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The emerging geography of e-commerce in British retailing

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This paper explores the growth of e-commerce in British grocery retailing and examines the spatial variations in e-commerce usage. The main data source is a large commercial consumer survey (Acxiom's Research Opinion Data) rarely used by academics to date. Using these data in combination with census data, the paper addresses a number of key questions. After outlining key trends in the dataset on e-commerce usage (by product and over time) the first research question is: How do e-commerce purchases vary by geodemographic group? To answer this question, we explore e-commerce usage by age, sex and social class. The second key question is: Does e-commerce usage vary by type of geographical region? Thus, we explore variations in usage for urban and rural areas. The dynamics of urban–rural diffusion are also addressed here – by examining, in addition, the spread of broadband use across Britain. The last question is: To what degree do e-commerce sales vary by access to physical stores? This is addressed by examining consumers' home locations in relation to geographical accessibility. The results show that age and income are crucial demographic discriminators of e-commerce usage, as is rural location versus urban, and distance from physical stores.

Keywords: e-commerce; retail; geography; grocery; UK

Introduction

E-commerce is one of the main drivers of retail growth in many of the economies in the developed world. A study in 2014 by the UK's Centre for Retail Research estimated that retail businesses generated an estimated £38.8 billion from e-commerce sales in 2013, with a forecast for £45 billion by the end of 2014. Thus, in 2013, market share for e-commerce sales in the UK was reported as being 13.5%. In the United States, the equivalent figures were reported at US$268 billion, or 10.6% of total sales (Centre for Retail Research, 2014).

In some markets (travel, books, DVDs, for example) the percentage of internet sales is undoubtedly higher, making up between 50% and 80% of all retail sales. In other sectors the contribution made by internet sales is significantly lower. Internet food sales, for example, are lower at around 5% (but also growing rapidly). Much of this growth has been fuelled by increasing household access to broadband technology. The UK has Europe's second highest, and the world's fifth highest, number of broadband subscriptions, although convergence is fast approaching across Europe (European Commission, 2014). These higher consumer usage rates of broadband have enabled the UK to

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become a leading centre for online sales in general, and for online sales of grocery products in particular (compared with rates outside the UK).

According to some commentators in the 1990s, increased e-commerce activity was predicted to spell the 'death of distance', implying that the market for e-commerce sales would be less spatially differentiated than traditional store sales patterns (Cairncross, 1997, being the most cited example). Although such predictions have been revised and thought out more carefully in recent years (Tranos & Nijkamp, 2013, for example, in relation to economic geography more broadly), very little research has explored *spatial* variations in e-commerce usage to test those predictions of the decline in importance of geography, and to examine whether in fact local geodemographics and distribution networks might still impact crucially on the volume of activity. The aim of this paper is to investigate the geography of e-commerce activity in more detail, especially as seen in UK grocery retailing. It will be concerned exclusively with transactions between businesses and consumers (B2C) rather than either business to business (B2B) or consumer to consumer (C2C). The paper makes extensive use of newly acquired data from Acxiom Ltd, which provides a major survey of UK consumers and their shopping habits. The Acxiom data have significant advantages over surveys seen in the literature to date. The first is the size of the survey: it gathers detailed and up-to-date information on consumer spending habits, preferences and socio-demographic information for over 1 million UK consumers every year. Second, each household in the survey has a postcode – thus the richness in terms of geography is substantial. In addition, it is a longitudinal dataset that permits the study of a rapidly changing market. Our partnership with Acxiom provides a unique opportunity for academics to explore such rich datasets on the geography and dynamics of consumer behaviour. The data are described in more detail in the second section.

The third section explores the growth of e-commerce in the UK in more detail. First, we examine total growth and growth by different product groups. Then, from an extensive review of the literature, we set out an important set of hypotheses or issues that we believe have major implications for the delivery and marketing of e-commerce products, allowing us to explore the geography of e-commerce in more detail in the fourth section. From that literature review we argue there are at least three major issues to be explored in more detail. First, there are a number of studies that have highlighted differences in activity rates by demographic group (e.g. Weltevreden, 2007). Thus, our first research question is: To what extent does e-commerce usage vary by demographic group? Second, studies suggest that there are interesting rural/urban differences in usage: in short, 'geography seems to matter for e-shopping' (Farag, Weltevreden, van Rietbergen, & Dijst, 2006, p. 56). These differences are in part driven by variations in rural/urban access to broadband technology (Longley & Singleton, 2009; Longley, Webber, & Li, 2008). Thus, our second main research question is: To what extent does e-commerce usage vary by population density (urban/rural)? Third, and related to the second argument above, access to physical stores may also be important in understanding spatial patterns. Thus, our third main research question is: To what extent do we see greater usage of e-commerce in areas where access to physical stores is limited? Such areas might especially include rural communities, but could also refer to areas within cities that have poor access to major grocery retailers – so-called 'food deserts' (Clarke, Eyre, & Guy, 2002; Wrigley, Warm, & Margetts, 2003). Concluding comments are offered in the fifth section.

The Acxiom Research Opinion Poll (ROP)

The primary aim of the ROP is to gather detailed and up-to-date information on consumer spending habits, preferences, socio-demographic information and the geographic location of respondents. The combination of these different pieces of information allows for detailed insights into the spending patterns of different types of people within different geographic areas. Moreover, with the survey being distributed annually and including questions not asked on other public sector surveys, it also provides a unique source of time-series data on the demographic and socioeconomic characteristics of people and households across the UK. The accuracy and robustness of Acxiom's products for very small geographic areas are in part due to the quality and volume of data that the ROP survey delivers (Thompson, Stillwell, Clarke, & Bradbrook, 2010, has a broader review of quality issues). Table 1 demonstrates the number of questions and contents in each survey between 2004 and 2010.

Table 1. Structure of the Acxiom Research Opinion Poll (ROP) questionnaire, 2004–10.

Year	Questions	Sections	Section contents
2004	147	8	Hobbies & Activities; Shopping; Personal Care; About Your Home; Computer/Internet; Smoking; Motoring; You and Your Family
2005	163	14	Hobbies & Interests; Shopping; Drinks; Smoking; Pets; You & Your Family; Motoring; Charities; Family Health; TV & Telephone; Computing & Internet; About Your Home; Financial Planning; Information Guides
2006	148	22	Groceries; Hobbies; Shopping; Your Interests; Drinks; Your Home; Outgoings; Your Occupation; Charities; You & Your Family; Pets; Family Health; Motoring; Financial Products; TV & Telephone; Computing & Internet; Local Area; Tobacco; Financial Planning; Planning Your Future; Information Guides
2007	136	25	Groceries; Shopping; Newspapers; Hobbies; Books; Home; Home Improvements; Your Local Area; Occupation; Outgoings; Financial Products; You & Your Family; Motoring; Cars; Charities; Family Health; Telephone & Internet; Shopping Channels; Leisure; Entertainment; Pets; Tobacco; Financial Planning; Retirement; Education
2008	133	27	Groceries; Shopping; Newspapers; Hobbies; Entertainment; Environment; Home; Home Improvements; Your Local Area; Charities; Occupation; Business Owner; You & Your Family; Family Health; Health Concerns; Outgoings; Internet; Telephone & TV; Financial Products; Financial Planning; Holidays; Pets; Education; Tobacco; Leisure; Motoring; Cars; TV Viewing
2009	130	26	Groceries; Shopping; Your Local Area; Hobbies; Newspapers; Coffee; Insurance; Environment; Internet & TV; You & Your Family; Occupation; Outgoings; Home; Leisure; Financial Products; Charities; Telephone; Credit Crunch; Financial Planning; Family Health; Technology; Education; Cars; Pets; Tobacco; Shopping Vouchers
2010	141	29	Groceries; Shopping; Coffee; Hobbies; Home; Home Improvements; Insurance; Household; Outgoings; You and Your Family; Family Health; Financial Products; Charities; Occupation; Your Local Area; Internet; Telephone; Technology & TV; Financial Planning; Environment; Research; Animal Welfare; Leisure; Tobacco; Education; Skills; Cars; Newspapers; Shopping Vouchers

Table 1 indicates that the ROP offers a large number of questions across a range of different areas. For example, the 2009 survey boasts 130 questions spread across 26 different sections. The survey covers topics such as consumption and expenditure (Groceries, Shopping, Newspapers and Outgoings), preferences and opinions (Environment, Charities and Local Area), health and education (Family Health, Education, and You & Your Family), demographics and geography (You & Your Family, and Home), and the economy (Occupation, Financial Products, Financial Planning and Credit Crunch). The ROP survey is undertaken twice a year, initially in September and then in the following January. The results from these two surveys are combined into one data file and are packaged up as the data for a complete year.

Acxiom ROP is the largest annual paper-based survey in the UK and the largest population study outside of the decennial Census of Population. On average, Acxiom has received over 1 million household responses from the ROP each year since 2004. The survey responses inevitably show a certain amount of variation between groups. For instance, there is a slight underrepresentation of younger and more affluent respondents and an overrepresentation of more elderly respondents. The sorts of bias found in the survey are by no means unique, however, as they are often found in many official sample-based surveys (Frosztega, 2000; Thompson et al., 2010). In a smaller sample, and for different purposes, then a case might perhaps be made for a need to reweight different members of the survey population. However, even with the slight underrepresentations we are confident that the size of the survey allows us to present a series of comparisons between the activity and behaviour patterns of different groups with conclusions that would be largely unaltered by the inclusion of weights. A similar strategy, based on a more detailed and critical examination of the Acxiom data, has been advocated elsewhere (Thompson et al., 2010).

Growth in e-commerce in the UK

Accurate predictions of the total e-commerce market are notoriously difficult to obtain, as argued in the Introduction. There are a multitude of surveys using different sample sizes and product ranges. As noted above, the Centre for Retail research in the UK estimates the retail market for e-commerce grocery sales in 2013 to be worth £38.8 billion. However, we know that market penetration varies by organization and by product. Some organizations have been seen as market leaders in the development of e-commerce strategies and technologies, whilst others have had notable failures, especially a number of early pure e-players who were 'crippled by distribution costs' (Wrigley & Currah, 2006). In the UK grocery market, Tesco has been widely acclaimed as the leading grocery e-commerce provider, whilst Sainsbury's and Waitrose had significant problems in the 2000s with their strategies. Wrigley and Currah (2006) note the importance of having a workable 'back region' strategy of stores or distribution depots to support and handle e-commerce orders (one of the reasons why e-commerce remains in their opinion a geographically grounded business). In addition, there is evidence that the quality of websites is important in determining usage – e-commerce will expand more quickly if the sites are attractive, which might include reputation, reliability, ease of navigation, ability or ease of product substitution, design and ease of interaction (Chiagouris & Ray, 2010; Kang & Kim, 2006; Wrigley & Currah, 2006).

Stern (1999) was among the first commentators to identify a greater likelihood of success for certain products than others. According to Stern, low rates of growth in e-commerce are expected in markets such as food and drink, rising to moderate levels

of uptake in clothes and electrical goods. The highest rates of penetration are expected in books and music/films. Later experience adds credibility to these suggestions. Thus, using data from the Dutch Multiscope panel, Weltevreden (2007) finds a 66% online share for books and 62% for 'CDs, DVDs and videos', falling to 5% for shoes and 3% for outer clothing. Similar evidence from the Acxiom ROP is shown in Figure 1 for the UK market. On the basis of this evidence, it seems that e-retail activity levels are high but steady for books, CDs and DVDs, and to a lesser extent for clothes. Although grocery sales are lower, expansion is still strong and, of course, there is a very large market by both volume and value.

Figure 2 shows the growth in total e-commerce sales in the UK between 2006 and 2011 as recorded by the UK Office of National Statistics (ONS). Alongside the general trend of escalating sales over time, punctuated with regular seasonal jumps at Christmas, it is useful when examining these figures to consider the thesis that e-commerce might be more important in times of economic hardship. Reynolds (2011) suggests the lower transaction costs that e-business firms are often more easily able to generate may appeal more to customers who are more price sensitive, additionally arguing that UK online retailers generally did well in late 2009 and early 2010.

There is also a body of literature that has explored the frequency and nature of purchases online and attempted to classify consumers by their behaviour in this respect. Thus, Soopramanien and Robertson (2007) break their internet users into 'browsers' and 'buyers' and argue that there are considerable differences in behaviour between those persons purchasing online, those who browse but do not purchase, and those who browse and then become purchasers. To explore the notion of different types of e-commerce shopper we draw here on the model suggested by Mokhtarian (2002) in relation to telecommunications, consumer dynamics and the impact of these changes on transportation patterns in the city (although we note other frameworks may be equally valid and useful). She identifies four different 'cross-mode' relationships between modes of communication: neutrality, modification, complementarity and substitution. Weltevreden (2007) transfers this framework directly to e-commerce:

- Neutrality: shoppers at physical stores who are not interested in e-commerce.
- Modification: these consumers may remain loyal to physical stores but modify their behaviour to include infrequent purchases from the internet.

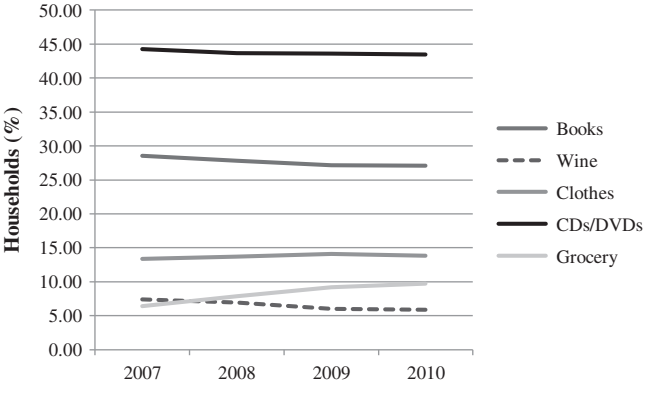

Figure 1. Percentage of households that use e-commerce 'often' to buy different products. Source: Acxiom Research Opinion Poll (ROP).

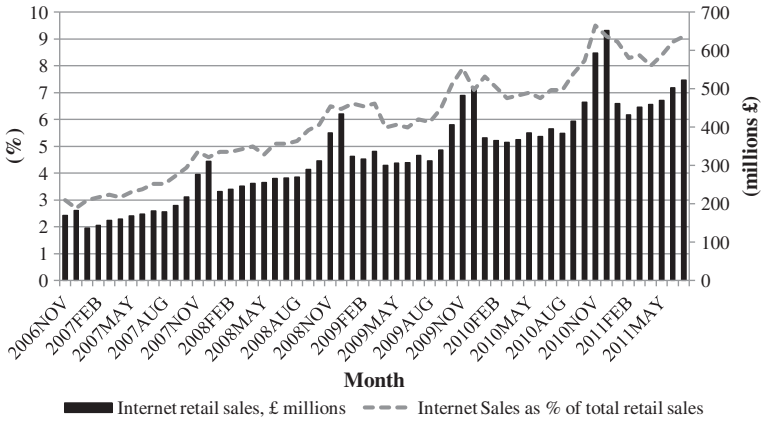

Figure 2. UK internet retail sale estimates, 2006–11.
Source: ONS (2011).

- Complementarity: here shoppers seem to switch equally between physical stores and e-commerce, and may be frequent users of both. From the literature to date this would seem the most frequent form of behaviour of those using e-commerce. Hernandez, Gomez-Insausti, and Biasiotto (2001), Ferrell (2004), and Farag et al. (2006) found that shoppers make extensive use of both modes of retailing and often browse online before purchasing at physical stores.
- Substitution: shoppers at physical stores become almost exclusively e-commerce shoppers. There is less evidence of this to date, although a number of studies indicate that regular online shoppers now make fewer physical shopping trips (Ferrell, 2004). This also relates to an interesting debate in the literature about whether e-commerce complements or conflicts with physical store retailing: the clicks *and* bricks versus the clicks *or* bricks debate (Burt & Sparks, 2003).

Some elements of an alternative framework for understanding demographic variations have been provided by Wilson-Jeanselme and Reynolds (2005). The major purchasing criteria are identified as *time*, *quality* and *cost*, and it is argued that consumer attitudes may be separated into five groups, as shown in Table 2. In order to compete for the business of each group, 'order quality' criteria need to be satisfied, and in order to capture them then 'order winning' criteria are paramount. In addition to evaluating the competitiveness of e-retailers, this framework is suggestive of uptake for both products

Table 2. Demographic segmentation by time, quality and cost.

	Order winning	Order qualifying
Quality on time	Quality	Delivery time reliability/subs
Time and cost conscious	Ordering time	Delivery cost/quality
Just what I ordered	Quality	Substitutes
Cost conscious	Delivery cost	10% discount
Time conscious	Ordering time	Delivery time reliability/subs

Source: Wilson-Jeanselme and Reynolds (2005).

(Figure 2) and also demographics. For groups who are 'cost conscious' (the elderly or less affluent perhaps) it might be expected that internet retailers could find it more difficult to compete (especially in relation to e-grocery where distribution costs are typically additional) than for those who are 'time conscious' (e.g. those with young families or in professional occupations).

Table 2 thus suggests that demographics are important in understanding different consumer uses and loyalties to e-commerce. This issue will be explored in more detail in the next section, which also introduces the importance of geography.

The geography of e-commerce

A socio-economic analysis

First, to test the significance of different socio-economic variables in the ROP data, we use a binary logistic regression to investigate the likelihood of households using the internet 'often' to purchase groceries, controlling for a range of explanatory variables (age, income, tenure, household size). Before presenting the statistical analysis, it is important to present a description of the dataset to show what percentage of respondents fall into each factor level and what is the overall sample size. Table 3 shows the sample size by three categories: 'uses the internet often to buy goods and services' (yes/no) and missing = no response.

Logistic regression has many similarities with linear regression, but linear regression cannot be used in this case because the outcome variable (grocery spend for e-commerce) in the ROP is recorded categorically. The logistic regression equation expresses the linear regression equation in logarithmic terms (called the logit) and thus overcomes the problem of violating the assumption of linearity (Field, 2009). The exact form of the equation can be expressed in multiple ways; however, in this case equation (1) expresses the probability of Y occurring (the probability that a household belongs in a certain e-commerce grocery spend category):

$$P(Y) = \frac{1}{1 + e^{-}\left(e^{b_0 + b_1 x_{1i}}\right)} \tag{1}$$

where e is the base of natural logarithms; b_0 is the constant; x_1 is the predictor variable; and b_1 is the coefficient (weight) attached to the predictor.

In terms of the defined model, the binary response variable (use the internet to purchase groceries) is represented as $Y = 1$ for 'often' and $Y = 0$ for everything else. Additionally, crucial to the interpretation of logistic regression is the value of the odds ratio (exp(B)), which is an indicator of the change in odds resulting from a unit change in the predictor (equation 2). If the odds ratio is greater than 1, then it indicates that as the predictor increases the odds of the outcome occurring increases. Conversely, a value less than 1 indicates that as the predictor increases, the odds of the outcome occurring decreases:

$$\Delta \, odds \, \frac{odds \; after \; a \; unit \; change \; in \; the \; predictor}{original \; odds} \tag{2}$$

The outputs of the binary logistic regression models are shown in Table 4. Each variable includes the odds ratio of using the internet 'often' to buy groceries (high usage) for each category of a variable compared with the reference/base level (the first category for each variable). An odds ratio greater than 1 means a household in that category is

Table 3. Sample size of respondents who 'use the internet often'.

	Variables	No	Yes	Missing	Total
OAC 1	Constrained by Circumstances	6004	1167	3968	11,139
	Multicultural	1910	382	1179	3471
	Typical Traits	9712	2712	5379	17,803
	Blue Collar Communities	9985	2389	6048	18,422
	Countryside	4410	1437	2229	8076
	Prospering Suburbs	9568	2534	4897	16,999
	City Living	760	209	457	1426
	Missing	0	0	0	0
Gender	Female	26,593	7000	15,930	49,523
	Male	15,695	3819	8209	27,723
	Missing	61	11	18	90
Age (years)	18–29	1713	824	1393	3930
	30–39	3295	1812	2067	7174
	40–49	6474	2739	3604	12,817
	50–59	7889	2130	4029	14,048
	60–69	9162	1574	4493	15,229
	70+	8953	509	6699	16,161
	Missing	4863	1242	1872	7977
Household size	1–2	33,481	8367	13,363	55,211
	3–4	5879	1947	2035	9861
	5+	268	97	68	433
	Missing	2721	419	8691	11,831
Cars	0	8002	1390	4175	13,567
	1	19,794	4642	6496	30,932
	2	7803	3381	1665	12,849
	3+	1567	764	381	2712
	Missing	5183	653	11,440	17,276
Income	< £9999	7563	939	4906	13,408
	£10,000–£19,999	10,369	2006	5453	17,828
	£20,000–£29,999	6195	1928	2923	11,046
	£30,000–£39,999	3680	1604	1841	7125
	£40,000–£49,999	2007	1204	1143	4354
	£50,000–£74,999	1232	950	742	2924
	£75,000+	483	458	289	1230
	Missing	10,820	1741	6860	19,421
Internet connection	No	310	44	267	621
	Yes	17,903	6599	8699	33,201
	Missing	24,136	4187	15,191	43,514

Source: Acxiom Research Opinion Poll (ROP).

more likely to use the internet 'often' to buy groceries/services than the base level and vice versa for odds ratios of less than 1. In this instance, the data are for 2011 and include households within Yorkshire and the Humber (an English region in the north-east of the country).

In the discussion below we analyse the key factors deemed to be most important from Table 4.

Age and gender

From Table 3, age is clearly seen to be an important discriminator in terms of e-commerce. Today, many young people access the internet on a regular basis. The ONS

Table 4. Significance of key socio-economic factors for explaining high e-commerce usage for groceries.

	Variables	*B*	SE	Wald	d.f.	Significance	Exp(*B*)	95% CI for Exp (B) Lower	Upper
OAC 1	Constrained by Circumstances			29.289	6	.000			
	Multicultural	−.230	.102	5.086	1	.024	.794	.650	.970
	Typical Traits	−.025	.062	.157	1	.691	.976	.864	1.102
	Blue Collar Communities	−.030	.062	.239	1	.625	.970	.859	1.095
	Countryside	.225	.073	9.465	1	.002	1.252	1.085	1.444
	Prospering Suburbs	−.030	.065	.211	1	.646	.971	.855	1.102
	City Living	.109	.129	.712	1	.399	1.115	.866	1.438
Gender	Female						1.000		
	Male	−.081	.036	5.119	1	.024	.922	.860	.989
Age (years)	18–29			309.402	5	.000			
	30–39	.027	.070	.149	1	.699	1.027	.896	1.179
	40–49	−.213	.066	10.362	1	.001	.808	.710	.920
	50–59	−.551	.068	65.157	1	.000	.577	.504	.659
	60–69	−.652	.073	79.346	1	.000	.521	.451	.601
	70+	−1.220	.103	139.475	1	.000	.295	.241	.361
Household size	1–2			9.088	2	.011			
	3–4	−.139	.047	8.876	1	.003	.870	.794	.954
	5+	−.162	.239	.464	1	.496	.850	.532	1.357
Cars	0			23.337	3	.000			
	1	.121	.052	5.411	1	.020	1.129	1.019	1.250
	2	.233	.060	15.250	1	.000	1.263	1.123	1.420
	3+	.373	.087	18.516	1	.000	1.452	1.225	1.720
Income	< £9999			274.042	6	.000			
	£10,000–£19,999	.218	.064	11.466	1	.001	1.244	1.096	1.411
	£20,000–£29,999	.413	.067	37.996	1	.000	1.512	1.326	1.724
	£30,000–£39,999	.626	.071	77.797	1	.000	1.870	1.627	2.150
	£40,000–£49,999	.860	.078	122.362	1	.000	2.364	2.030	2.753
	£50,000–£74,999	1.021	.085	144.296	1	.000	2.777	2.351	3.281

(*Continued*)

Table 4. (*Continued*).

	Variables	*B*	SE	Wald	d.f.	Significance	Exp(*B*)	95% CI for Exp (B)	
								Lower	Upper
	£75,000+	1.254	.109	131.706	1	.000	3.504	2.829	4.341
Internet connection	No					1.000			
	Yes	.907	.173	27.325	1	.000	2.477	1.763	3.479
	Constant	−2.039	.185	120.943	1	.000	.130		

Note: Odds ratios shown in italics are not significantly different from the reference category.

show that 98.7% of 16–24 year olds have used the internet compared with only 23.8% of those aged 75 or more (ONS, 2011). An interesting study by FDS International in 2010 (on behalf of the UK Office of Fair Trading – OFT) asked 1800 telephone interviewees about their e-commerce habits as well as their more general internet usage. Of those regular users of e-commerce there was again important demographic variations. Amongst the 16–34-year age group, 45% were classed as regular users, with this figure declining to 28% for 35–44 year olds, 10% for 55–64 year olds and only 5% for those aged 65+. Figure 3 shows the much more frequent use of e-commerce by young people seen in the Acxiom data.

Variations in e-purchasing patterns are also structured by gender, although this is a weaker discriminator in Table 4. According to the literature, men are consistently more likely to patronize the internet than women (Weltevreden, 2007) and, as shown in Figure 4, those men who do use the internet are more likely to be *frequent* users in the ROP data. This pattern holds for all groups up to age 40 and for those aged 50–74, and could reflect the increased value attached by men to the (reduction in) time spent shopping, or perhaps a lower emphasis on quality.

Income

An appealing feature of the Acxiom data, as compared with the UK Census, for example, is extensive capture of individual and household income data. Thus, it is possible to demonstrate, as in Table 4, that the highest income households are those with the strongest e-retail preferences. Figure 5 explores the income data in more detail. On this measure, the very wealthiest households are 10 times more likely to be frequent users than their low-income counterparts. Low usage is marked for all groups with an annual income below £25,000, and even more pronounced below £10,000. There could be some interaction with the age variable here, so that the elderly who have already been found to be relatively low users are also often low earners. Uptake of broadband and internet services is clearly also an important issue as typically low-income groups simply lack access to the necessary technologies and funds (see below).

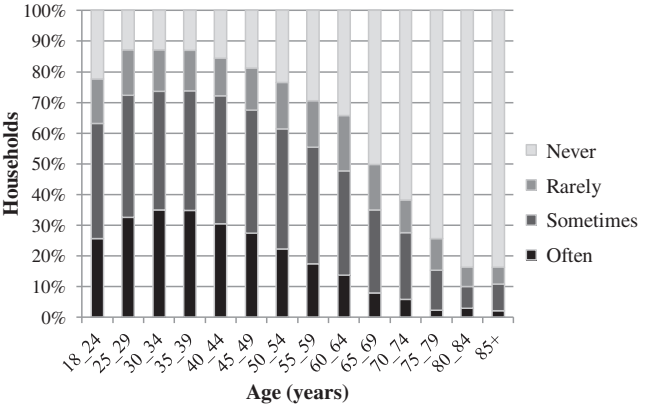

Figure 3. Percentage of households recording frequency of use of the internet to buy goods and services by age.
Source: Acxiom Research Opinion Poll (ROP).

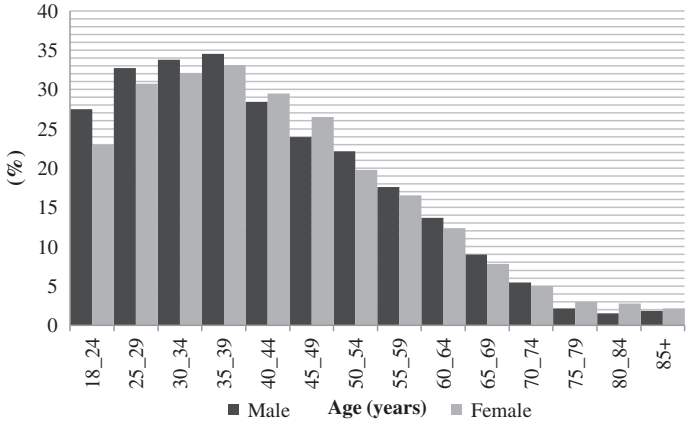

Figure 4. Percentage of households that responded 'Often' to the question 'How often do you use the internet to buy goods and services?' by age and gender.
Source: Acxiom Research Opinion Poll (ROP).

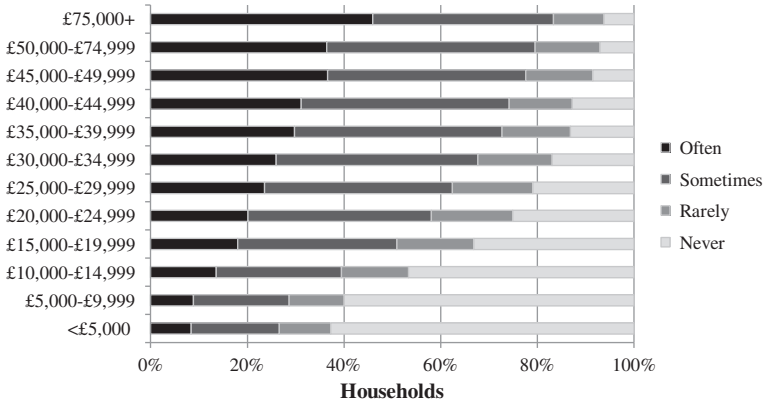

Figure 5. Variations in usage for the question 'How often do you use the internet to buy goods and services?' by household income.
Source: Acxiom Research Opinion Poll (ROP).

A geodemographic analysis

From Table 4 it can be seen that a number of output area classification (OAC) geodemographic groups are seen to be important discriminators of e-commerce activity. In particular, 'countryside' and 'city living', which contains more younger, professional residents. It is useful to consider whether some further discussion around geodemographics could also provide important insights. In Table 5 a composite assessment using the UK OAC is provided. The UK OAC uses a combination of many socio-economic, demographic and housing variables to classify neighbourhoods into clusters of areas varying from 'transient' to 'settled' and from 'public housing' to 'prospering semis' (Vickers & Rees, 2007). The results show an interesting level of variation; for example, a threefold variation of 'internet avoidance' between 'prospering younger families' (only

Table 5. Households purchasing goods online by output area classification (OAC).

Code	Name	Often	Sometimes	Rarely	Never	Total	Internet connection
4a	Prospering Younger Families	23.62	39.32	15.84	21.22	100	91.96
3a	Village Life	21.51	32.40	12.60	33.49	100	80.85
6a	Settled Households	19.61	33.88	14.07	32.43	100	83.39
2b	Settled in the City	18.90	34.55	12.80	33.74	100	80.33
3b	Agricultural	21.27	31.52	15.37	31.83	100	82.96
3c	Accessible Countryside	18.30	34.00	14.40	33.30	100	83.27
6c	Young Families in Terraced Homes	19.72	31.16	14.53	34.59	100	82.32
6d	Aspiring Households	19.14	30.93	15.93	34.00	100	84.19
4c	Prospering Semis	17.41	31.91	13.62	37.05	100	82.28
6b	Least Divergent	21.11	28.13	13.63	37.13	100	79.76
4b	Prospering Older Families	17.09	31.68	14.47	36.76	100	82.92
4d	Thriving Suburbs	16.07	31.08	15.25	37.60	100	84.62
1c	Older Blue Collar	17.18	29.54	12.81	40.47	100	76.98
1b	Younger Blue Collar	16.54	29.69	12.87	40.90	100	77.97
2a	Transient Communities	18.11	26.77	18.11	37.01	100	82.88
1a	Terraced Blue Collar	17.17	26.60	12.10	44.13	100	77.27
7a	Asian Communities	15.36	27.59	14.73	42.32	100	79.27
5b	Older Workers	15.57	25.42	12.40	46.62	100	73.34
5c	Public Housing	13.38	24.71	11.97	49.94	100	72.14
7b	Afro-Caribbean	9.50	24.50	14.50	51.50	100	67.29
5a	Senior Communities	9.60	19.02	8.59	62.79	100	54.59
	Total	17.73	30.15	13.54	38.58	100	83.11

Sources: Acxiom Research Opinion Poll (ROP), 2004–10; ONS (2001).

21.22% do not use the internet) and 'senior communities' (62.79%). Highest usage appears for groups 'prospering younger families' and 'village life'. The lowest usage levels appear for groups 'senior communities', 'Afro-Caribbean' and 'public housing' (Picot-Coupey, Hure, Cliquet, & Petr, 2009, have a comparison analysis of French demographic groups most likely to shop online).

An inevitable reservation with this style of geodemographic analysis is the degree of averaging that takes place even when the census output areas (OAs) are relatively small neighbourhoods in the order of only 120 households. Hence, 'senior communities', for example, cannot be expected completely to exclude younger residents (the 'ecological fallacy'; Birkin, 1995). Unfortunately similar classifications for *individuals or households* are not available for this purpose (cf. Longley and Singleton, 2009, who suggest a classification of households with specific reference to their online behaviours; and also Burns, Birkin, Heppenstall, & See, 2012, in which a general-purpose individual and household classification is currently in development).

Geospatial: urban/rural

Table 5 shows variations between different neighbourhood clusters reflecting underlying demographics and social geography. 'Village life' appears to have high internet usage. It is an interesting debate as to whether we might expect rural e-commerce usage to be higher than urban. Rural consumers certainly face greater accessibility problems in relation to physical stores and may thus find e-commerce and home delivery more

convenient and 'accessible'. In contrast, De Blasio (2008) concludes for e-banking that internet usage is more frequent among urban consumers than among non-urban ones and that e-commerce is largely unaffected by city size. In relation to the rural/urban question, it is often argued that e-commerce is a predominantly urban phenomenon because new technology usually starts in centres of innovation (innovation-diffusion hypothesis; Farag et al., 2006).

Table 6 shows a profile of internet usage according to population density by residence of user. The locations are classified into three bands according to the MLSOA urban/rural classification (where MLSOA is the Middle-Layer Super Output Area spatial scale of around 7000 households; ONS, 2013). While the patterns of variation that emerge are not compelling, if anything what we see contradicts evidence to be found elsewhere in the literature that urban areas are more important for e-commerce.

Perhaps these high contemporary rates for rural areas reflect the rise and diffusion of broadband technology over space. However, there has been little or no research to date depicting *changing* broadband penetration for smaller geographical areas (although see the useful static analysis in Longley & Singleton, 2009; Longley et al., 2008). Thus, it is useful to explore the growth of broadband usage across the UK using the annual Acxiom ROP data.

Figure 6 shows the very rapid rollout of broadband in the UK by government region (GOR). Overall connection rates start at around 57% in 2007, with a marked concentration of internet access in London and the south-east of the country. In the next three years, availability accelerates quickly to a situation in which the vast majority of areas provide internet access to more than 70% of households. Although there is still a pattern of greatest concentration in the south and east, only the most extremely rural areas of Wales and the Southern Uplands of Scotland look to be relatively underprovided.

These changing patterns over time can be interpreted in a number of ways. In contrast to the diffusion effect, it is rural users who have most to gain from electronic transactions (because they lack access to high-quality urban retail services; see below). Certainly, there is evidence outside the UK also that as internet technology spreads to rural areas, there is a greater awareness and belief that this form of retailing can be more relevant to rural consumers (Lennon et al., 2007). Another consideration here is that place of residence could be becoming less important as a determinant of internet access. Thus, it could be that many users are actually accessing services from the workplace and increasingly from mobile devices, which could ultimately neutralize provision to a considerable extent.

Given this diffusion of broadband diffusion from the south-east we might also expect internet usage to be higher in similar communities in the south-east compared with further north – in other words, to see a higher market share within prospering young families in the south-east compared with prospering young families in the

Table 6. Variations in usage for the question 'How often do you use the internet to buy goods and services?' by Middle-Layer Super Output Area (MLSOA) urban/rural classification.

	MLSOA urban/rural	Often	Sometimes	Rarely	Never	Total
Urban	Urban	17.11	29.78	13.55	39.56	100
Rural	Town and Fringe	20.33	31.17	13.25	35.25	100
Rural	Village, Hamlet & Isolated Dwellings	20.43	32.90	13.96	32.71	100
Total	Total	17.76	30.18	13.54	38.52	100

Source: Acxiom Research Opinion Poll (ROP).

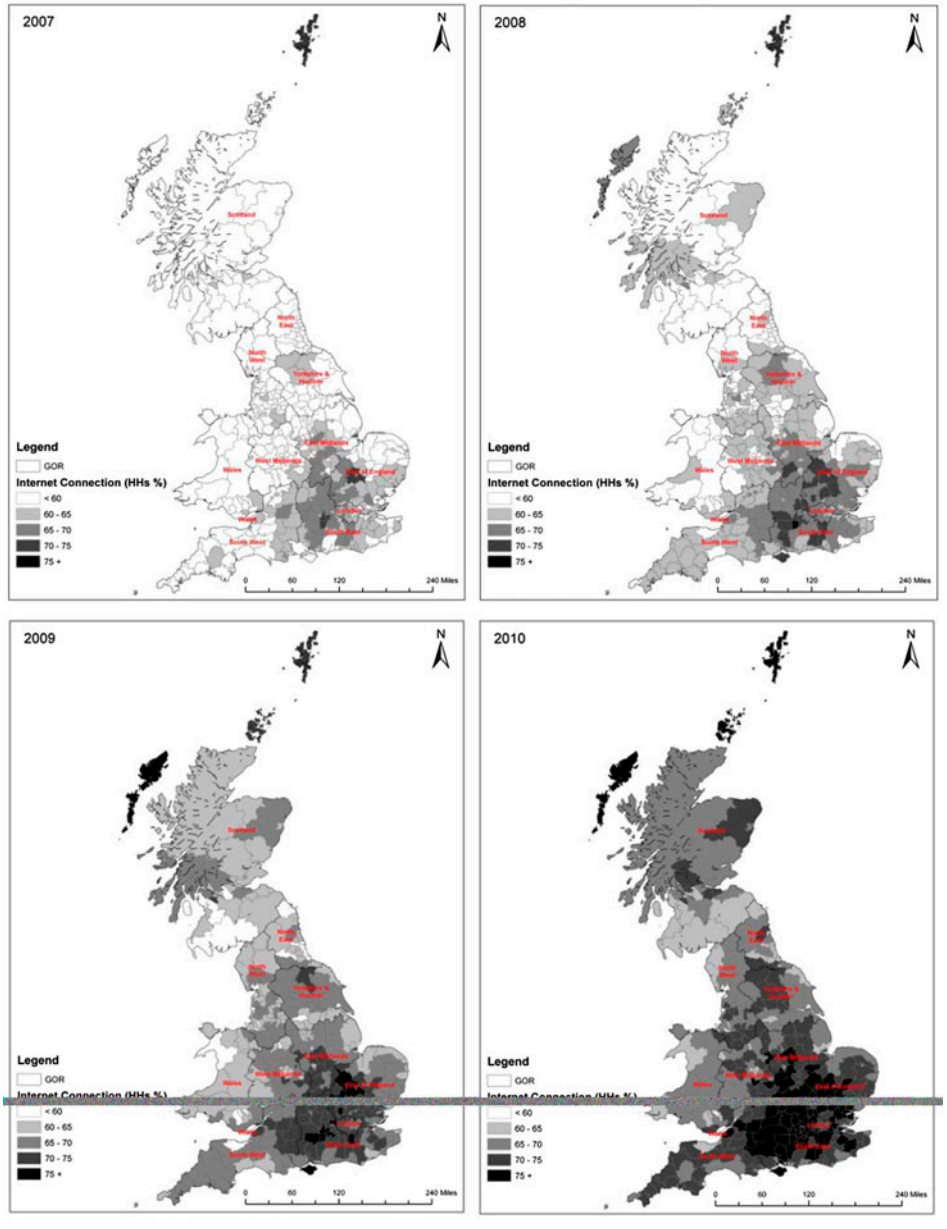

Figure 6. Households with an internet connection, 2007–10.
Source: Acxiom Research Opinion Poll (ROP).

north-east. The rationale for this hypothesis comes from surveys that have shown that early adopters of online channels are more likely to buy a wider range of products and more frequently than late adopters (Chiagouris & Ray, 2010; Liu & Forsythe, 2011; Shih & Venkatesh, 2004). Figure 7 plots the spatial diffusion of e-commerce shopping since 2007; it seems to support the idea that on a like-for-like basis the more highly urbanized consumers of the south are more advanced in their internet usage (see also

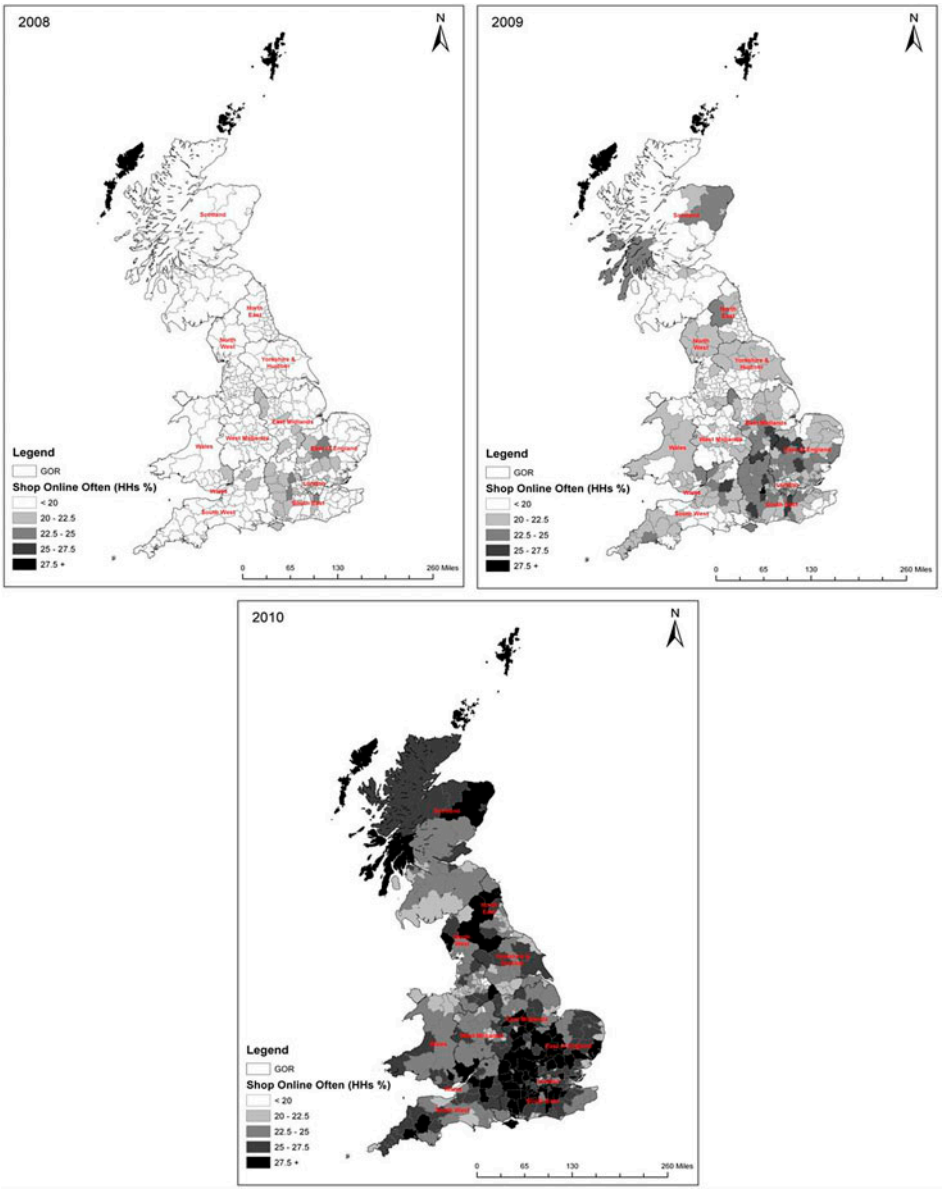

Figure 7. Frequent e-commerce usage by households in the UK, 2008–10.
Source: Acxiom Research Opinion Poll (ROP).

Sinai & Waldfogal, 2004). However, the growth of e-commerce shopping in more rural areas is striking by 2010, especially in Wales, Scotland and northern England.

Geographical accessibility

The rural/urban issue raises the efficiency hypothesis of Farag et al. (2006), which argues that consumers are more likely to adopt e-commerce when their accessibility to

physical shops is relatively low. They ask the question: Do people with low shop accessibility, as in less urbanized or non-urbanized areas, buy more products online? This again may impact most on rural communities, but may also be applicable to areas of cities that lack good access to retail facilities. In a grocery context such areas have been labelled 'food deserts' (Clarke et al., 2002; Wrigley et al., 2003). The evidence so far is rather limited. Sinai and Waldfogal (2004) did find high correlations between online retailing for books and clothes and access to the nearest physical store, whilst Farag et al. (2006) found that people are more likely to adopt e-commerce when access to physical stores is low.

The Acxiom data indicate the preferred grocery brand for each respondent as well as their favourite retail destination and preferred distribution channel. This facilitates a direct comparison at OA level between the distance people are required to travel to access retail opportunities and their channel preference. So to further the exploration into accessibility and e-commerce, Table 6 displays the average distance consumer's travel to their nearest grocery store (over 3000 square feet). The figures are also broken down by the three main online food retailers and by 'online' (frequently use the internet for grocery shopping) and 'offline' customers (never use the internet for grocery shopping. The results in Table 7 show strong support once more for the efficiency hypothesis. It is clear that for all the major grocers, online customers have much poorer physical access to retail outlets than their offline counterparts. In all cases, online consumers have further on average to travel to their nearest grocery store than those who never use the internet. This is most evident for those customers who shop at Asda. As Asda stores are mainly large stores located in outer suburban areas, this might explain the differences between brands (Tesco and Sainsbury's have more mixed portfolios of large and convenience stores throughout the urban/rural landscape).

Towards a comprehensive city-wide view of e-commerce use

In this concluding section of analysis, we plot the small-area household internet usage for one city, namely Leeds in the UK (Figure 8), and for groceries only. There are around 10,000 households covered by the Leeds area (for this variable). The spatial units are census OAs, the lowest spatial scale of census zones available. Given the discussion above, these spatial variations in e-commerce use are thus likely to be the result of a mixture of geodemographic, geospatial and accessibility issues.

First, Figure 8 can be seen to support the demographic analysis given in the fourth section. High market share for e-commerce can be seen in the more affluent northern (semi-rural) suburbs to the north and north-east of the city (as illustrated in area A of the map). To the south and south-east of the city centre there is evidence of low market penetration for e-commerce (area B). These are some of the most deprived, densely

Table 7. Average distance travelled to the nearest grocery store by retailer for online and offline customers.

Retailer	Offline (miles)	Online (miles)
Asda	2.54	4.90
Tesco	2.12	3.47
Sainsbury's	2.44	3.14

Source: Acxiom Research Opinion Poll (ROP).

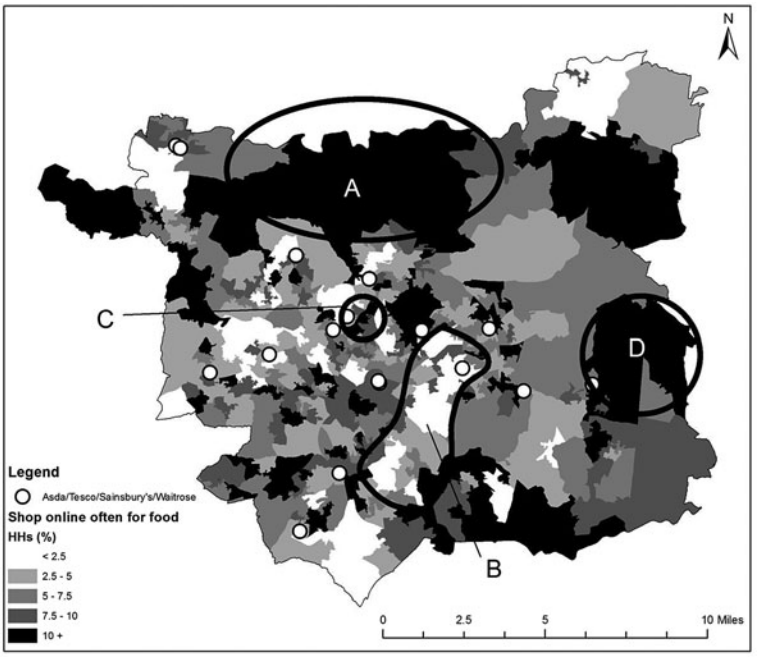

Figure 8. Online grocery penetration by the lower Super Output Area in Leeds.
Source: Acxiom Research Opinion Poll (ROP).

populated neighbourhoods in the city. As some of these regions may also be perceived to be in food deserts (or at least areas with lower accessibility to the largest stores), it might be argued that they are more likely to use e-commerce (on the accessibility argument above). However, it can be seen that this is not the case. Thus, perhaps geodemographics are more important than accessibility issues alone. There is a massive irony here: the very areas that could benefit the most from e-commerce in terms of improving access to high-quality fruit and vegetables are the areas that can least afford to do so. In addition to direct access costs (computer hardware, broadband etc.) the delivery charge for most e-commerce operating systems makes this mode of distribution even more prohibitive to low-income consumers. To add to that injustice, some firms have already blacklisted certain public housing estate areas on the basis of fear of crime and harassment of drivers (e.g., Schlesinger, 2010).

Area C in Figure 8 forms another area of high internet use. This is associated with the university area and student households in Hyde Park and Headingley. Although students are not high-income earners, their age profile fits the geodemographic analysis above, and of course many are highly computer literate with a high likelihood of adopting new technologies. Area D is a very rural area of Metropolitan Leeds and again supports the hypothesis of increased use by rural householders.

Conclusions

In this paper the latest evidence from a major survey of consumption patterns in the UK population has been examined to provide an understanding of internet retailing trends,

with special reference to e-grocery. Online retail sales are growing; however, they are still far behind those generated from stores. Grocery sales lag significantly behind other products including books, DVDs and videos, but are continuing to grow rapidly. Online consumers are most likely to be men aged 25–44 years, affluent and living in city centres. While e-commerce did originally diffuse out from London and the main cities, it is no longer just an urban trend. There is evidence of increasingly high usage in rural areas due to increased quality in broadband services. In the case of the grocery market people are more likely to adopt e-shopping the further away they live from a supermarket. However, these interactions are complex, particularly in urban areas where socioeconomics and demographics can override accessibility effects.

There is still a lot of research to be undertaken in exploring the geography of e-commerce. One outstanding task is to explore the spatial variations in the locations of consumers who shop at stores and those online for the same organization. An interesting question remains about whether e-commerce provides access to a different set of customers for a particular retailer or merely serves existing face-to-face customers more comprehensively. If this question can be answered, then many retailers could better understand the importance of e-commerce in capturing *new* sales. It would also help them decide on suitable distribution strategies for growing in areas of low market share; new stores versus 'virtual' stores (sometimes called dot.com or even 'dark' stores) serving internet customers from distribution depots, or stores where the shoppers are only retail employees (Tesco, for example, in 2012 had four 'dark' stores ringing London, in Enfield, Croydon, Aylesford and Greenford, with another three in prospect in Didcot, Erith near Dartford and in Crawley; Wood, 2012). Coupled with the kind of geodemographic analysis provided here on consumer usage of e-commerce, this would provide a powerful framework for incorporating e-commerce fully into the retail distribution chain.

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