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Using workplace population statistics to understand retail store performance

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Abstract

We explore the value of recently released workplace geographies and accompanying census-based workplace zone statistics (WZS) and an associated classification of workplace zones (COWZ). We consider how these data could support retailers in their operational and strategic decision making, including the evaluation of retail demand and retail store performance in localities where trade is driven by non-residential demand. In collaboration with major UK grocery retailer '*The Co-operative Group*' we explore the relationship between workplace population composition and store trading characteristics using a series of case study stores within Inner London. We use empirical store trading data to identify store and product category level temporal sales fluctuations attributable to workplace populations. We also use census-derived flow data to identify the spatial origins of workplace population inflow. We identify that store performance exhibits characteristics attributable to demand driven by these populations. We conclude that workplace population geographies, WZS and the COWZ afford considerable potential for understanding drivers of store performance, observed store trading patterns and evaluation of retail store performance. We suggest that the next step is to build these populations and their micro geography spatial and temporal characteristics into predictive models and evaluate their potential for store performance evaluation and location-based store and network decision making within this sector.

Key words

Workplace derived trade, Workplace zone statistics, Classification of workplace zones, 'Co-Operative Food', Inner London

Workplaces as a driver of retail demand

Workplaces are a key driver of non-residential daytime population distributions and associated origin-destination flows driven by the journey to work (Martin, Cockings, and Leung 2015; Martin, Cockings, and Harfoot 2013; Smith and Fairburn 2008). The presence of workplace populations within city centres, out of town office developments or an industrial centre, for example, may represent important drivers of demand for local services, including the retail sector. Retail demand originating from these populations may not be adequately captured by traditional census-based population statistics which are primarily based on residential geographies (Martin, Cockings, and Harfoot 2013). We assess whether recently published output geographies and population statistics related to workplace populations can support the evaluation of retail demand and retail store performance in localities which experience an inflow of workplace populations.

We make use of census-based Workplace Zones (WPZsⁱ) and associated Workplace Zone Statistics (WZSⁱⁱ) published by the Office for National Statistics (ONSⁱⁱⁱ) (Mitchell 2014; ONS 2014a). We also introduce a geodemographic classification of workplace zones (COWZ^{iv}), derived from the 2011 census in England and Wales and published by the University of Southampton in conjunction with the ONS (Cockings, Martin, and Harfoot 2015a). These data provide considerable enhancements to the provision of small area population statistics related to workplace populations, enabling analysis of their composition, characteristics and flows using a set of geographic zones specifically designed for the dissemination of workplace population statistics. This paper is focused explicitly on the UK (and specifically England and Wales) given the availability of these data. Nevertheless, the international importance of – and interest in – data on workplace populations and their spatial and temporal distributions has been recognised (Martin, Cockings, and Harfoot 2013; Bell 2015).

This study has been undertaken in conjunction with the Co-operative Groups' grocery and convenience store division, *'The Co-operative Food'* (Co-op). Co-op is the UK's fifth largest grocery retailer (by market share), with a national market share of around 6.5%¹ across the grocery sector. Co-op derives market share from a network of ~2,800 stores which include smaller-format local or convenience stores (stores under 3,000 ft² providing opportunities for local 'top up' shopping in urban and suburban neighbourhoods, rural areas, transport interchanges, town and city centres, petrol station forecourts etc.) and medium-sized supermarkets meeting the everyday shopping needs of local communities. The Co-op's store estate is constantly evolving as a result of new store development and portfolio review (including refits, changes to product ranges, opening hours etc.,) designed to meet consumer needs, especially preferences for more frequent 'top-up' grocery shopping close to home, work, place of study, transport networks or other amenities (Elms et al. 2010; Thompson et al. 2012; Hood, Clarke, and Clarke 2015).

Drivers of small-format food store performance are complex and reflect the spatiotemporal characteristics of demand in the vicinity of a given store. Stores predominantly serving a suburban neighbourhood, for example, are tailored towards a specific 'shopping mission' and will exhibit a very different trade pattern to stores serving major town or city centre locations (ACS 2015). In these urban centres store level trade is predominantly non-residential and driven by the presence of local workers,

¹ Kantar Worldpanel Grocery Market Share (UK) for 12 weeks ending 11.10.15

shoppers, students, tourists and people in transit. Identifying the composition, characteristics and spatiotemporal behaviours of these non-residential populations - within tightly defined store catchment areas – is crucial for understanding the demand-side drivers of trade in these localities (see Hood, Clarke, and Clarke 2015, for a more detailed discussion of key variables influencing consumers' shopping missions in convenience stores).

The store-level drivers and impacts of non-residential demand - and workplace demand in particular - remains an under-researched area. Thus, operational decision making (store ranging and product placement, staffing and localised offers) may be based on an incomplete evidence base, with a lack of robust data on workplace populations. Similarly, strategic decision making including store performance evaluation (assessing observed store trading performance relative to indicators of likely store performance) and store location planning (identifying locations for new stores and predicting their trading potential) requires detailed demand-side insight (Birkin, Clarke, and Clarke 2016). Prior to the release of specific workplace geographies, workplace population statistics and area-based classifications, there have been limited demand-side data related to non-residential populations suitable for retail decision making.

We make use of empirical store trading data and performance indicators provided by the Co-op, with the explicit aims of a) evaluating the utility of WPZs, census-derived WZS and the COWZ as tools to support retail operations and location-based decision making, and; b) improving retailers' understanding of the drivers behind observed small-format food store trading characteristics in areas with considerable workplace populations. We specifically consider Co-op stores in Inner London where store trading characteristics are predominantly attributable to demand originating from workers and commuter flows, rather than originating from local residential populations.

Whilst this journal has previously reported on empirical research to understand the localised impact of non-residential demand in the grocery retail sector (Newing, Clarke, and Clarke 2013), we believe this to be the first such study explicitly addressing workplace populations. The recent release of WZS using custom-built output geographies provides new opportunities to understand the micro geographies of workplace demand as a potential driver of individual retail store performance. We believe, therefore, that this study is both timely and relevant. We hope that this paper will support the retail sector in evaluating the utility of census-based workplace geographies and population statistics. There are an absence of academic studies that demonstrate the impact of workplace populations on retail store trading characteristics, and the empirical analysis presented in this paper will go some way to address that gap in the literature.

In the following section we briefly outline the development of workplace geographies, WZS and the COWZ. We explore the characteristics of Inner London workplace populations using these data, linking these populations to observed trading characteristics at selected Co-op stores. We subsequently reflect on the value of these data for supporting retail operations, for the evaluation of store performance and for location-based decision making by retailers trading within highly transient workplace locations.

Census-derived workplace population geographies and population statistics

In spite of the importance of non-residential populations in driving store-level retail demand in certain localities, census-based population statistics and small area geodemographic classifications related to

residential populations are the primary tool for small-area expenditure estimation, store-location planning and store performance assessment (Birkin, Clarke, and Clarke 2016; Newing, Clarke, and Clarke 2013). Census-based population statistics used for retail analysis in the UK are reported in relation to an individuals' usual place of residence. They are released using a series of hierarchical output zones related to residential geographies, of which Output Areas (OAs^v) are the smallest. OAs are built from unit postcodes with the explicit aims of generating a set of output zones with consistent population and household counts (with a target size of 125 households), geographical compactness and social homogeneity (Coady 2014; Martin, Cockings, and Harfoot 2013). OAs are an important geographic zone for retail analysis and are widely used for demand estimation, market share evaluation and area-based geodemographics. However they are not best-suited to the release of data related to populations which have a spatial distribution that is not consistent with residential populations. Many residential areas contain very limited workplace populations, in many cases failing to meet minimum statistical disclosure control thresholds required to enable the release of workplace statistics at this level of aggregation (Mitchell 2014). As such, attempts to release workplace population statistics at the OA level, using information on respondents' place of work collected as part of the 2001 census, had very limited success in part due to concerns over potential disclosure risks (Martin, Cockings, and Harfoot 2013). Such risks were driven by the spatial mismatch between residential and workplace populations, rendering residential geographies as not fit-for-purpose for the release of workplace population statistics.

Major employment centres such as inner-city financial, legal or civic 'districts', major retail centres, factories, industrial estates, hospitals and educational establishments often contain very few residential dwellings and limited residential populations. Thus, OAs containing predominantly commercial, administrative, industrial and educational land uses often cover a large spatial extent in order to meet minimum residential population thresholds for statistical disclosure control (40 households and 100 people) (ONS No Date). Clearly the spatial distributions of workplace and residential populations, and most notably the locations in which the former concentrate, are not consistent. Three quarters of 2011 OAs in England and Wales contain less than 100 workers, yet over 4,000 OAs contained workplace populations in excess of 1,000 workers (Coady 2014). Thus by their very nature as a residential geography, OAs are unsuited to the dissemination of workplace population statistics.

In light of these weaknesses, and following extensive user and public consultation (see ONS 2011b, for a summary) and academic input (see for example Martin, Cockings, and Harfoot 2013), ONS released a new census output geography termed 'Workplace Zones' (WPZs) in 2013. WPZs were created using data related to respondents place of work and are designed to complement OAs, providing national coverage at the small area level to support the release of data related to workplace populations. They are designed to be as compact as possible, to contain consistent counts of workers and maintain internal homogeneity, where possible, in terms of the industry or sector of employment (Mitchell 2014).

A total of just over 53,000 WPZs cover England and Wales, created using a similar automated zone design procedure to that developed for the construction of OAs (Martin, Cockings, and Harfoot 2013; Mitchell 2014). The process involved merging or splitting existing OAs (with some WPZs remaining identical to their corresponding OAs) generating an output geography specifically designed for workplace population statistics and consistent with other ONS output geographies (Martin, Cockings,

and Harfoot 2013; Mitchell 2014). Statistical disclosure control stipulates a minimum workplace population size (200) and zonal constraints (minimum three separate unit postcodes) such that individual workplaces cannot be identified (Mitchell 2014).

Figure 1 shows the relationship between 2011 OAs and WPZs for two London boroughs, Tower Hamlets and the City of London. The predominantly non-residential City of London (also known as the Square Mile) contains just 31 OAs, driven by the very low residential populations within this financial and business district (Table 1). With a workplace population of over 350,000 individuals, these City of London OAs have a mean workplace population of over 11,000, with one OA containing 127,354 workers. This is a clear example of the need for WPZs, with the City of London OAs having been split to form 349 WPZs (a tenfold increase on the number of OAs), with a mean workplace population of just over 1,000 workers per WPZ. The one OA with 127,345 workers has itself been split to form 115 separate WPZs, considerably increasing the geographical resolution of workplace population distribution within the City of London.

In the more residential London borough of Tower Hamlets, a majority of the 748 OAs have been merged to form just 251 WPZs (Figure 1 and Table 1). Mitchell (2014) notes, however, that two Tower Hamlets OAs contain workplace population counts in excess of 35,000 workers. These OAs, located on the 'Isle of Dogs' (the peninsula to the south of the borough) have been split (or undergone a more complex change involving a combination of merging and splitting of OAs) to form 15 WPZs to accommodate the Canary Wharf development, the single largest business district in the UK, containing over 15m ft² of office, retail and leisure space (Canary Wharf Group 2015).

Table 1 – Comparison of OA and WPZ residential and workplace population counts and compositions for the City of London and Tower Hamlets.

	City of London		Tower Hamlets	
	OAs	WPZs	OAs	WPZs
Count	31	349	748	251
Mean Residential Pop	260	n/a	361	n/a
Max Residential Pop	461	n/a	1,533	n/a
Mean Workplace Pop	11,507	1,022	314	935
Max Workplace Pop	127,354	6,636	35,746	11,403

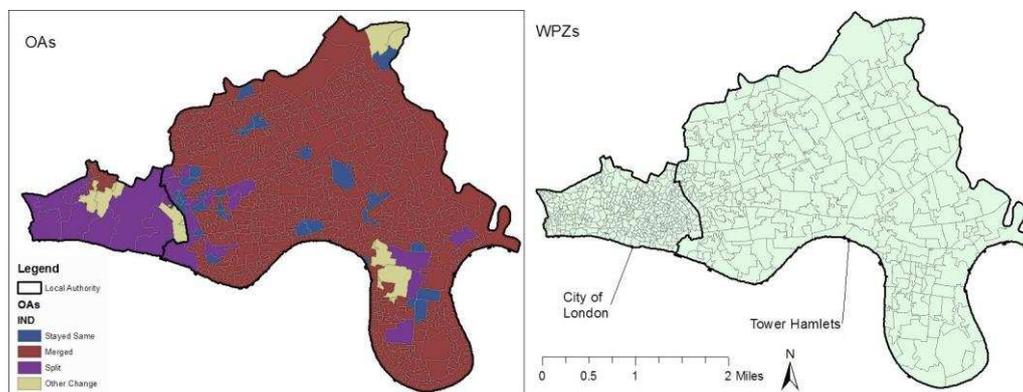


Figure 1 Contrasting census geographies for residential (left) and workplace populations (right). 2011 OAs and WPZs for the City of London (Square Mile) and London Borough of Tower Hamlets.

In areas of high workplace population density, WPZs are smaller than the corresponding OAs and provide considerably greater detail in relation to the spatial distribution of the workplace populations within commercial centres such as the City of London and Canary Wharf (Tower Hamlets). From the retail analytics perspective workplace zones enable the provision of meaningful census-based WZS, using a fit-for-purpose output geography.

WZS report counts of workers by WPZ and associated attributes related specifically to the population working within that WPZ, based on the self-reported postcode of their usual place of work. Those attributes include age, sex, ethnic group, general health, qualifications and employment status etc., routinely collected as part of census questions related to usual household residents. For a full list of WZS released see ONS (2014c). The workplace population of a given WPZ includes a) non-resident commuter inflow, b) home workers with a home address in that WPZ and c) usual residents of that WPZ who are in employment but have no fixed place of work. It relates only to those people working within a given area (whether from home or a commercial premises) and should not be confused with the census 'workday' population, which includes all people thought to be within a given area during the workday including usual residents who are not in work (see ONS 2014c, for a more detailed overview of workplace and workday population bases and their relationship to usual resident populations).

A Classification of Workplace Zones (COWZ) has also been produced; grouping WPZs based on the geodemographic characteristics of their workplace populations. Existing geodemographic classifications such as the 2011 ONS Output Area Classification (OAC^{vi}) (ONS 2014a; Gale 2014) have become important segmentation tools used by the retail sector to support operational, location based and marketing decisions (Birkin, Clarke, and Clarke 2016). The OAC classifies OAs based on the characteristics of usual residents, the composition of their households and the nature of their dwellings (ONS 2014a; Gale 2014). Whilst the OAC incorporates some indicators related to usual resident employment status and characteristics of that employment, it does not account for the characteristics of workplace population inflow. Commercially available geodemographic classifications related to workplace populations such as 'CAMEO Workplace', which profiles workplace populations based on the CAMEO geodemographic classification of commuters' residential origins, makes use of residential geographies (Postal Sectors and OAs) as the output geography (CallCredit 2015). The COWZ account for employee and employment characteristics and is reported at the WPZ level, thus addressing some of the limitations of the OAC or commercial 'workplace' geodemographic classifications in this context.

The COWZ has been developed using a comparable approach to the OAC, utilising a hierarchical k-means clustering process (Cockings, Martin, and Harfoot 2015e). It segments and classifies WPZs based on indicators of the composition and socio-economic characteristics of their workplace populations, the nature of their employment, and an indicator of the built environment within each WPZ (Cockings, Martin, and Harfoot 2015e). Resultant clusters were designed in consultation with potential end users and comprise 29 groups, nested within 7 'supergroups', (Table 2) (see Cockings, Martin, and Harfoot 2015b, 2015c, 2015d; 2015e, for more detail on the COWZ methodology, supergroup and group structure and profiles for individual supergroups and groups). Supergroups identify the nature of typical employment within a given workplace zone, such as 'retail' or 'manufacturing and distribution', with the group level providing greater detail on the specific nature of employment within each WPZ. For example, the 'Top Jobs' supergroup (discussed further within

our store level case studies) reflects high status employment centres related to commerce, finance, and public service and is comprised of constituent groups such as ‘Global Business’ and ‘Big City Life’. Given the important role of geodemographic segmentations such as the OAC in the estimation of retail demand and the analysis of store performance in the retail sector, the COWZ could afford tremendous potential in this sector. The tendency for workplace populations to cluster spatially and thematically (e.g. education, retail, financial, legal, agricultural etc.) at the small area level has important implications for the estimation of retail demand and the analysis of retail store performance.

Table 2 – Overview of COWZ Supergroups (Cockings, Martin, and Harfoot, 2015e).

Supergroup ID	Supergroup Name
1	Retail
2	Top Jobs
3	Metro Suburbs
4	Suburban Services
5	Manufacturing and Distribution
6	Rural
7	Servants of Society

WPZs have been designed for the release of workplace population statistics and specifically address the limitations of using residential output geographies for the visualisation and analysis of data related to workplace populations. It is important to recognise, however, that the census is not an enumeration of workplaces or their employees. Therefore WZS and the COWZ are not derived from or linked to other ONS surveys of businesses or their employees such as the Annual Business Survey, Business Register and Employment Survey or Monthly Business Survey. They relate solely to 2011 census respondents self-reported employment status, place of work and characteristics.

This potential of these data, all of which are freely available, has been recognised by the industry. The Society for Location Analysis (SLA^{vii}), which supports the interests of the site location community, held a briefing seminar titled ‘*All you need to know about Workplace Zones*’ in 2014, shortly after the initial release of WPZ data (SLA 2014). It is hoped that this paper, produced shortly after the release of the COWZ, will provide further impetus for the retail sector to consider the value of free and openly accessible WZS and COWZ. In the following sections we explore WZS and the COWZ for Inner London, specifically considering their role in the analysis and evaluation of retail store performance in areas dominated by workplace populations.

Inner London Workplace Populations

For the remainder of this paper we focus exclusively on London, and specifically ‘Inner London’, a statistical grouping of 13 London Boroughs and the ‘City of London’² (Figure 2). Inner London functions as a major employment centre with considerable workplace population commuter inflow. WZS reveal that over 2.7m employees are recorded as having workplaces located within Inner London. High density clusters of workplace populations (Figure 2) present considerable opportunities to evaluate

² For the dissemination of statistical workplace and population data, the City of London can be considered equivalent to a London Borough.

the impacts of these populations on the retail sector. This section explores the WZS and COWZ for Inner London, identifying and illustrating the insights afforded by this alternative population base.

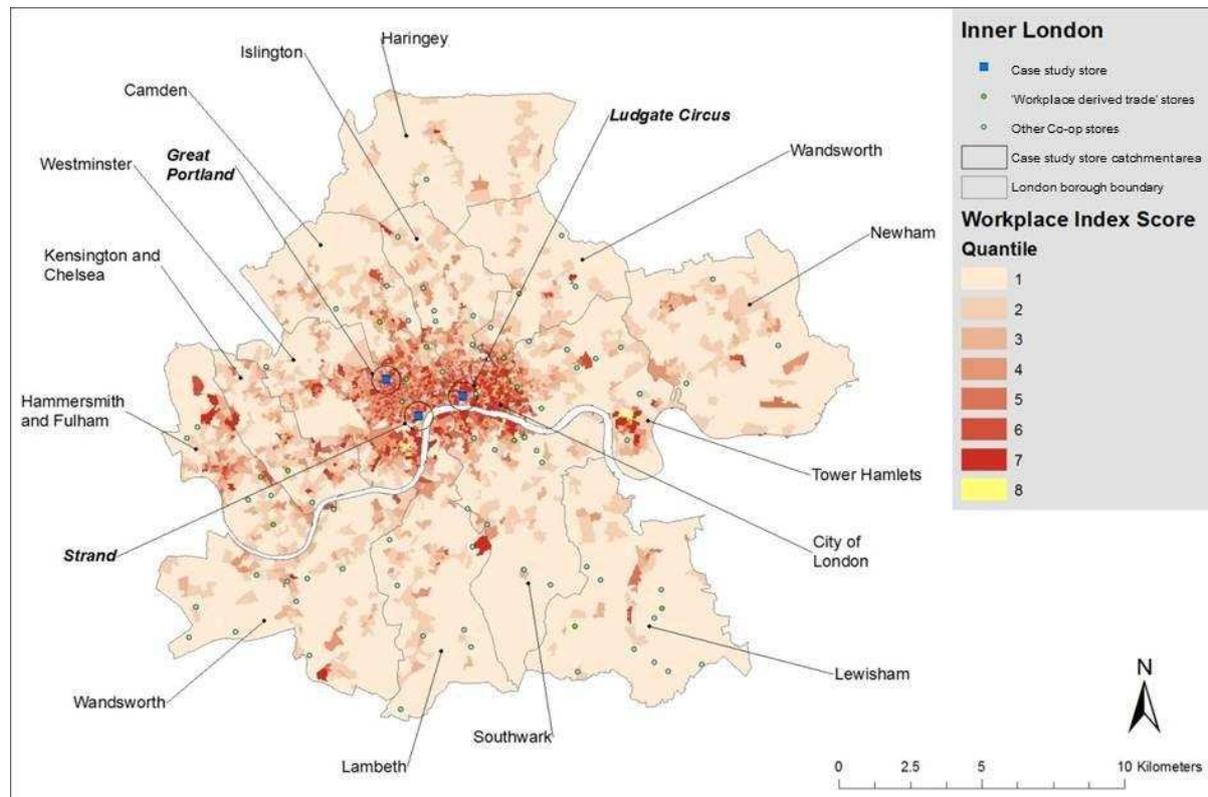


Figure 2 – Inner London boroughs and Co-op stores. The Strand, Great Portland Street and Ludgate Circus study stores are identified. Workplace index score shown for all Inner London workplace zones based on workplace population density.

Figure 2 reveals an indicator of the underlying workplace population intensity (WPI^{viii}). This has been derived by categorising WPZs into one of 8 quantiles based on their workplace population density. The WPI enables identification of those WPZs with the highest density of workplace populations. Unsurprisingly, clusters of high density workplace populations are evident in Westminster (home to Parliament), within the City of London (a major financial district) and a distinct cluster in the borough of Tower Hamlets around the Canary Wharf development. The single highest workplace population intensity is found at Plantation Place, which is one of the largest office developments in the City of London financial district.

The COWZ reveals that Inner London is almost exclusively dominated by WPZs where the nature of employment is classified as ‘Top Jobs’ or ‘Metro Suburbs’, with the former clustered within the Central London boroughs of Westminster, City of London and Tower Hamlets. This supergroup includes the ‘highest status city centres’ and their employees in the commercial and public sectors, with these WPZs notable for their high density workplace populations, comprising highly qualified employees with a tendency for longer distance commuting (Cockings, Martin, and Harfoot 2015a).

The workplace population characteristics suggested by the COWZ are consistent with the underlying WZS. Figure 3 shows a series of variables related to the underlying workplace populations within Inner London WPZs. These indicators reflect the nature of employees with a workplace within the given

WPZ irrespective of place of residence. It is clear that the central London boroughs of Westminster and the City of London contain a high proportion of high social class ‘professionals, managers or directors’ working full time, consistent with the nature of the governmental, financial and legal organisations located in these areas. Similarly, there is a clear spatial pattern to commuting, with a high propensity for employees working in Inner London to commute by train or tube (metro), as discussed further below.

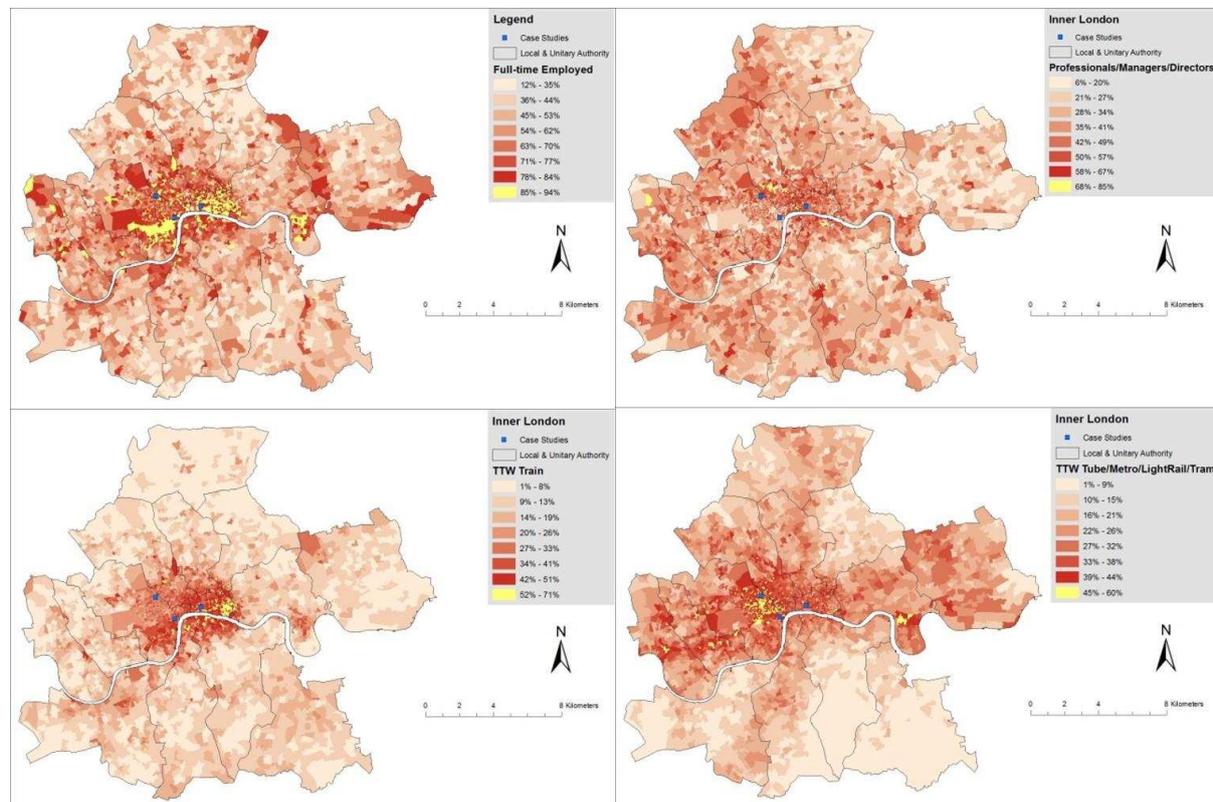


Figure 3 – Key indicators of Inner London workplace population composition and characteristics by workplace zone. Source: derived using WZS (ONS 2014b)

Based on the COWZ, over 55% of Inner London WPZs are categorised as ‘Top Jobs’, accounting for almost 1.9m employees, around 69% of the total employees working in Inner London. In the following section we make use of the COWZ at the group level, in conjunction with WZS in order to understand the localised composition of these ‘Top Jobs’ workplace populations within the vicinity of selected Co-op stores.

Store trading characteristics driven by workplace populations

At the time of analysis the Co-op operates a total of 85 stores in Inner London, with an average size of just over 3,000 ft². As a relatively late entrant to the convenience retail sector in Central London, Co-op were able to learn from the experiences of their competitors and their own insights into consumer behaviours and preferences. Consequently, store locations, formats and in-store offer (e.g. ranging) have been tailored to the needs of Central London residential, workplace, commuter and leisure consumers. The research underpinning this paper demonstrates Co-op’s commitment to developing their store estate in line with consumer needs, and in understanding the small-area geographies of non-residential demand. Store investments in Inner London have heightened their need for a robust

understanding of the impacts of workplace populations on their store operations within this geographical area. Exploratory Co-op analysis of typical customer 'baskets' identified a number of their Inner London stores where trade is believed to be driven largely by non-residential workplace demand. These stores (referred to here as 'workplace derived trade') exhibit a high proportion of sales on product categories such as 'food to go', comprising hot and cold snack food and drink for immediate consumption. These stores are located in areas where considerable clusters of affluent and professional workplace populations exist (Figures 2 and 3). The assumed drivers of trade within this group of stores corresponds closely to the catchment area characteristics which Hood, Clarke, and Clarke (2015) associate with a distinctive cluster of convenience stores located in major town/city centres or in proximity to transport interchanges.

We focus in particular on three of these stores; Strand, Ludgate Circus and Great Portland Street (Figure 2). These stores are all located in Central London (the commercial heart of Inner London) and have been selected for further analysis due to the intensity of workplace populations in immediate proximity to these stores. On the supply side, the Co-op have particular interest in understanding the drivers of trade at these specific stores, which include established and well-performing stores and more recent store investments. The Strand and Ludgate Circus stores also enable us to consider the presence of proximate major transport interchanges which are likely to drive additional workplace-driven commuter footfall around these stores.

We make use of store trading data for the calendar year 2014, enabling us to identify store transactions and revenues by product group and by time period (morning – 7am to midday; afternoon – midday to 4pm; early evening – 4pm to 7pm and; evening – 7pm to store close or midnight). Where stores opened during 2014 their performance indicators are based on 2014 trading characteristics since launch. We also make use of an 8-week snapshot of store sales and transactions by hour of the day, covering an 8 week period during December 2014 and January 2015, but excluding Christmas and New Year. All observed trading patterns reported within this paper reflect store trading characteristics at the time of analysis. Trading patterns may have subsequently changed as a result of store refits and range/category reviews. Some data have been rounded, generalised, aggregated or redacted for publication in order to preserve commercially sensitive information, but were incorporated in their raw or most detailed form within the analysis.

Using Co-op insight and anecdotal evidence of industry practice for convenience stores in major urban areas, we constructed indicative store catchment areas using 500m buffers, broadly equating to a 5 minute walk. Given the nature of these store locations in London's commercial and leisure districts, with limited parking, pedestrianisation and traffic congestion, almost all store level trade is driven by consumers accessing stores on foot. The micro geographies of store location in relation to workplaces, transport interchanges and competitor stores are important in driving observed trading patterns. In particular, proximity to - and visibility from – key commuter and workplace population footfall routes and transport interchanges are important in driving store level trade, as explored throughout our discussion of trading characteristics at these stores.

The 500m inferred catchment area for our Strand study store contains just three OAs, yet 81 WPZs, demonstrating the increased spatial detail that this geography provides within areas of low residential and considerable non-residential populations. The Ludgate Circus store, in the heart of the London's financial district, has a total of 60,905 individuals working in WPZs within that buffer, the highest

workplace population of our three study store catchments (Table 3). Table 3 provides detail on the workplace populations falling within each store catchment. Table 3 includes a count of WPZs and workplace populations by COWZ group. COWZ groups from the ‘Top Jobs’ supergroup dominate these store catchment areas, with all WPZs falling within the Strand and Ludgate Circus store catchments, and all but two of the 140 WPZs in the Great Portland Street catchment, categorised within this supergroup. The spatial distribution of those COWZ groups within each store catchment clearly reflects the nature of the employment opportunities, with core administrative and commercial sectors evident. Given their proximity to these major clusters of workplace populations, we would expect trading characteristics at Co-op Inner London ‘workplace derived trade’ stores to be influenced by the presence of these populations.

Table 3 – Workplace population characteristics by store: count of WPZs and workplace populations by COWZ group for study store 500m catchment areas. Source: Constructed by authors using COWZ-EW (Cockings, Martin, and Harfoot 2015a).

COWZ Group	Strand		Ludgate Circus		Great Portland St	
	WPZs	Workplace Pop	WPZs	Workplace Pop	WPZs	Workplace Pop
Supergroup: Top Jobs						
Administrative Centres	13	15,512	4	4,003	23	8,014
Big City Life	32	13,044	7	2,351	35	13,849
Global Business	36	25,527	58	63,503	79	38,356
Science and Business Parks	-	-	-	-	1	232
Supergroup: Metro Suburbs						
Cosmopolitan Metro Suburban Mix	-	-	-	-	1	235
Supergroup: Retail						
Shop until you Drop	-	-	-	-	1	219
Total	81	54,083	69	69,857	140	60,905

Store sales and transactions by core ‘product department’ (related to the year 2014) reveal that in-store transactions at these stores are dominated by high-volume low-value transactions incorporating product lines such as soft drinks, confectionary, crisps, snacks, breakfast cereals, fruit and veg and dairy provisions (including milk and juices). These product lines and associated high-volume low-value transactions are likely to be attributable to workplace populations purchasing food for immediate consumption (including breakfast and lunch items) during the workday or essential top-up shopping as part of the journey home.

Temporal patterns of trade at these stores also exhibit characteristics which we would associate with workplace populations. For example, notable reductions in store revenues at the weekend (relative to weekdays) and a tendency for revenues to be driven primarily by daytime transactions are evident. The temporal patterns of transactions (Figure 4) (based on all weekdays during a representative 8 week sample of store trading data from 2014) highlight a distinct trade pattern at our three case study Inner London study stores. Transactions at these stores are clearly driven by early morning (~8.00am - 9.00am), lunchtime (~midday – 13.30pm) and early evening (17.00pm – 18.30pm) trade, consistent with local workplace populations shopping as part of their morning and evening commute and also during their lunch break. Store trading patterns are thus consistent with trade driven primarily by weekday daytime workplace populations.

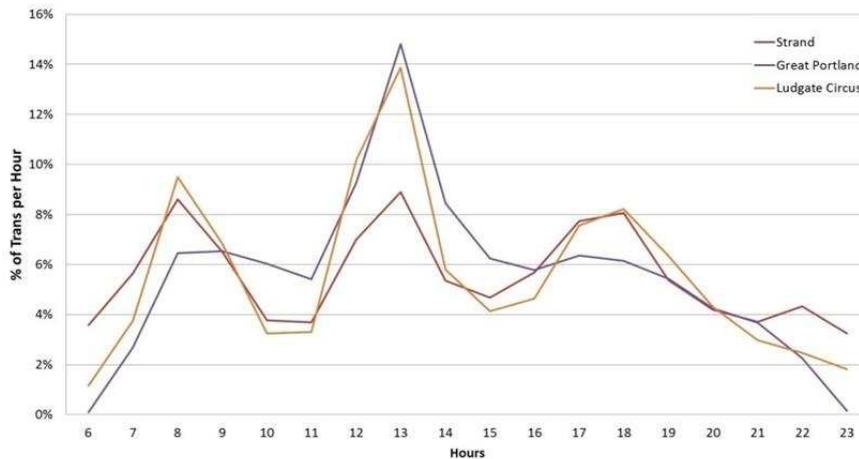


Figure 4 - Transactions by hour of the day (expressed as a proportion of total store transactions) for three Inner London case study stores. Averaged across all weekdays during 8 representative weeks in 2014 and 2015.

Across our three study stores variations in these temporal trade profiles are exhibited. Based on a years' worth of store trading data, we note a much higher dependence on morning trade, and a lower dependence on lunchtime trade, in driving transaction volumes at the Strand store. Around 40% of all transactions at the Strand store take place in the morning (6am to midday) period, in contrast to just over 20% at both the Great Portland and Ludgate Circus stores. By contrast, over 40% of transactions at the Great Portland Street store originate during the midday to 4pm 'afternoon' period, including the core lunchtime trade. We now explore some of the differences in store trading profiles with reference to the characteristics of the stores themselves, the composition and likely spatial origins of workplace populations in proximity to these stores and the nature of local competition.

The Strand store derives high volume sales during the morning from the in-store bakery and delicatessen (which includes sales of coffee and hot food), consistent with commuters and workplace populations in the vicinity of the store. It may be driven by the proximity of this store to the major commuter rail terminus at Charing Cross, with morning trade driven by commuters passing through this station, the sixth busiest in the UK with an annual footfall of over 50 million people (Network Rail 2013). Similarly, trade in the early evening (4pm – 7pm) includes notable sales of alcohol, ready meals and fruit and veg, consistent with commuters purchasing 'food to go' on their journey home from work (Figure 5). The favourable micro location of this store relative to key competitors serving the Strand, in a direct line of sight from the main station entrance and on a major footfall route for pedestrians heading towards Trafalgar Square, is likely to be a major driver of commuter and workplace derived transactions at this store

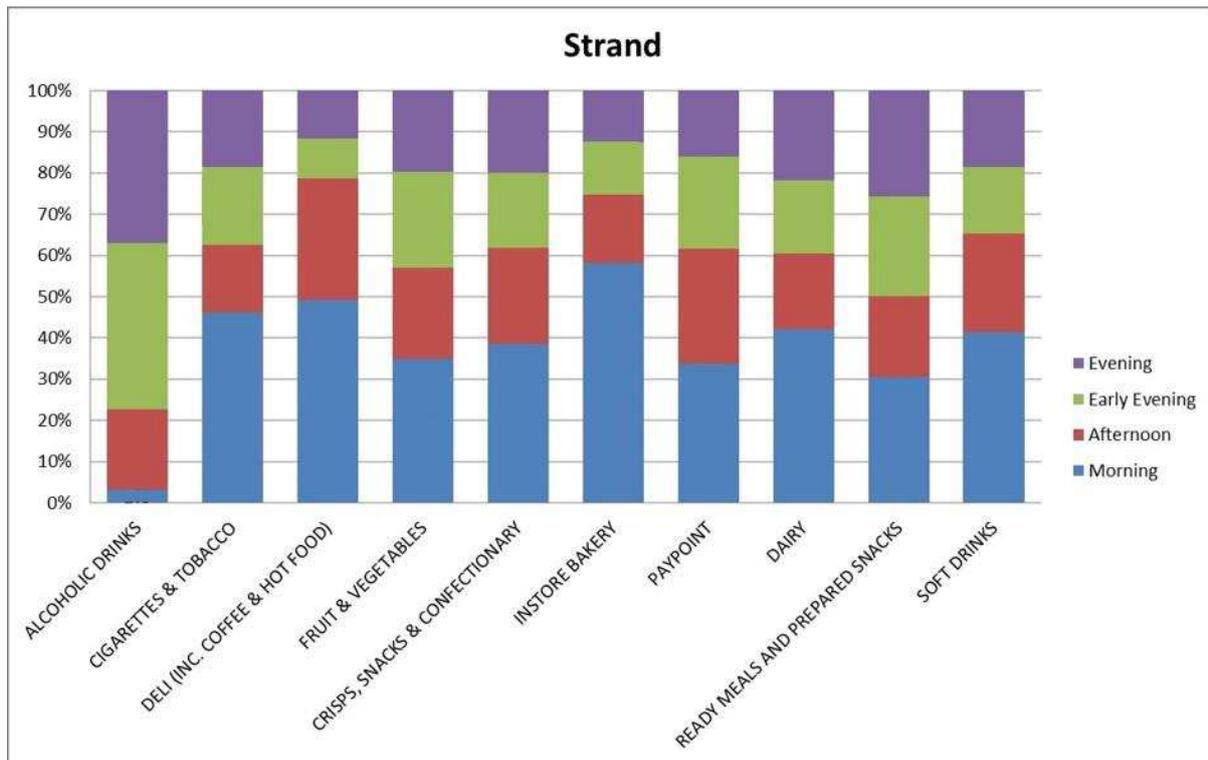


Figure 5 - Proportion of in-store transactions by time of the day for the Strand store (2014)

By contrast, the Great Portland Street store is not proximate to a major transport interchange. Therefore, daytime workplace-induced trading characteristics are more likely to be influenced by those working in proximity to the store and predominantly driving lunchtime trade, in particular originating from the ~5,500 employees at the adjacent BBC 'Broadcasting House'. In common with the Strand store, this store exhibits strong micro locational factors in relation to major competitors. This store is the closest convenience store to BBC 'Broadcasting House' and is also located in a high footfall area on a major thoroughfare between Oxford Circus and Great Portland Street. The strong performance of specific product lines such as sandwiches and core product categories including soft drinks and crisps, snacks and confectionary, is consistent with lunchtime trade driven by workplace populations. The early evening sales uplift is not so prominent at this store (Figure 4), yet revenues at this time of the day are dominated by sales of alcoholic beverages, consistent with post-work purchases by these workplace populations. Nevertheless, and in spite of its location in proximity to considerable workplace populations, this store doesn't benefit from the morning and early evening sales uplift to the same extent as the Strand.

The Ludgate Circus store is located within the City of London financial district, an area of very high density workplace populations (Figure 2). This store has an excellent micro location, on a major crossroads and immediately adjacent to the 'City' station on the Thameslink commuter railway line, a major footfall driver. The store catchment incorporates the heart of the financial district and St Paul's area of the City. This store exhibits considerable lunchtime trade, yet this trade is dominated by low-value transactions of crisps, snacks, confectionary, soft drinks and fruit and veg. An evening sales peak is also evident (Figure 4) with strong sales of alcohol during the late afternoon and evening periods. Interestingly revenues at this store derived from sales of Champagne are far in excess of 'typical' Inner

London store revenues on this product line, perhaps suggesting particularly localised demand for these products within London's financial district.

At an operational level, maximising revenue from this combination of high-volume low-value lunchtime transactions and low-volume high-value evening transactions may present challenges and opportunities. These, along with further implications and recommendations based on observed trading characteristics, are discussed further below. Firstly, however, we consider flow or interaction data in order to draw observations about the spatial origin of these workplace and commuter populations.

Workplace population inflow to Inner London store catchments

Our analysis in the previous sections considers exclusively census-based workplace statistics and COWZ, related specifically to individuals self-reported workplace location. In this section we make use of separately released census flow data from the 2011 Census Special Workplace Statistics (ONS 2011b) in order to identify the spatial origins of Inner London workplace populations. Specifically we take the inferred workplace catchment areas (500m buffers) for our three stores of interest and use census flow or interaction data to identify the residential origins of those workplace populations. Thus if we consider the Inner London workplace zones as commuter destinations, these data enable us to identify the (residential) origin of these flows. In Figure 6 commuter origin is shown at the Middle Layer Super Output Area (MSOA^{ix}) level, offering a trade-off between spatial detail and clarity in observing patterns at the regional level. As major employment destinations, it is unsurprising that all three study store catchment areas are comprised of workplace populations that have travelled some distance to work. Commuter origins are drawn from across Greater London and the south east, with a distinct distance decay effect evident.



Figure 6 - Workplace population residential origin by Inner London case study store: a) Ludgate Circus b) Strand and c) Great Portland Street. Residential origin is shown at MSOA level and relates to all individuals with a self-reported workplace location in a workplace zone falling within the relevant store catchment area. Derived from 2011 Census Special Workplace Statistics (ONS 2011b)

The Ludgate Circus and Strand store catchment areas extend well beyond the Greater London boundaries, with notable inflow from affluent residential areas from the south and east of Greater London, extending into the counties of Surrey and Kent. Given the nature of employment in this store

catchment, and the observed characteristics of these workplace populations (Figure 3) it is unsurprising that clear clusters of inflow originate from core affluent commuter towns such as Sevenoaks, in part driven by rail transport linking commuter towns from across Kent, Sussex and South East London directly with major rail termini in the City of London. By contrast, inflows to WPZs within the Great Portland Street store catchment area are slightly more tightly clustered from origins within Greater London and in a corridor extending north and north west into Hertfordshire and Buckinghamshire, where major commuter towns such as Chesham are served by direct rail links to Great Portland Street Underground station.

The patterns observed in Figure 6 confirm reasonable expectations about the nature of commuter inflow to Central London workplaces. Such analysis affords considerable potential for retailers to understand more about the nature of commuter flows and provides opportunities to target their in store offer appropriately. For example, the typical mode of transport (train) and distance travelled by commuters using the Ludgate Circus and Strand stores may considerably limit the potential for sales of bulky, heavy or perishable goods due to the impracticalities of carrying grocery shopping on commuter transport. They also afford potential for retailers such as the Co-op to understand more about the connections between different parts of their store network, as discussed in the following section, where we comment on the utility and potential of these forms of analysis for the retail sector.

Implications and value for the retail sector

Our analysis of Co-op store trading characteristics highlights the importance of workplace populations in driving observed trading patterns at stores in highly transient locations. The recent availability of freely accessible data related to workplace populations and their composition and characteristics thus affords considerable potential for the retail sector. Anecdotal evidence of industry practice suggests that, to date, the focus on workplace populations within retail organisations has been led by 'Property', 'Location Planning' or 'Site Location' functions within the business. This is further reinforced by the selection of workplace populations as a specific topic for an SLA event (SLA 2014), attended almost exclusively by professionals within this sector. The academic-industry collaboration which formed the basis for this research is also driven by the property function within the Co-op.

Nevertheless, a number of the insights gained from our analysis of workplace populations have the potential to support operational decision making related to store operations and marketing, which are not the preserve of location or property teams. Wood and Reynolds (2012) clearly demonstrate the potential for the analysis and insights originating from these location-based functions to support wider decision making across these organisations. We argue that the potential operational uses of these insights related to workplace populations highlight the need for intra-organisational knowledge-sharing in order that these analysis can support both strategic and operational functions. Drawing on our observations in relation to Co-op stores in Inner London, this section identifies specific enhancements to operational and strategic decision making which could be achieved through incorporation of workplace population statistics.

The use of key workplace population indicators such as the WPI or COWZ by store operations and marketing functions may assist in the segmentation and categorisation of store networks and identification of stores where trading characteristics are likely to be driven by workplace derived trade. Our case study stores, located in areas with dense workplace populations, exhibit a trade pattern which is clearly concentrated around the weekday morning (7.30 - 9.30 am), lunchtime (midday - 2pm)

and late afternoon/early evening (4.30 - 6.30pm) periods. These 'time poor' workplace populations are likely to be undertaking a very specific shopping mission, based around the purchase of key breakfast and lunch items, plus snacks and drinks in these convenience stores. The temporal concentration of this trade around the lunchtime period is likely to present a number of operational challenges for these stores related to servicing a high volume of low-value transactions, maintaining on-shelf availability of these key product categories and managing in-store congestion.

The nature of these store catchments, which are predominantly non-residential, limit the volume of transactions on heavier, bulkier or perishable top-up shopping, driven by the high propensity for trade to originate on foot, with many consumers having lengthy commutes by public transport, which may not be conducive to transporting any more than essential grocery shopping. There may thus be limited opportunities to directly generate increased basket-sizes or additional revenue from these consumers due to the specific shopping mission and the nature of demand within these catchments. However, the high sales of specific niche lines such as champagne, at the Ludgate Circus store, suggests that careful consideration of store ranges and product lines at the store level is important in order to maximise sales opportunities. The very high proportion (84%) of WPZs in this store catchment categorised as 'Global Business' is indicative of these types of purchases, with the group dominated by employees in elite managerial and professional roles (Cockings, Martin, and Harfoot 2015a).

The strong late afternoon and evening transaction volumes of higher-value alcoholic beverages and ready meals at these stores represents a distinct shift from the morning and lunchtime bakery and deli sales. Maximising revenue from this combination of high-volume low-value lunchtime transactions and low-volume high-value evening transactions may present considerable opportunities. Flexible use of sales space and in-store ranging to prioritise bakery and deli lines during the morning and lunchtime period, followed by alcoholic beverages and ready meals in the late-afternoon and evening periods would maximise the fit with typical customer shopping missions.

Furthermore, high volumes of affluent consumers utilising these Central London stores present considerable broader opportunities for retailers such as the Co-op to increase their brand presence, brand loyalty and market shares. The habitual nature of workplace (lunchtime) trade means that consumers may frequently visit the same stores in proximity to their workplace, yet may not routinely use other Co-op stores when shopping from home or elsewhere. Our analysis of interaction data identifies that these consumers originate from a commuter belt across the south east and 'Home Counties' and may reside in a town or village where Co-op have fewer stores. Central London Co-op stores could thus be seen as flagship stores where the Co-op brand and values are showcased to the consumer and where vouchering or other promotions could be used to incentivise consumers to use Co-op stores in proximity to their home neighbourhoods, many of which are likely to stock larger ranges and facilitate a larger basket size and value.

Our analysis also suggests that micro level store location matters, particularly in relation to competitor store locations and major drivers of footfall. We observe that overall store performance and temporal trade patterns at the Strand store are driven by its proximity to – and visibility from – a major transport interchange. This store has a lower workplace population within its catchment area (than our other study stores), yet exhibits characteristics consistent with these populations due to the presence of additional commuter footfall driven, at least partially, by the presence of Charing Cross station. The Ludgate Circus store occupies a prime location on a major crossroads and is both the most proximate

and visible convenience store to a nearby key transport interchange. By contrast, the Great Portland Street store does not contain a major transport interchange within its catchment area, but occupies an optimum location on a major thoroughfare adjacent to a major employment site. Whilst this store exhibits very strong lunchtime performance, driven by proximate workplace populations, the comparatively poorer morning and late afternoon/evening performance is likely to be partially driven by the lack of a proximate transport interchange. We suggest that an area of further research should consider these locational factors in detail, considering micro level pedestrian flows, footfall and their temporal characteristics.

Considerable potential also exists to incorporate workplace population data within retailers' store performance evaluation and store location planning functions. Hood, Clarke, and Clarke (2015) note that competition between the major retailers within the convenience grocery sector has intensified the need for robust location-based decision making. Such decision making seeks to evaluate the trading potential of possible new sites and select the best locations for new convenience store development. Given the important role of workplace populations in driving trade at these city centre stores, we argue that the next step is to build these workplace populations into the spatial decision making tools used by retailers for site evaluation.

Wood and Browne (2007) assert that location planning and analysis tools used for large food store development are less valuable for the convenience store format, resulting in a "back to basics" (p233) approach. Thus site visits and analogue approaches (predicting sales at proposed store investments by comparison with existing stores which are similar in size, location and catchment) remain important tools for convenience store location-based decision making (Birkin, Clarke, and Clarke 2016; Wood and Browne 2007). Within densely populated urban areas such analogies would commonly include footfall, visibility, local competition and adjacencies (complementary and competing services within the immediate store vicinity). The incorporation of workplace population statistics and the COWZ offers tremendous potential to select analogues which are comparable to a target site in terms of the magnitude, characteristics and spatial origin of proximate workplace populations.

For large format store development retailers use sophisticated gravity or spatial interaction models (SIMs) and associated spatial decision support systems (SDSS) to predict interactions between retail demand and supply (accounting for store accessibility and attractiveness), enabling prediction of store revenues, retailer market shares and impacts of new store openings on competitors (Birkin, Clarke, and Clarke 2016; Wood and Browne 2007). Whilst we are unaware of current SIM applications for convenience store location-based decision making, ongoing research outlined by Hood, Clarke, and Clarke (2015) recognises the need to evaluate the potential contribution that spatial modelling, including the SIM, could make within the convenience foodstore sector. We argue that the availability of small area data related to workplace populations could considerably improve the feasibility of this approach.

We recommend that subsequent research should seek to use WZS in conjunction with store trading data to build a more complete picture of the magnitude of demand driven by workplace populations. Such insight would enable the demand associated with workplace populations to be estimated with greater accuracy and spatial precision, supporting demand side estimations of retail expenditures, an important component of a spatial modelling framework (Birkin, Clarke, and Clarke 2016). This could be used to evaluate of the potential application of established spatial modelling and revenue

forecasting tools, such as the SIM, to support site evaluation for these smaller-format stores. The greater demand-side locational precision provided by WPZs could make this form of modelling viable at this spatial scale.

A modelling framework incorporating workplace populations would be suitable for the assessment of potential new store locations, providing robust estimations of the volume and composition of non-residential trade to support an evaluation of trading potential. They could also support the identification of existing stores that are performing above/below their modelled potential, enabling retailers to look more closely at the specific trading characteristics of individual stores, in conjunction with demand and supply side data (for example related to competition) and micro level location factors (such as the presence of transport interchanges), in order to understand more about the specific drivers of performance at a store level. In turn, such an assessment would enable pre- and post-investment review to consider not only overall store performance, but also suitability of store format, marketing, ranging and operational characteristics.

Spatial modelling incorporating workplace populations may also support retailers with the development of new store formats within high-density workplace locations. Sainsbury's recent trial of a 'micro' format 1,000 ft² store in Central London (Felsted 2015), plus the opening of dedicated small-format 'Food on the Move' stores by M&S demonstrates grocers desire to tap into transient workplace populations via the development of new formats suitable for major city centre locations. Retailers across a range of sectors are recognising a propensity for store-level demand to be driven by non-residential workplace and transient populations, such as workplace populations shopping close to work during a lunch break or shopping whilst commuting. As a result, 'Click and Collect' points operated by traditional high street retailers such as Argos, or specialist e-commerce collection point operator Doodle have emerged at major commuter transport interchanges and high footfall workplace locations in London. These developments are undoubtedly driven by retailers' recognition that workplace populations represent an important component of store-level demand, fuelled by the availability of robust workplace population statistics, discussed further in our concluding section.

Workplace populations for retail analytics

Our analysis, based on selected Co-op convenience stores in Inner London, strongly suggests that observed store-trading characteristics at these stores are driven by considerable workplace populations within these store catchments. In the commercial and administrative heart of Central London, traditional census-based residential population statistics fail to capture these drivers of retail demand. Non-residential populations, and in particular workplace populations and commuter inflow, represent a crucial alternative population base which we argue is essential for robust retail analytics in locations where considerable clusters of workplace populations are found. These locations include major city centres, such as in our case studies, but also extend to large hospitals, educational establishments (e.g. universities), retail centres and major science or industrial parks.

The recent provision of a specific output geography for the provision of workplace population statistics is a major enhancement which considerably strengthens the potential for incorporation of workplace populations in retail analysis and decision making. The specific workplace geography is fit-for-purpose for the analysis of non-residential workplace populations which tend to cluster spatially and temporally in non-residential locations. Prior to the release of workplace zones, the provision of small

area workplace population statistics which could support retail analysis had been limited, largely due to the limited utility of existing census geographies in reporting data on workplace populations.

We demonstrate that workplace population geographies, workplace zone statistics and the classification of workplace zones afford tremendous potential for understanding drivers of store performance, observed store trading patterns and evaluation of retail store performance, supporting operational and strategic decision making. We identify that more work is needed to make use of these population statistics in a predictive context. The next step is to evaluate the potential to build these populations and their micro geography spatial and temporal characteristics into predictive models that can be used at a strategic level for store performance evaluation and store and network location-based decision making.

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Endnotes

- ⁱ WPZs – Workplace Zones – a small area output geography specifically created for the release and dissemination of workplace population statistics
- ⁱⁱ WZS – Workplace Zone Statistics – small area population statistics related to individuals working within a given WPZ and derived from self-reported postcode of an individual's 'usual place of work'
- ⁱⁱⁱ ONS – Office for National Statistics – the UK national statistical institute and official producer of population statistics
- ^{iv} COWZ – Classification of Workplace Zones – a geodemographic classification of WPZs based on workplace population (employee and employment) characteristics
- ^v OAs – Output Areas – the smallest of a hierarchy of output zones used for dissemination of census-based population statistics, with an average population of 309 individuals
- ^{vi} OAC – Output Area Classification – a geodemographic classification of Output Areas based on residential population composition and characteristics
- ^{vii} SLA – Society for Location Analysis – the not-for-profit professional organisation supporting the site location research community in the UK
- ^{viii} WPI – Workplace Population Intensity - A derived indicator of workplace population density by WPZ
- ^{ix} MSOA – Middle Layer Super Output Area – an output zone used for dissemination of census data with a minimum population of 5,000 and maximum of 15,000