented can affect travel costs through two channels. Firstly, TCFP restricted growth of new retail to central locations. Therefore, how close the consumers are top these locations would affect the extent to which they are affected by the policy. Secondly, depending of LPA applied the planning rules set up by the TCFP, the supply of grocery (both in terms of number of stores – units- and in terms of how large these are – employment-) in the shopping area would change, and thus affect how far and how often consumers travel for grocery shopping. TCFP directly affected new openings, but it could have also affected store closures or reductions in size given that it changed the spatial competition structure of retail supply.

In this second approach, we exploit the spatial differences on the extent to which locations were treated and estimate a continuous treatment using only locations in England. In contrast to the previous approach, instead of comparing treated and non-treated, we compare only treated areas estimate the impact of the policy from the intensity of the treatment between the pre and post periods.

We use two definitions of the intensity of the treatment. The first one is the distance to town centres. The closer the origin location of the consumers was to the areas at which new grocery openings were aimed to, the more we expect consumers to be treated. In practice, we use distance to the closest major railway station to

proxy for town centres, as the exact definition of town centres in the policy wording is vague and unknown to us. We estimate the following specification:

$$\log_waver_trav_cost_{p,t} = \beta_0 + \boldsymbol{\beta_1}(\log_dist_to_TC_p * d2008_t) + \beta_2(\log_dist_to_TC_p) + \beta_3(d2008_t) + \Gamma(sh_area_controls_{p,t}) + \varepsilon_{p,t} \quad (2)$$

As before, the outcome variable is the postal sector travel costs in 1998 and 2008 and we estimate the causal effect of the policy by comparing the effect of being closer to town centre before and after the policy. The coefficient of interest is β_1. We include shopping area controls to make sure the parallel trend assumption holds conditional on these.

The second measure of continuous treatment is the supply of grocery in the shopping area of the consumers. We use the number of establishments (units) and their size (employment) of sector 52.1.1, which we can identify with supermarkets or generalist grocery stores. TCFP affected the number of new grocery shops openings and also the size of these stores. The growth in the number of stores between 2008 and 1998 captures the amount of new stores opened between the two years (net of store closures) with respect to the initial (pre-policy stock). Areas in which this proportion grew more would be "more treated" as the proportion of post policy stores over pre-policy stock would be larger. Using the (log) supply of grocery supply in 1998 and 2008 is in equivalent to using the share of pre-policy stores stock (1998) over total current stock of stores.

We estimate the following specification:

$$\log_waver_trav_cost_{p,t} = \beta_0 + \boldsymbol{\beta_1}(\log_grocery_supply_p * d2008_t) + \beta_2(\log_grocery_supply_p) + \beta_3(d2008_t) + \Gamma(sh_area_controls_{p,t}) + \varepsilon_{p,t} \quad (3)$$

Our coefficient of interests is β_1, and now we estimate the causal effect of the policy by comparing how postal sectors travel costs were affected by changes in shopping area grocery supply before and after the policy. Again, we use only observations in the treated country, e.g. postal sectors with shopping areas fully contained in England.

6.4. Limitations and proposed future methodology

It is worth noting that, even if it is clear that the supply of grocery was affected by TCFP, the planning rules did not only affect the number and size of the stores but also their typology and their location. In this sense, neither of the two proposed treatment proxies fully capture the effect of the policy as one of them focuses on the location with respect of town centres and the other one focuses on changes in grocery supply. We are aware that this is a limitation. We are working on a better measure of the extent of treatment for different locations. In this section we outline a proposal of it and in this paper we provide a first attempt.

We define an alternative treatment which is a combination of the distance and the changes in supply and estimate the following specification:

$$\log_waver_trav_cost_{p,t} = \beta_0 + \boldsymbol{\beta_1}(\log_dist_to_TC_p * \log_grocery_supply_p * d2008_t) + \beta_2(\log_dist_to_TC_p * \log_grocery_supply_p) + \beta_3(d2008_t) + \Gamma(sh_area_controls_{p,t}) + \varepsilon_{p,t} \quad (4)$$

Now, the causal effect of the policy is estimated by comparing the changes in supply interacted with the distance to town centres. This approach captures the intuition behind a better proxy of the policy treatment, but does not fully account for the effect of TCFP.

To illustrate the (future) construction of a better policy measure, Figure 4 depicts the extent of the shopping areas for a representative postal sector and also the location of the postal sector with respect to the closest rail station, our town centre measure. The shaded area around the train station is a 10 kilometre buffer, this distance chose for illustration purposes. A better measure of the extent of the policy treatment would account for the changes in supply of grocery around town centres (shaded area) relatively to total supply in the shopping area. In addition, it would account for the fact the not only the numbers but also their type of grocery stores are different in these central locations, in particular they are smaller. Our aim is to use micro-data[14] to construct a measure that takes into account these two facts (location and changes in the type of supply) to fully capture the extent to which different English locations were treated by the policy. Additionally, we aim to complete the analysis by using information on the degrees to which different English local authorities are more or less restrictive with the application of planning laws, for example by using Hilber and Vermeulen planning application refusal index for the period 1979-2008.

7. Empirical results

7.1. Baseline results

In this section we explain the regression results for the estimation of the specifications presented in sections 6.2 and 6.3.

[TABLE 5]

Table 5 presents the results for the first approach, in which we compare English and Scotland weighted-by-consumers postal sector average travel time before and after the introduction of the policy in England (1998). The sample includes all postal sectors for which we had area travel cost estimates and we use the p95 shopping area for the calculation of the controls. The standard errors are robust and clustered at the LPA level.

Column 1 shows the results for specification (1) without any controls. In columns 2 and 3 we introduce the shopping area time invariant and time varying controls. The coefficient of the DiD interaction is always very close to zero and insignificant, and it is estimated with precision (the standard errors are low). In column 4 and 5 we use postal sector fixed-effects to control for time-invariant un-observables correlated with the treatment and the outcome variable. The causal effect coefficient remains insignificant and close to zero. These results show no evidence that the introduction of the policy had an effect on average travel costs, but as said before, this could be due to lack of variation or to the fact that the England dummy does not fully capture the effect of TCFP.

In tables 6 we restrict the sample to England and compare the effect of different levels of treatment before and after the policy. We focus on the specifications which include either all the controls (column 3 of Table 5) or the postal sector fixed-effects and the time-varying controls (column 5 of Table 5).

[TABLE 6]

Columns 1 and 2 show the results when we use (log) distance to town centres to capture the effect of the policy and correspond to the estimation of specification (2). The DiD interaction coefficient is negative and significantly different to zero at the 1% significance level. The parameter is very similar for both models and

[14] The Business Structure Database (BSD) is the micro-data accessible version of the ABI and it is accessible in a secure server environment via the UKDA Secure Data Service. This data contains exact location (postcode), sector (full digits) and employment for the universe of British production, and also the structure of enterprise groups (group-enterprise-fim-plant). We can use this data to create exact measures of total and by-size supply of retail stores at very fine geographical levels.

around -0.25. This implies that doubling the distance from the origin postal sector to the town centre (for example, getting from 1 to 2 kilometres closer) would increase average travel costs by 25%. This is a substantial effect[15].

In columns 3-4 and 5-6 we use the supply of grocery stores treatment and estimate specification (3). We use number of plants (units) and the size of the grocery sector (employment) in the shopping area in which the postal sector is located. We estimate the impact of the growth in grocery supply with respect to the pre-policy initial levels. The estimated causal effect is positive and significantly different from zero, and the elasticity coefficient is around 0.25. This suggests that in areas where supply of grocery increased more as compared to the 1998 stock, travel costs also increased.

The current approach does not allow to fully disentangle what drives this result. TCFP probably increased the net number of stores but these were smaller and located in particular central places. If this new stores were less convenient than the one already existing in 1998 (pre-policy), then consumers would keep travelling to this further away locations. If the total changes in the size of the grocery supply is capturing this, then this results suggests that the change in supply induced by the policy increased travel costs related to grocery shopping. However, we need a better measure on the nature of the changes in the supply to be able to draw clearer conclusions.

[TABLE 7]

In table 7 we provide a first attempt to capture the combined effect of the TCFP on the location and on the changes of the grocery supply. These results correspond to the estimation of specification (4). We define the treatment as the interaction of the supply of grocery (either units or employment) and the distance to town centres (rail stations). We did not include all the interactions as there is not enough variation in the data to estimate all these coefficients. We find some suggestive evidence that places further from town centres in which grocery supply increased more experienced reductions on average travel costs. Taking these results with caution, this would imply that in locations where grocery supply was allowed to grow far from central locations (either by more stores or bigger stores) consumers traveled less and thus the (environmental) costs stemming from shopping travel were smaller. This would mean that TCFP did not make shopping travel more sustainable as initially intended.

In terms of size of the impacts, the estimates suggest that the effect was substantial. The elasticities in Table 6 are around 0.25. This implies that doubling the size of the treatment (either distance to town centres or the supply of grocery) increases average postal sector travel costs by 25%. For the average postcode (the average of the weighted average travel time is 9.63 – Table 3) this implies 46% of a standard deviation.

7.2. Robustness checks

In the results in the previous section we use a specific definition of the shopping area (p95), definition of travel cost (driving time) and aggregation of the travel costs (weighted-by-consumers postal sector average). In this section we check the robustness of the results of Tables 5 and 6 to the use of alternative definitions. In all the robustness tables we present the results for four treatment measures: England versus Scotland, distance to town centres in England, grocery supply (units) changes in England, grocery supply changes (employment) in England.

[15] We aim to provide a proper quantification of the magnitudes of the effects, but we will do it when the methodology and the results are definitive and our treatment variable captures better the effect of the policy.

[TABLE 8]

Table 8 shows the main results in columns 1 and 2 and compares them with the coefficients obtained if we define the shopping areas using different distance radius (the 1998 average, the 75% percentile -p75- and the 90% percentile –p90-). The table shows that the results are extremely robust to changes in the size of the shopping area as the coefficients barely move with respect to the baseline estimates.

[TABLE 9]

Table 9 we present the results for alternative definitions of travel cost. Columns 1-2 present the baseline results in which we use Google Maps travel times between postal sector and grocery store postcode centroids. In columns 3-4 we use predicted travel time calculated using GIS major road networks for 1998 and 2008 (based on Gibbons et al, 2012). We do this because the Google travel times correspond to 2012 transport network values and if the networks have substantially changed over time then the travel time measure would be collected with error. This measurement error (ME) can bias the results substantially if it is systematically correlated with our treatment variables. This is likely the case as England would have different infrastructure policy than Scotland, and within England, the supply of roads is probably correlated with distance to town centres and grocery supply. However, the predicted travel time measure is also not ideal as it only has information on major roads and short shopping trips are likely to take place using smaller roads. In fact, the results in columns 3-4 are only robust for the supply of grocery treatment variables and are larger than in the baseline results. The results are more robust to using distances instead of travel times, either crow-fly distances (columns 5-6) or driving distances (columns 7-8). This suggests that TCFP did not only had an effect on the time spent travelling for grocery shopping, which depends on the exact routes chosen, but also on the distances traveled, which depends on the choice of stores.

[TABLE 10]

Finally, in Table 10 we explore the effects when we use different aggregations from the individual origin postal sector-destination grocery store information to the postal sector levels. We use weighted-by-consumer travel time as the measure of costs. Columns 3-4 use a non-weighted average of the consumer distances. The coefficients are very similar to the baseline result, slightly larger for the supply of grocery treatment variables. This would suggest that it is not only the costs (that depend on the choices) but also the number of consumers that pick a specific origin-destination pair that are affected by the policy. Consumers are travelling more, and more consumers are travelling more.

In columns 5-6 we investigate this further an instead of the average we use the total travel costs from the postal sector, obtained multiplying the cost by the number of consumers and summing across destinations from an origin postal sector. This variable measures the total number of minutes traveled for shopping by consumers living in a given area and it is more closely related to a measure of "total sustainability" of travel [16]. In this case, the effect remains negative significant, and it is double, for the distance to town centre treatment, but it is weaker for the supply of grocery treatment. Finally, in columns 7-8 we test the effect of the policy on the dispersion of travel costs using the area standard deviation as the outcome variable. We find that the dispersion was reduced in areas further away from town centres, but changes in grocery supply had no effects on the dispersion of travel.

[16] Ideally we would want to add the shopping frequency to this measure to calculate the total cost by year. Currently we only have information on total number of grocery shopping trips for small geographies as an average for the period 2003-2010 (due to small samples we need to pull several years together to get reliable area estimates). We are working on this in order to create a better "environmental" impact measure.

8. *Conclusions*

In this paper we use novel shopping destination data to investigate the impact of Town Centre First Policies (TCFP) on travel and city 'sustainability' before and after the policy was introduced. We design a methodology to causally estimate the impact of the policy. Two features of our approach are novel: firstly we define shopping areas around the origin postal sectors to account for continuous treatment of space and secondly we construct different measures of the extent to which locations were affected by the policy.

In preliminary results we find that in place that were affected by TCFP to a larger extent (closer to town centres or where supply of grocery changed more) average travel costs for shopping increased after the policy came about. This evidence is suggestive that, if anything, TCFP made shopping travel less sustainable and stores in which consumers shop their main grocery goods were made less accessible. The size of the estimated effects are substantial.

However given the data limitations we had, the analysis is limited and subject to some caveats. We have some proposed solutions for them and will be working on solving them in the near future.

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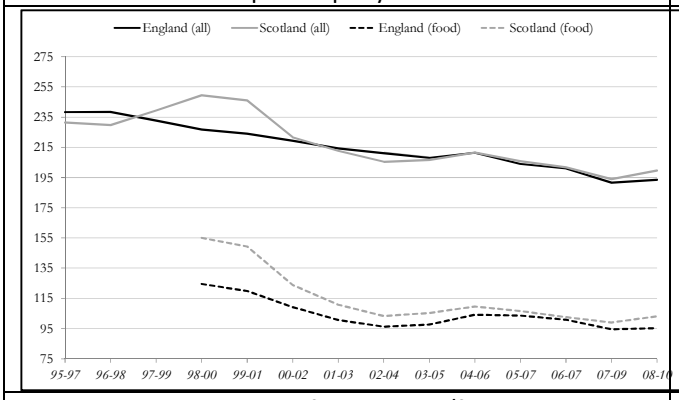
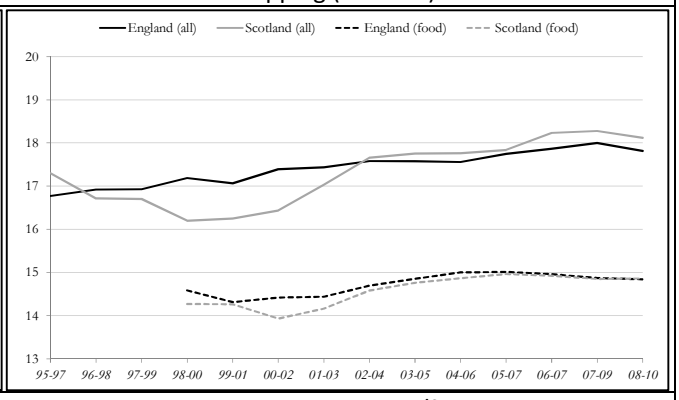
Tables and figures

FIGURE 1: TRAVEL BEHAVIOUR IN ENGLAND AND SCOTLAND OVER TIME

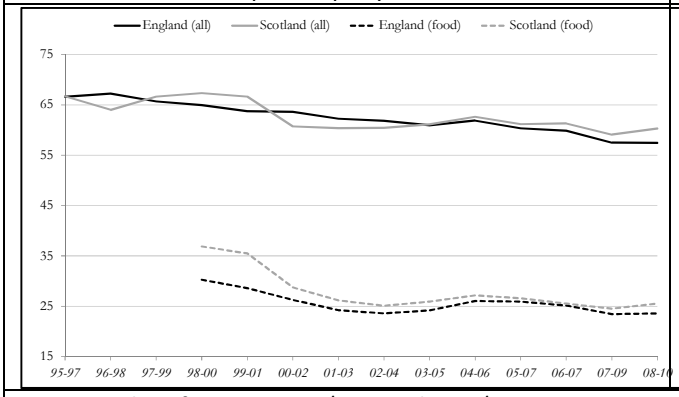
Panel 1.A: Number of shopping/food shopping trips per person per year



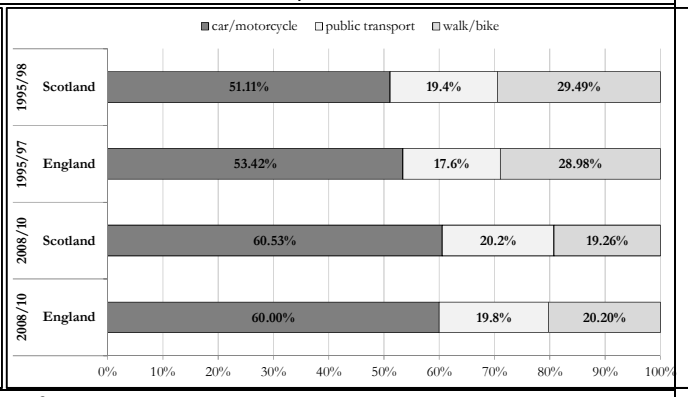
Panel 1.B: Average duration per trip for shopping/food shopping (minutes)



Panel 1.C: Hours traveled for shopping/food shopping per person per year



Panel 1.D: Mode changes in shopping/food shopping during period



Source: Authors from NTS 1995/2001 and 2002/2010, moving averages for 3 years.

TABLE 1: DESCRIPTIVE STATISTICS NSLSP 1998 ORIGIN-DESTINATION SHOPPING DESTINATIONS DATA

1998	variable	min	p10	p25	p50	mean	p75	p90	p95	max	sd	N
England	*Number of shoppers*	0	45	72	176	566.18	575	1580	2563	12695	976.28	78478
	Crow-fly distance	0.00	1.24	2.55	5.28	7.56	10.36	17.18	22.08	49.00	7.03	78481
	Driving distance	0.00	1.97	3.83	7.40	10.70	14.16	23.04	29.45	782.14	15.95	78476
	Driving time	1	5	8	12	14.22	19	26	32	94	8.97	78476
	Driving time (major network)	0.00	5.93	11.34	20.30	26.42	33.69	52.67	70.06	180.00	23.50	78481
Scotland	*Number of shoppers*	7	37	65	149	527.42	499	1508	2561	9940	953.68	8261
	Crow-fly distance	0.02	1.24	2.70	6.22	9.94	14.05	24.23	31.54	48.81	9.96	8261
	Driving distance	0.16	2.00	4.01	8.76	13.59	18.99	31.49	41.35	749.95	15.72	8258
	Driving time	1	5	8	14	16.88	22	33	42	148	12.98	8258
	Driving time (major network)	0.00	5.48	11.02	20.00	28.74	35.97	59.56	86.81	179.92	28.50	8260
Wales	*Number of shoppers*	13	47	71	192	574.82	632	1605	2527	7768	925.59	4433
	Crow-fly distance	0.02	1.54	3.85	8.62	11.25	15.51	25.03	31.60	48.76	9.74	4433
	Driving distance	0.12	2.45	5.75	12.02	15.47	21.40	33.31	42.57	79.30	12.98	4432
	Driving time	1	5	10	16	18.65	25	35	43	76	12.18	4432
	Driving time (major network)	0.01	6.67	12.60	22.98	29.58	37.17	63.57	79.66	177.18	25.40	4433
Great Britain	*Number of shoppers*	0	44	71	174	563.09	572	1576	2561	12695	971.90	91172
	Crow-fly distance	0.00	1.25	2.60	5.47	7.96	10.88	18.24	23.63	49.00	7.56	91175
	Driving distance	0.00	2.01	3.86	7.72	11.19	14.81	24.41	31.33	782.14	15.85	91166
	Driving time	1	5	8	13	14.68	19	27	33	148	9.65	91166
	Driving time (major network)	0.00	5.91	11.35	20.41	26.78	34.00	53.73	72.27	180.00	24.11	91174

Source: Authors from CBRE NSLSP data in 1998 and 2008.

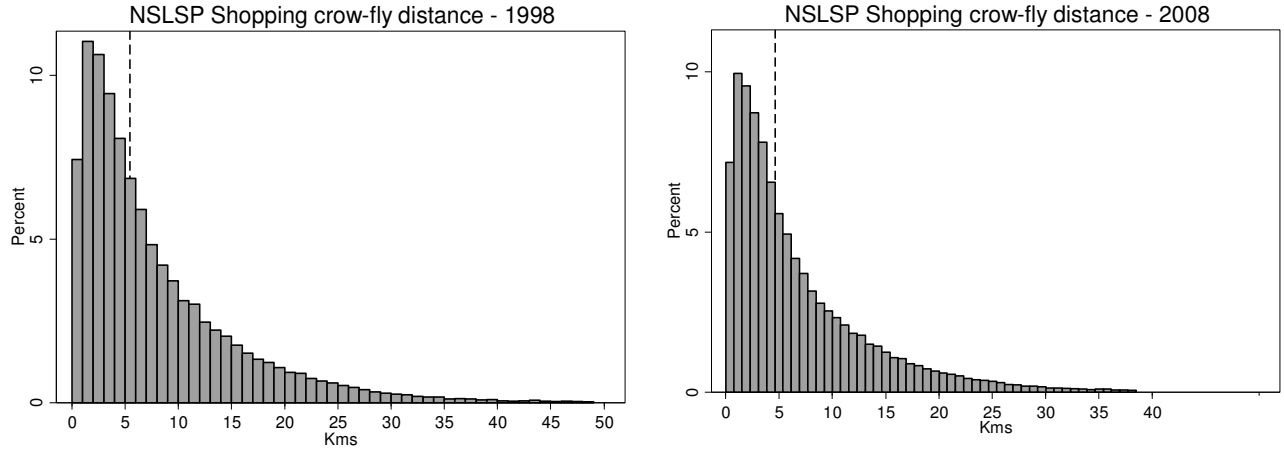
TABLE 2: DESCRIPTIVE STATISTICS NSLSP 2008 ORIGIN-DESTINATION SHOPPING DESTINATIONS DATA

2008	variable	min	p10	p25	p50	mean	p75	p90	p95	max	sd	N
England	*Number of shoppers*	0	49	64	131	442.21	385	1191	2091	11830	821.78	93879
	Crow-fly distance	0.01	0.99	2.14	4.54	6.66	9.14	15.37	19.89	38.50	6.34	93879
	Driving distance	0.00	1.61	3.22	6.60	9.98	12.71	21.08	26.88	803.06	21.90	93879
	Driving time	1	4	7	11	13.06	17	25	30	105	8.57	93879
	Driving time (major network)	0.00	1.58	4.40	9.02	11.60	15.61	24.40	31.17	147.99	10.59	93879
Scotland	*Number of shoppers*	0	51	69	147	476.47	444.5	1316	2254	12870	825.32	8676
	Crow-fly distance	0.03	1.00	2.17	4.84	8.00	11.22	20.52	25.30	38.44	8.09	8677
	Driving distance	0.16	1.61	3.38	7.08	11.82	15.45	27.20	34.44	786.97	22.94	8677
	Driving time	1	4	7	12	14.53	19	29	36	109	11.15	8677
	Driving time (major network)	0.00	1.38	4.25	9.46	13.80	18.08	30.30	41.17	149.44	15.04	8677
Wales	*Number of shoppers*	14	48	60	135	444.78	402	1271	2044	7391	791.95	5319
	Crow-fly distance	0.04	1.27	3.13	7.14	9.50	13.56	21.95	27.06	38.50	8.21	5319
	Driving distance	0.16	2.09	4.67	10.14	13.29	18.99	30.10	36.37	68.40	11.15	5319
	Driving time	1	5	8	14	16.50	22	32	37	75	10.67	5319
	Driving time (major network)	0.00	1.90	5.42	10.56	12.95	18.01	26.95	32.88	79.36	10.45	5319
Great Britain	*Number of shoppers*	0	49	64	133	445.09	390	1207	2104	12870	820.67	107874
	Crow-fly distance	0.01	1.00	2.18	4.66	6.90	9.50	16.12	20.96	38.50	6.64	107875
	Driving distance	0.00	1.61	3.38	6.76	10.29	13.20	21.89	28.32	803.06	21.60	107875
	Driving time	1	4	7	11	13.35	18	25	31	109	8.96	107875
	Driving time (major network)	0.00	1.57	4.43	9.12	11.85	15.89	24.97	31.98	149.44	11.03	107875

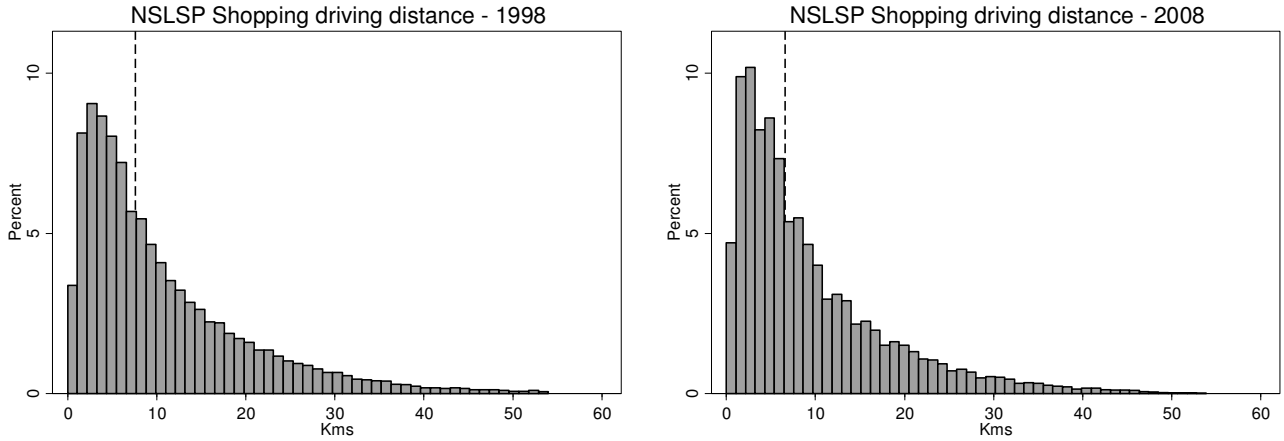
Source: Authors from CBRE NSLSP data in 1998 and 2008.

FIGURE 2: HISTOGRAMS OF DISTANCES AND TRAVEL TIMES IN 1998 AND 2008

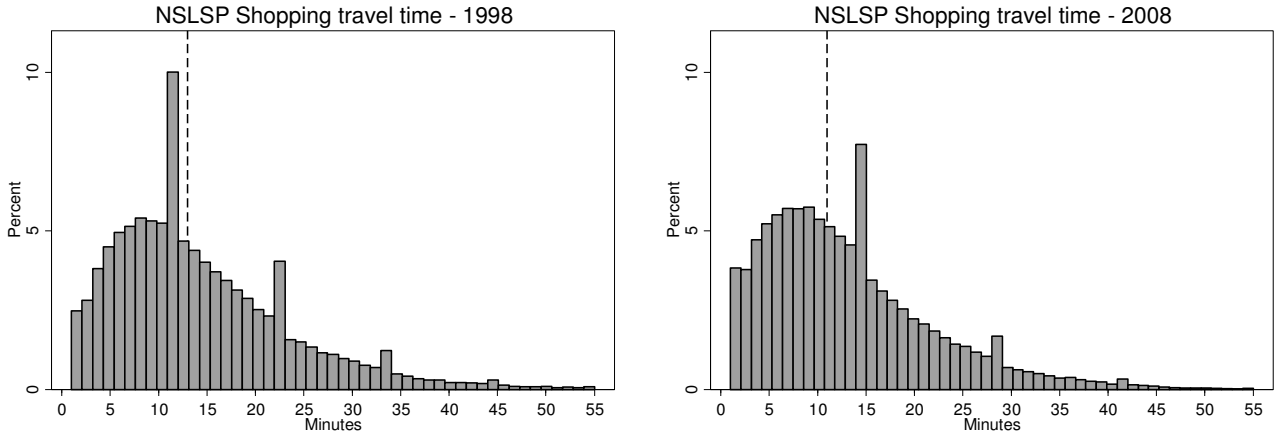
Panel 2.A: Crow-fly distance between origin postal sector and destination grocery store



Panel 2.B: Driving distance between origin postal sector and destination grocery store



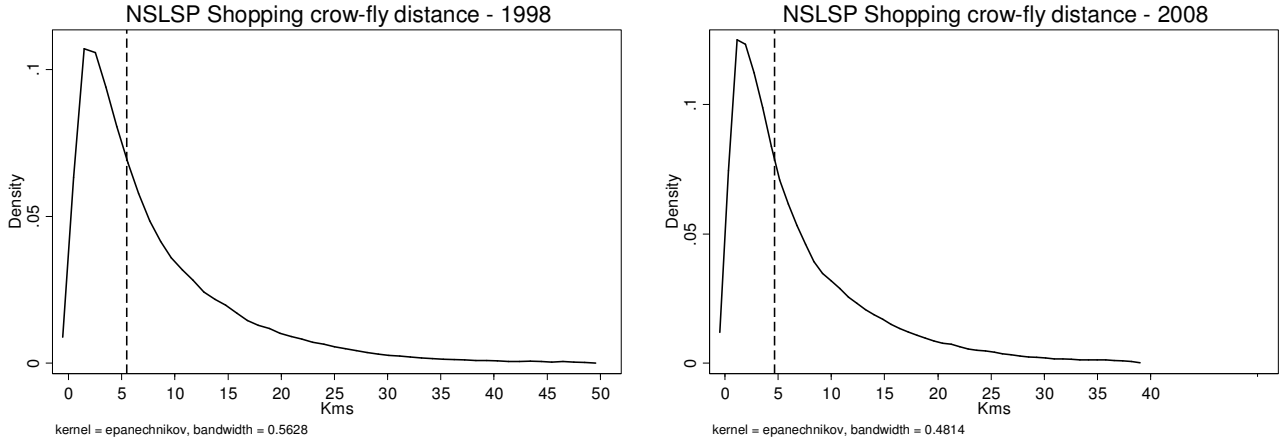
Panel 2.C: Driving travel time between origin postal sector and destination grocery store



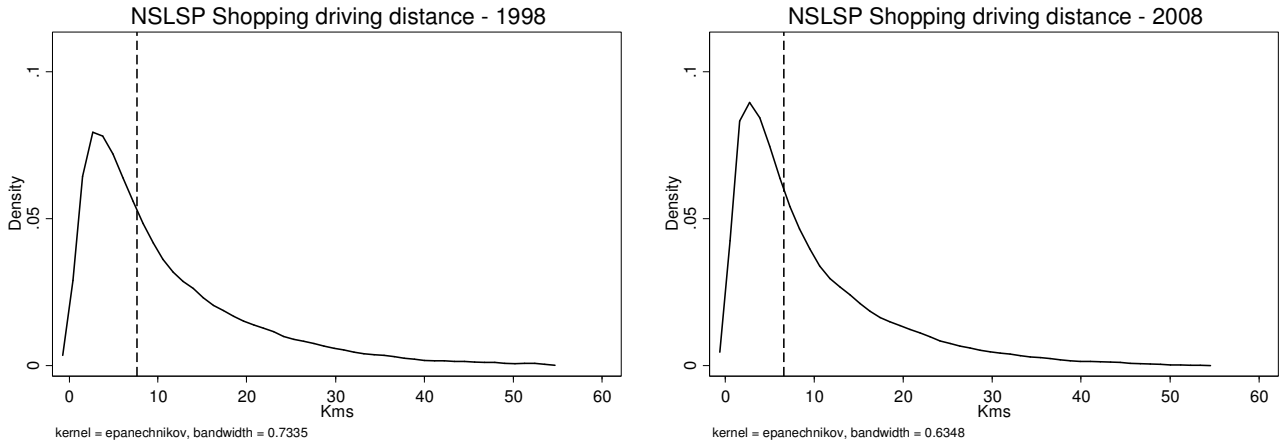
Source: Authors from CBRE NSLSP data in 1998 and 2008. These are origin postal sector destination supermarket distances and travel times from centroids. Top 0.5% observations are excludes. The vertical dashed lines mark the median value.

FIGURE 3: DISTRIBUTION OF DISTANCES AND TRAVEL TIMES IN 1998 AND 2008

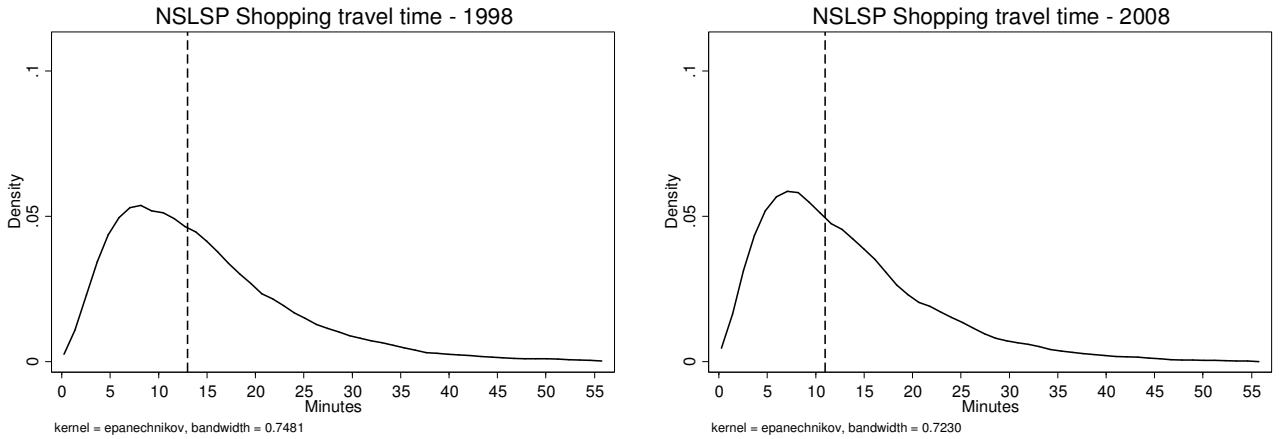
Panel 3.A: Crow-fly distance between origin postal sector and destination grocery store



Panel 3.B: Driving distance between origin postal sector and destination grocery store



Panel 3.C: Driving travel time between origin postal sector and destination grocery store



Source: Authors from CBRE NSLSP data in 1998 and 2008. These are origin postal sector destination supermarket distances and travel times from centroids. Top 0.5% observations are excludes. The vertical dashed lines mark the median value.

TABLE 3: SUMMARY STATISTICS POSTAL SECTORS SAMPLE

POSTAL SECTORS IN ENGLAND AND SCOTLAND

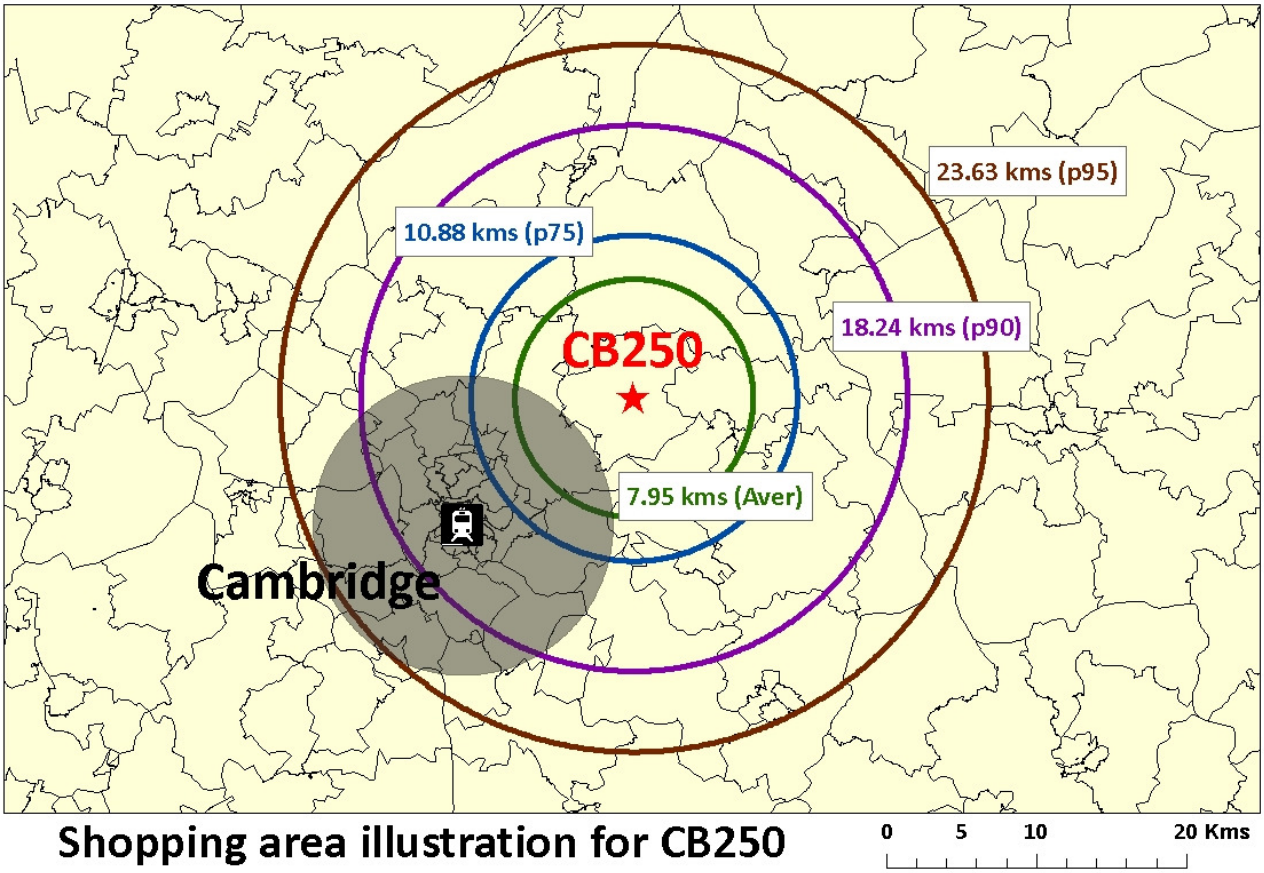
Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Number of shopping destinations	15626	11.58	4.82	1	37
Number of shoppers	15626	177576	139032	3334	904246
Weighted average travel time	15626	9.97	6.22	1	114
Non-weighted average travel time	15626	13.85	7	1	114
Sum of travel times	15626	52277.42	31238.02	6	404751
Std. Dev. of travel times	15486	6.62	3.49	0	73.54
England	15626	0.89	0.31	0	1
Distance to closest main rail station	15626	18.28	18.43	0.11	357.67
Plants sector 5211 band p95	15626	1149.71	1522.86	0	6989
Plants retail sector band p95	15626	6623.29	8261.54	1	32889
Plants all sectors band p95	15626	61962.72	89578.38	13	381571
Employment sector 5211 band p95	15626	23640.15	26043.72	0	114885
Employment retail sector band p95	15626	44291.45	55379.23	4	237730
Employment all sectors band p95	15626	773348.3	1028582	152	4241103

POSTAL SECTORS IN ENGLAND

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Number of shopping destinations	13902	11.81	4.81	1	37
Number of shoppers	13902	174662	139043	3334	904246
Weighted average travel time	13902	9.63	5.19	1	68.25
Non-weighted average travel time	13902	13.47	5.97	1	74.66666
Sum of travel times	13902	52812.8	31018.56	6	280451
Std. Dev. of travel times	13822	6.49	3.13	0	38.74
England	13902	1	0	1	1
Distance to closest main rail station	13902	17.25	15.3	0.17	112.86
Plants sector 5211 band p95	13902	1228.81	1588.09	6	6989
Plants retail sector band p95	13902	7164.82	8575.77	16	32889
Plants all sectors band p95	13902	67575.95	93309.36	304	381571
Employment sector 5211 band p95	13902	25355.23	26955.51	15	114885
Employment retail sector band p95	13902	47699.92	57530.78	54	237730
Employment all sectors band p95	13902	833695.7	1071049	1885	4241103

Source: Authors from CBRE NSLSP data in 1998 and 2008, NOMIS, NSPD, and other data sources.

FIGURE 4: ILLUSTRATION OF EXTENT OF SHOPPING AREA FOR ONE POSTAL SECTOR



Source: Authors from CBRE NSLSP data in 1998 and 2008.

TABLE 4: TYPE OF STORES AND THEIR SURFACE PRE-POST 1998 FOR MAJOR SUPERMARKET CHAIN

		Percentage over stores			
		Convenience	**Supermarkets**	**Average area**	**Average food area**
England	Pre-1998	0.0%	100.0%	38226.76	29622.72
	Post-1998	69.5%	30.5%	9843.26	8109.67
	Total	47.0%	53.0%	19033.84	15075.59
Scotland	Pre-1998	0.0%	100.0%	51797.67	36380.56
	Post-1998	60.3%	39.7%	13306.33	10287.86
	Total	52.8%	47.2%	18117.75	13549.44
Total	Pre-1998	0.0%	100.0%	38601.42	29809.28
	Post-1998	68.7%	31.3%	10144.19	8298.95
	Total	47.4%	52.6%	18971.08	14971.04

Source: Authors from data from an undisclosed major UK supermarket chain. Based on mid-2012 company estate numbers.

TABLE 5: England versus Scotland treatment – all postal sectors					
Log of weighted average travel time to grocery shopping from pcsect	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
England * Year 2008	0.029	0.029	0.015	0.029	0.018
	[0.025]	[0.025]	[0.023]	[0.035]	[0.033]
England	-0.174*	0.005	-0.02		
	[0.098]	[0.079]	[0.080]		
Year 2008	-0.014	-0.014	0.068	-0.014	-0.001
	[0.024]	[0.024]	[0.050]	[0.034]	[0.047]
Log of total population		-0.228***	-0.234**		
		[0.066]	[0.094]		
Log of area in sq kms		0.202***	0.209***		
		[0.067]	[0.066]		
Share of urban addresses		0.039	0.021		
		[0.154]	[0.155]		
Log of roads kms		0.001	-0.009		
		[0.084]	[0.083]		
Number of road junctions		-0.001*	-0.001*		
		[0.001]	[0.001]		
Unemployment rate		-4.987*	-8.005**		
		[2.986]	[3.458]		
Share of non-white population		-0.074	-0.021		
		[0.437]	[0.450]		
Share of workforce with no qualif		-0.108	-0.414		
		[0.629]	[0.625]		
Share of workforce with qualif 1-2		-1.192	-1.389		
		[0.869]	[0.859]		
Share of workforce with qualif 3		0.35	0.557		
		[2.015]	[2.027]		
Share of home owner households		-0.987*	-1.009*		
		[0.552]	[0.548]		
Share of social renter households		-1.257	-1.469		
		[0.947]	[0.948]		
Average household size		0.546	0.585*		
		[0.352]	[0.350]		
Share of students over 16 years old		-0.311	-0.885		
		[1.583]	[1.636]		
Share of retired population		1.632	1.407		
		[1.373]	[1.537]		
Share of workers working at home		2.062	2.686*		
		[1.354]	[1.456]		
Share of public transport commuters		0.812**	0.795**		
		[0.376]	[0.374]		
Share of walk-bike commuters		-0.67	-0.566		
		[0.950]	[0.911]		
Average commuting distance		0.003	0.003		
		[0.009]	[0.009]		
Log of claimant count in t			0.085*		0.038
			[0.049]		[0.037]
Log of retail plants (excl grocery) in t			0.02		-0.081
			[0.090]		[0.130]
Log of total plants (excl retail) in t			-0.095		0.067
			[0.120]		[0.146]
Constant	2.316***	3.496***	3.802***		
	[0.096]	[1.171]	[1.243]		
Number of observations	15626	15626	15626	15626	15626
Adjusted R2	0.01	0.244	0.245	0.862	0.862
F-test	3.357	49.289	43.8	1.621	0.867

7831 postal sector in England and Scotland. S.e. are robust-clustered at the LPA level (382). Time invariant controls correspond to 2001 values. Excluded categories are share of workforce with qualif 4-5, share of private renter households, and share of private motor commuters.

TABLE 6: Continuous treatments only in England						
Log of weighted average travel time to grocery shopping from pcsect	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	Log Distance to TC		**Log grocery units**		**Log grocery employment**	
Treatment * Year 2008	-0.025***	-0.027***	0.012	0.025***	0.022***	0.028***
	[0.006]	[0.008]	[0.008]	[0.008]	[0.007]	[0.008]
Treatment	0.113***		0.272***	-0.007	-0.048	-0.024
	[0.009]		[0.104]	[0.076]	[0.073]	[0.045]
Year 2008	0.125***	0.051	-0.111	-0.206***	-0.179**	-0.289***
	[0.043]	[0.040]	[0.077]	[0.076]	[0.085]	[0.090]
Log of total population	-0.103		-0.267**		-0.251**	
	[0.097]		[0.108]		[0.105]	
Log of area in sq kms	0.310***		0.220**		0.192**	
	[0.091]		[0.088]		[0.092]	
Share of urban addresses	0.033		0.158		0.092	
	[0.186]		[0.182]		[0.187]	
Log of roads kms	-0.077		0.028		0.038	
	[0.096]		[0.100]		[0.102]	
Number of road junctions	0.000		-0.001		-0.001	
	[0.001]		[0.001]		[0.001]	
Unemployment rate	-7.985**		-6.459		-6.061	
	[3.630]		[3.953]		[3.854]	
Share of non-white population	0.024		0.114		0.007	
	[0.424]		[0.489]		[0.474]	
Share of workforce with no qualif	1.551**		0.946		1.343*	
	[0.662]		[0.729]		[0.718]	
Share of workforce with qualif 1-2	-1.349*		-1.171		-0.772	
	[0.812]		[0.880]		[0.905]	
Share of workforce with qualif 3	8.522**		7.138**		5.849*	
	[3.361]		[3.458]		[3.440]	
Share of home owner households	-0.990*		-1.012		-0.945	
	[0.579]		[0.623]		[0.643]	
Share of social renter households	-1.818*		-1.671		-1.344	
	[0.943]		[1.025]		[1.072]	
Average household size	0.57		0.486		0.453	
	[0.373]		[0.402]		[0.416]	
Share of students over 16 years old	-3.789*		-4.897**		-3.645*	
	[2.137]		[2.259]		[2.156]	
Share of retired population	0.495		0.072		0.354	
	[1.491]		[1.648]		[1.655]	
Share of workers working at home	3.078*		2.792		2.837*	
	[1.775]		[1.770]		[1.718]	
Share of public transport commuters	0.531		0.776**		0.899**	
	[0.362]		[0.380]		[0.395]	
Share of walk-bike commuters	0.478		0.248		0.053	
	[0.961]		[1.059]		[1.090]	
Average commuting distance	0.006		0.014		0.008	
	[0.012]		[0.012]		[0.012]	
Log of claimant count in t	0.012	-0.034	-0.032	-0.034	0.025	-0.027
	[0.045]	[0.034]	[0.047]	[0.033]	[0.048]	[0.032]
Log of retail plants (excl grocery) in t	0.097	-0.003	-0.054	-0.048	-0.002	-0.05
	[0.108]	[0.127]	[0.118]	[0.124]	[0.077]	[0.074]
Log of total plants (excl retail) in t	-0.162	0.04	-0.147	0.151	0.034	0.148
	[0.133]	[0.143]	[0.152]	[0.159]	[0.132]	[0.097]
Constant	1.166		3.761***		2.720*	
	[1.255]		[1.418]		[1.467]	
Number of observations	13902	13902	13902	13902	13902	13902
Adjusted R2	0.247	0.872	0.218	0.872	0.215	0.873
F-test	35.79	2.518	29.045	2.147	29.156	2.509

S.e. are robust-clustered at the LPA (350). Time invariant controls correspond to 2001 values. Excluded categories are share of workforce with qualifications 4-5, share of private renter households, share of private motor commuters. When applicable, treatment variables in logs.

TABLE 7: Combining treatments				
Log of weighted average travel time to grocery shopping from pcsect	**(1)**	**(2)**	**(3)**	**(4)**
	Log grocery units		**Log grocery employment**	
Treatment_Dist * Year 2008	-0.004***	-0.004*	-0.002***	-0.001
	[0.001]	[0.002]	[0.001]	[0.001]
Treatment_Dist	0.018***	0.018	0.011***	-0.030*
	[0.001]	[0.018]	[0.001]	[0.017]
Year 2008	0.122***	0.052	0.077**	0.042
	[0.047]	[0.046]	[0.031]	[0.028]
Log of total population	-0.105		-0.153*	
	[0.104]		[0.091]	
Log of area in sq kms	0.307***		0.296***	
	[0.089]		[0.090]	
Share of urban addresses	-0.011		0.043	
	[0.186]		[0.188]	
Log of roads kms	-0.098		-0.07	
	[0.096]		[0.096]	
Number of road junctions	0.000		0.000	
	[0.001]		[0.001]	
Unemployment rate	-8.589**		-7.204**	
	[3.599]		[3.521]	
Share of non-white population	0.003		-0.137	
	[0.424]		[0.401]	
Share of workforce with no qualif	1.458**		1.645**	
	[0.660]		[0.666]	
Share of workforce with qualif 1-2	-1.431*		-1.421*	
	[0.815]		[0.834]	
Share of workforce with qualif 3	8.516**		7.612**	
	[3.344]		[3.302]	
Share of home owner households	-1.040*		-1.027*	
	[0.579]		[0.589]	
Share of social renter households	-1.687*		-1.650*	
	[0.938]		[0.964]	
Average household size	0.641*		0.6	
	[0.371]		[0.368]	
Share of students over 16 years old	-4.193*		-3.164	
	[2.135]		[2.060]	
Share of retired population	0.579		0.957	
	[1.487]		[1.466]	
Share of workers working at home	3.508**		3.096*	
	[1.751]		[1.688]	
Share of public transport commuters	0.451		0.503	
	[0.365]		[0.368]	
Share of walk-bike commuters	0.45		0.534	
	[0.972]		[0.968]	
Average commuting distance	0.005		0.004	
	[0.012]		[0.012]	
Log of claimant count in t	0.023	-0.016	0.014	-0.021
	[0.045]	[0.033]	[0.043]	[0.033]
Log of retail plants (excl grocery) in t	0.086	-0.014	-0.016	0.017
	[0.107]	[0.130]	[0.071]	[0.077]
Log of total plants (excl retail) in t	-0.189	-0.005	-0.033	0.075
	[0.135]	[0.151]	[0.107]	[0.107]
Constant	1.623		1.532	
	[1.261]		[1.288]	
Number of observations	13902	13902	13902	13902
Adjusted R2	0.247	0.871	0.245	0.872
F-test	38.532	1.14	36.552	1.9

S.e. are robust-clustered at the LPA (350). Time invariant controls correspond to 2001 values. Excluded categories are share of workforce with qualifications 4-5, share of private renter households, share of private motor commuters. When applicable, treatment variables in logs.

TABLE 8: Robustness to other shopping areas sizes								
Log of weighted average travel time to grocery shopping from pcsect	*P95*		*AVERAGE*		*P75*		*P90*	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
England versus Scotland								
England_2008	0.015	0.018	0.019	0.026	0.013	0.024	0.016	0.027
	[0.023]	[0.033]	[0.023]	[0.032]	[0.023]	[0.033]	[0.023]	[0.034]
England	-0.02		-0.021		-0.028		-0.031	
	[0.080]		[0.036]		[0.041]		[0.062]	
y2008	0.068	-0.001	0.007	0.036	0.024	0.032	0.055	0.013
	[0.050]	[0.047]	[0.028]	[0.042]	[0.030]	[0.044]	[0.040]	[0.048]
N	15626	15626	15665	15665	15655	15655	15658	15658
Log Distance to TC								
Treatment * Year 2008	-0.025***	-0.027***	-0.025***	-0.026***	-0.023***	-0.026***	-0.023***	-0.026***
	[0.006]	[0.008]	[0.006]	[0.008]	[0.006]	[0.008]	[0.007]	[0.008]
Treatment	0.113***		0.013		0.040***		0.094***	
	[0.009]		[0.009]		[0.009]		[0.009]	
Year 2008	0.125***	0.051	0.081***	0.096***	0.089***	0.071***	0.139***	0.068**
	[0.043]	[0.040]	[0.019]	[0.030]	[0.023]	[0.024]	[0.036]	[0.033]
N	13902	13902	13942	13942	13925	13925	13931	13931
Log grocery units								
Treatment * Year 2008	0.012	0.025***	0.021***	0.026***	0.017***	0.027***	0.012**	0.024***
	[0.008]	[0.008]	[0.005]	[0.006]	[0.005]	[0.007]	[0.006]	[0.008]
Treatment	0.272***	-0.007	0.128***	-0.007	0.158***	-0.022	0.272***	-0.009
	[0.104]	[0.076]	[0.025]	[0.030]	[0.037]	[0.039]	[0.072]	[0.055]
Year 2008	-0.111	-0.206***	-0.119***	-0.104**	-0.110***	-0.130***	-0.087	-0.164***
	[0.077]	[0.076]	[0.029]	[0.041]	[0.036]	[0.047]	[0.057]	[0.062]
N	13902	13902	13924	13924	13919	13919	13931	13931
Log grocery employment								
Treatment * Year 2008	0.022***	0.028***	0.021***	0.024***	0.019***	0.025***	0.023***	0.026***
	[0.007]	[0.008]	[0.004]	[0.005]	[0.005]	[0.006]	[0.006]	[0.007]
Treatment	-0.048	-0.024	-0.105***	-0.028	-0.155***	-0.094***	-0.055	-0.05
	[0.073]	[0.045]	[0.014]	[0.022]	[0.020]	[0.028]	[0.044]	[0.036]
Year 2008	-0.179**	-0.289***	-0.113***	-0.165***	-0.081*	-0.194***	-0.169**	-0.247***
	[0.085]	[0.090]	[0.037]	[0.039]	[0.045]	[0.056]	[0.068]	[0.075]
N	13902	13902	13924	13959	13919	13919	13931	13931

All results include time invariant and time varying controls. Time invariant controls correspond to 2001 values. Excluded categories are share of workforce with qualifications 4-5, share of private renter households, share of private motor commuters.

TABLE 9: Robustness to other travel cost measures

Log of weighted (x) to grocery shopping from pcsect	*Driving travel time*		*Major networks travel time*		*Crow-fly distance*		*Driving distance*	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
England versus Scotland								
England_2008	0.015	0.018	-0.104	-0.098	0.026	0.029	0.016	0.027
	[0.023]	[0.033]	[0.072]	[0.106]	[0.034]	[0.043]	[0.033]	[0.044]
England	-0.02		0.095		-0.027		0.006	
	[0.080]		[0.110]		[0.127]		[0.117]	
y2008	0.068	-0.001	-1.012***	-1.109***	0.11	-0.005	0.144*	0.000
	[0.050]	[0.047]	[0.096]	[0.170]	[0.077]	[0.063]	[0.073]	[0.078]
N	15626	15626	15625	15625	15626	15626	15626	15626
Log Distance to TC								
Treatment * Year 2008	-0.025***	-0.027***	0.01	0.011	-0.036***	-0.035***	-0.042***	-0.047***
	[0.006]	[0.008]	[0.021]	[0.029]	[0.011]	[0.012]	[0.012]	[0.016]
Treatment	0.113***		0.033*		0.224***		0.194***	
	[0.009]		[0.019]		[0.016]		[0.016]	
Year 2008	0.125***	0.051	-1.209***	-1.214***	0.195***	0.084	0.234***	0.093
	[0.043]	[0.040]	[0.081]	[0.166]	[0.066]	[0.057]	[0.064]	[0.068]
N	13902	13902	13902	13902	13902	13902	13902	13902
Log grocery units								
Treatment * Year 2008	0.012	0.025***	0.048***	0.055*	0.018	0.034***	0.012	0.029**
	[0.008]	[0.008]	[0.017]	[0.028]	[0.012]	[0.013]	[0.012]	[0.014]
Treatment	0.272***	-0.007	0.08	-0.115	0.275*	-0.048	0.347**	0.057
	[0.104]	[0.076]	[0.142]	[0.298]	[0.166]	[0.114]	[0.155]	[0.141]
Year 2008	-0.111	-0.206***	-1.569***	-1.624***	-0.129	-0.273**	-0.072	-0.243*
	[0.077]	[0.076]	[0.135]	[0.265]	[0.122]	[0.115]	[0.122]	[0.132]
N	13902	13902	13902	13902	13902	13902	13902	13902
Log grocery employment								
Treatment * Year 2008	0.022***	0.028***	0.053***	0.056**	0.028***	0.037***	0.027**	0.035**
	[0.007]	[0.008]	[0.019]	[0.027]	[0.010]	[0.012]	[0.011]	[0.014]
Treatment	-0.048	-0.024	-0.082	-0.003	-0.035	-0.065	-0.06	-0.056
	[0.073]	[0.045]	[0.088]	[0.184]	[0.110]	[0.070]	[0.102]	[0.075]
Year 2008	-0.179**	-0.289***	-1.763***	-1.793***	-0.198	-0.368***	-0.169	-0.337**
	[0.085]	[0.090]	[0.202]	[0.311]	[0.134]	[0.136]	[0.137]	[0.161]
N	13902	13902	13902	13902	13902	13902	13902	13902

All results include time invariant and time varying controls. Time invariant controls correspond to 2001 values. Excluded categories are share of workforce with qualifications 4-5, share of private renter households, share of private motor commuters.

TABLE 10: Robustness to other travel time aggregations								
Log of (x) travel time to grocery shopping from pcsect	*Weighted average*		*Non-weighted average*		*Sum of distances*		*S. Deviation of distances*	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
England versus Scotland								
England_2008	0.015	0.018	0.041	0.051	0.016	0.012	0.055	0.048
	[0.023]	[0.033]	[0.027]	[0.036]	[0.034]	[0.031]	[0.043]	[0.064]
England	-0.02		-0.111		0.359***		-0.154	
	[0.080]		[0.087]		[0.134]		[0.094]	
y2008	0.068	-0.001	0.018	-0.047	-0.026	-0.032	0.052	-0.021
	[0.050]	[0.047]	[0.056]	[0.051]	[0.064]	[0.067]	[0.068]	[0.085]
N	15626	15626	15626	15626	15626	15626	15461	15461
Log Distance to TC								
Treatment * Year 2008	-0.025***	-0.027***	-0.028***	-0.028***	-0.063***	-0.067***	-0.022**	-0.029**
	[0.006]	[0.008]	[0.007]	[0.008]	[0.015]	[0.020]	[0.011]	[0.014]
Treatment	0.113***		0.154***		0.312***		0.116***	
	[0.009]		[0.010]		[0.043]		[0.012]	
Year 2008	0.125***	0.051	0.094**		0.042	0.087	0.143***	0.103
	[0.043]	[0.040]	[0.042]		[0.083]	[0.084]	[0.050]	[0.082]
N	13902	13902	13902	13902	13902	13902	13808	13808
Log grocery units								
Treatment * Year 2008	0.012	0.025***	0.026***	0.038***	0.016	0.028*	0.017*	0.029*
	[0.008]	[0.008]	[0.008]	[0.009]	[0.012]	[0.015]	[0.010]	[0.015]
Treatment	0.272***	-0.007	0.203*	-0.068	0.399***	-0.137	0.1	-0.085
	[0.104]	[0.076]	[0.110]	[0.086]	[0.147]	[0.143]	[0.097]	[0.174]
Year 2008	-0.111	-0.206***	-0.236***	-0.320***	-0.372***	-0.264*	-0.077	-0.182
	[0.077]	[0.076]	[0.083]	[0.079]	[0.127]	[0.138]	[0.098]	[0.136]
N	13902	13902	13902	13902	13902	13902	13808	13808
Log grocery employment								
Treatment * Year 2008	0.022***	0.028***	0.036***	0.039***	0.035***	0.02	0.020*	0.021
	[0.007]	[0.008]	[0.007]	[0.008]	[0.012]	[0.015]	[0.011]	[0.014]
Treatment	-0.048	-0.024	0.002	-0.078	0.188*	-0.044	0.037	-0.148
	[0.073]	[0.045]	[0.068]	[0.054]	[0.107]	[0.079]	[0.066]	[0.102]
Year 2008	-0.179**	-0.289***	-0.366***	-0.435***	-0.526***	-0.265	-0.132	-0.185
	[0.085]	[0.090]	[0.091]	[0.091]	[0.155]	[0.163]	[0.125]	[0.159]
N	13902	13902	13902	13902	13902	13902	13808	13808

All results include time invariant and time varying controls. Time invariant controls correspond to 2001 values. Excluded categories are share of workforce with qualifications 4-5, share of private renter households, share of private motor commuters.