Food prices in Scottish remote rural areas: Measuring and explaining the ‘remoteness premium’

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Abstract

The paper investigates whether consumers in Scotland's remote areas suffer of food prices higher than the country's average prices (i.e., a 'remoteness premium'). The question is of particular importance given the concerns about the sustainability of those communities. The Aguiar and Hurst (2007) expenditure index (AHEI) was computed as a measure of food expenditure using a sample of 2,636 households from Kantar Worldpanel database for Scotland for 2018. It showed that consumers in remote areas pay a small (0.2 per cent) but statistically significant premium. The differences amongst households were explained by demographic variables and shopping habits using a weighted least square regression. On average, consumers in remote areas are older and shop less actively (shopping in concentrated in fewer stores, with a lower number of trips) than others consumers in Scotland. The results raise concerns as these factors are expected to become even more severe in the future.

Keywords: Food prices, remote rural areas, scanner panel data, Scotland.

1 Introduction

Since the consumer prices skyrocketed in 2007, prices have been regularly monitored to anticipate potential impact of communities' welfare. Traditionally, there have been concerns that remote communities have been particularly affected by higher prices due to the effect of higher transportation costs or even the possibility that retailers may have spatial market power (e.g., McEachern and Warnaby, 2006; Paddison, 2007; Smith et al., 2010; Clarke, 2000).

Scotland is an interesting case to study remote rural areas prices and compare them with urban part of the country given the substantive proportion of small rural communities (Melo, 2015). Moreover, the motivation of this study comes from advice work that residents of smaller settlements in Dumfries and Galloway (Scotland), with a local economy primarily based on agriculture and forestry with a range of light industries and tourism, where public transport is limited throughout the region, often having to pay higher prices (Dumfries and Galloway Citizen Advice Service, 2015, 2017). Other similar evidence comes from studies carried out by Highlands and Islands Enterprise for remote rural areas in Scotland (e.g., Hirsch et al, 2013, 2016; BBC, 2016).

A common characteristic of the above studies is that either they use a basket of goods that are not necessarily related to actual basket of goods used by consumers or they use aggregated categories, where the presence of different qualities distorts price comparisons (Beatty, 2010). Hence, the purpose of this study is to analyse whether on average remote rural areas in Scotland suffer of food prices that are higher than the country's average prices considering an index and a dataset disaggregated at the level of products, which avoid quality issues.

We found that consumers in remote areas pay a small but statistically significant 'remoteness premium', meaning that they pay higher prices for their food basket. Our econometric analysis concludes that the premium can be explained by the differences in demographic variables (ageing), social deprivation and shopping habits between remote and non-remote areas. Limited

shopping opportunities and high transportation costs may result in a remote-area consumers' reduced capability of searching for best-prices.

The structure of the paper is as follows: it starts with a literature review focused on the discussion of high prices in rural areas in Scotland; next, the methodology is presented which comprises the data and methods used in the analysis in the analysis. The next section presents and discusses the results and the final section state the conclusions.

2 Literature review

The sustainability of communities in remote areas of Scotland depends on people being able to afford to live there (Hirsch et al., 2013). A key factor for the purchasing power of the population is the prices they face, particularly food prices. Hirsch et al. (2013) assessed how much it would cost for households in Highland and Island communities of Scotland to achieve a minimum acceptable standard of living. Their research considered 24 groups of residents in different parts of remote rural Scotland which provided what items households in their communities needed as a minimum. Pricing of the specified items was carried out in shops, through online or catalogue ordering and from other suppliers, following specifications by the groups of where residents would buy various types of item. The research was held in three parts of remote rural Scotland: the Highlands, the Islands and remote southern Scotland. They compared the living cost in those communities, i.e., not just food, with the rest of the UK based on the views of local people about what constitutes an acceptable living standard. Their results indicated that the budgets that households needed to achieve a minimum acceptable living standard in remote rural Scotland were typically 10-40 per cent higher than elsewhere in the UK. These premiums were most modest for pensioners and greatest for single people and families supporting children.

Hirsch et al. (2016) updated their 2013 report by considering a new set of prices but without updating their baskets. They found that, in 2016, a minimum acceptable standard of living in remote rural Scotland typically requires between a tenth and a third more household spending than in urban parts of the UK. In general, the picture painted in their work was similar to the one in 2013, although the lower price of petrol and diesel significantly reduced the additional cost for people having to travel long distances, particularly regular travel for work. Moreover, the additional costs come from a range of sources. In particular, the costs of travelling, heating one's home and paying for goods and their delivery were much higher for many residents of the areas under review, especially those in the remotest areas.

Additional work was done by the Dumfries and Galloway Citizens Advice Service (DGCAS) for their local authority, which corresponds to the south west of Scotland. The motivation of this study comes from advice work that residents of smaller settlements in Dumfries and Galloway (Scotland), with a local economy primarily based on agriculture and forestry with a range of light industries and tourism, where public transport is limited throughout the region, often having to pay higher prices (Dumfries and Galloway Citizen Advice Service, 2015, 2017). Their methodology was simpler than Hirsh et al. as they considered a list of basic grocery products, which they priced across different towns in Dumfries and Galloway. Over the course of a week, and across the four historical counties of Dumfries and Galloway, they visited 38 supermarkets, minimarkets and village shops pricing the selected basket of products and each

time they would choose the cheapest version on offer. They found that a 'poverty premium' exists in some of the towns (e.g., Upper Nithsdale); people in poorer areas are paying more for their essentials than those in the less disadvantaged parts of Dumfries and Galloway. Moreover, they found that a 'rural premium' - sometimes in conjunction with the poverty premium - existed. In general, essential products costed more the further the distance from urban areas. This was also often the case with individual items, i.e., the most expensive were to be found in rural areas.

Limitations of the aforementioned studies were that in the case of Hirsch et al. they used aggregated expenditure categories in their comparison, which creates problems due to quality differences in the products considered (Beatty, 2010). In addition, although they used 24 different groups, these baskets are still different to those of the individual households in rural areas. The latter point is of more significance in the case of the DGCAS study, due to the fact that they use only one basket, which is modified to capture the cheapest version on offer. In this paper, we address these limitations by considering a price index introduced by Aguiar and Hurst (2007) that allows for comparison of prices amongst households taking into account the quality problem.

3 Measuring the remoteness premium.

3.1 Data

The data used for the analysis were the Kantar Worldpanel database for Scotland for 2018, which is a scanner panel dataset that includes information about food and drink purchases (at the level of the actual product) for 2,636 households. In addition, the dataset gives information about the characteristics of the households in terms of age of the household' head, their gender, number of children, number of trips to shops and in what shops the purchases were made. The dataset was matched with the Scottish Neighbourhood Statistics, which provide information about the households' rurality considering six categories: from urban large areas to remote rural areas and the 2016 Scottish Index of Multiple Deprivation (SIMD).[1]

3.2 Methods

The data allowed to construct monthly price indexes by household following Aguiar and Hurst (2007) approach, where products where compared like with like avoiding quality problems. In other terms, they construct a price index in a way that allows cross-household comparisons despite the fact that households' shopping baskets differ. The indexes responded the question whether the actual purchases bought by each household were more expensive than the cost of their purchased basket evaluated at the Scottish average prices. The index is briefly presented here for completeness sake. Let us define:

$p^{j}_{i,t}$ = Price paid for good i, by household j at time t

[1] The SIMD is a statistical tool used by government bodies in Scotland to support policy and decision making, which measures deprivation across seven domains: current income, employment, health, education, skills and training, housing, geographic access and crime. These seven domains are calculated and weighted for 6,976 small areas, called 'data zones', with roughly equal population.

$q^j_{i,t}$ = Quantity purchased of good i, by household j at time t

X^j_m = = Monthly expenditure by household j

They are defined as in (1) to (3):

$$X^j_m = \sum_{i\in I, t\in m} p^j_{i,t}\, q^j_{i,t} \tag{1}$$

$$\bar{q}_{i,m} = \sum_{j\in J, t\in m} q^j_{i,t} \tag{2}$$

$$\bar{p}_{i,m} = \sum_{j\in J, t\in m} p^j_{i,t}\left(\frac{q^j_{i,t}}{\bar{q}_{i,m}}\right) \tag{3}$$

If the household pays the average price for the same basket of goods, the cost of the bundle would be (4):

$$Q^j_m = \sum_{i\in I, t\in m} \bar{p}_{i,m} q^j_{i,t} \tag{4}$$

The price index for the household (5) is the ratio of expenditure at actual prices divided by the cost of the bundle at the average price.

$$\tilde{p}^j_m \equiv \frac{X^j_m}{Q^j_m} \tag{5}$$

The index is normalised by dividing through the average price index across households within the month, ensuring that for each month the index is centred around one (6):

$$p^j_m \equiv \frac{\tilde{p}^j_m}{\frac{1}{J}\sum_{j'} \tilde{p}^{j'}_m} \tag{6}$$

As pointed by Aguiar and Hurst (2007), the above price index shares the typical feature (as with Laspeyres and Paasche indices) that the basket of goods is held constant as the prices vary between numerator and denominator. To the extent that relative price movements induce substitution between goods, there is no reason to expect that the household would keep its basket constant. Moreover, given the fact that the goods are not aggregated, i.e., the prices are for identical goods, the price index does not reflect differences in quality.

For convenience, we refer to p^j_m as Aguiar and Hurst Expenditure Indicator (AHEI). We computed AHEI for food for each household in the sample. We defined 'remoteness premium' a statistically significant difference in the mean value of AHEI between remote and non-remote areas of Scotland.

In order to measure the remoteness premium, Scotland's households were grouped into three clusters: Remote Rural Areas (RRA), Remote Small Towns (RST) and Non-Remote Areas (NRA), according to the rural urban classification provided by the Scottish Neighbourhood

Statistics classification.[2] A set of pairwise t-test on the equality of the weighted mean value of the AHEI allows us to reject the null hypothesis of equality of means between RRA and NRA at 90 per cent confidence level. **Error! Reference source not found.** reports the results of the tests.

Table 1: Pairwise testing of equality of weighted mean AHEI between areas

	Sample n	Population N	Mean AHFI	St. Dev. AHFI	Difference in mean with respect to		
					NRA	RST	RRA
NRA	2,358	2,292,213	1000.096	14.154	0		
RST	102	78,842	999.953	19.587	-0.143 (2.684)	0	
RRA	176	144,814	1002.620	16.454	2.524 (1.364)*	2.667 (2.972)	0

Notes: Number in parenthesis are standard deviations. The AHFI was multiplied by 1000.
* stands for the difference is statistically significant at 90 per cent confidence level.

The data support the hypothesis that a small (.25 per cent) but statistically significant remoteness premium is paid by consumers in RRA only. The result is consistent with Dumfries and Galloway Citizen Advice Service (2015, 2017) that found that prices of essential goods increase with the distance from urban areas.

The estimated of the remoteness premium in this study is lower than the ones found by previous studies. The difference with existing literature can be explained by the use of actual purchases instead of a pre-determined basket (as the 'acceptable standard of living' in Hirsch et al., 2013). Because of essential goods are more expensive in rural Scotland (Dumfries and Galloway Citizen Advice Service, 2015, 2017), the price difference on a minimal basket of necessities might be higher on average than the one on a more realistic basket.

4 Drivers of remoteness premium: Access effect and In-store effect

In order to investigate the aforementioned result further, two effects of living in remote areas were identified on food expenditure. People in remote areas might face constraints to their shopping strategy such as access to a limited number of stores or higher cost of transportation limiting the number of possible shopping trips. As a consequence, people living in remote areas might be unable to shop for best prices as actively as those in accessible areas. This issue is referred as the Access Effect. The other possible effect of remoteness concerns a generalised higher price level due to retailers' higher logistic costs for procurement or other factors, which is referred as the In-Store Effect. While the Access Effect affects the choice of the retailer, the In-Store effect is conditional to the consumer's shopping strategy. Table 2 reports descriptive statistics of the variables in the dataset.

An empirical test was developed to assess whether the difference in the expected AHEI for food across different areas was due to Access and/or In-Store effects. First, it was tested whether any

[2] Non-Remote areas include: Large Urban Areas, Other Urban Areas, Accessible Small Towns, Accessible Rural Areas.

systemic difference the expected AHEI existed after controlling for the consumer's shopping strategy (and a vector of social and demographic characteristics).

Table 2: Weighted Descriptive Statistics

Variable	Description	NRA		RST		RRA	
		Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
AHEI[a]	AHEI for food	1000.096	14.154	999.953	19.587	1002.620	16.454
TRIPW[a,b]	N. of shopping trips (weekly average)	2.280	1.1730	1.973	0.778	2.017	0.945
NSTORE[a,b]	N. stores visited in the period	8.562	4.184	7.479	3.873	7.099	3.853
HHI[a,b]	Expenditure concentration index	0.453	0.230	0.507	0.215	0.515	0.248
AGE[a,c]	Age of head of household	46.933	13.518	46.390	14.343	51.361	12.715
FEMALE	1 if female, 0 otherwise	0.723	0.448	0.723	0.450	0.702	0.459
MARRIED[a]	1 if married, 0 otherwise	0.579	0.494	0.589	0.494	0.665	0.473
CHILD	N. of children in the household	0.548	0.901	0.691	1.039	0.542	0.949
INCLOW[a,b]	1 if income < £30K; 0 otherwise	0.478	0.500	0.618	0.488	0.584	0.494
SIM1[a,b,c]	1 if SIMD = 1; 0 otherwise	0.234	0.424	0.099	0.300	0.025	0.158
SIM2[a,c]	1 if SIMD = 2; 0 otherwise	0.210	0.407	0.256	0.438	0.110	0.314
SIM3 [a,b,c]	1 if SIMD = 3; 0 otherwise	0.179	0.383	0.326	0.471	0.523	0.501
SIM4 [a]	1 if SIMD = 4; 0 otherwise	0.180	0.385	0.231	0.423	0.308	0.463
SIM5[a,b]	1 if SIMD = 5; 0 otherwise	0.196	0.397	0.088	0.285	0.334	0.180

Notes:
[a]: the mean value in NRA is statistically different from the mean in RRA at 90 per cent confidence level (t-test on continuous variables only)
[b]: the mean value in RST is statistically different from the mean in RST at 90 per cent confidence level (t-test on continuous variables only)
[c]: the mean value in RRA is statistically different from the mean in RRA at 90 per cent confidence level (t-test on continuous variables only)

Second, it was tested whether there was any systematic difference in the shopping strategies of consumers living in different areas. It was concluded that there were an In-Store Effect if the AHEI for food was on average higher in remote areas than in non-remote areas, holding the shopping strategy constant. Moreover, it was concluded that an Access Effect existed if two conditions held: there was a systematic difference in shopping behaviour across the areas and there was a systematic impact of shopping behaviour on the AHEI for food.

A consumer's shopping behaviour was summarised using three variables: the average number of weekly trips for grocery shopping (TRIPW), the number of different retail chains that the consumer visited during the observed period (NSTORE) and a concentration index of expenditure by household among different retail chains (HHI)[3]. It is expected that consumers visiting a higher number of stores, shopping more often and with more diversified (less concentrated) expenditure across chains pay less for the same food basket than other consumers with less active shopping behaviour, holding everything else constant.

In the estimation it was controlled for a vector of social and demographic characteristics of the household, in order to account possible differences in the demographic structure of population between remote and non-remote areas. The dataset includes age, gender and marital status of the head of the household[4] (variables AGE, FEMALE, MARRIED, respectively), the number of children in the household (CHILD), and a binary variable identifying households with an income lower than £30,000 (INCLOW). We include a set of binary variables (SIMD1 to SIMD5) identifying the quintiles of the SIMD. These variables were introduced to control for local deprivation and compare remote and non-remote areas with similar social conditions.

4.1 Measuring the In-store effect

In order to investigate the existence of an In-Store effect on food expenditure, the AHEI for food was regressed on a vector of variables including consumer shopping behaviour (TRIPW, NSTORE and HHI variables), social and demographic factors (a quadratic function of AGE, FEMALE, CHILD, MARRIED and INCLOW) and local deprivation indices (SIM2 to SIM5, with SIM1 being excluded to avoid the dummy variable trap). The In-Store effect was measured by two binary variables identifying households living in remote small towns and remote rural areas. If the coefficient of the two binary variables was positive and statistically significant, it was conclude that there was an In-Store Effect.

Table 3 reports the results of the regression. Weights for the households were constructed based on three variables: local authorities, rural urban and the 2016 SIMD. The model used the weights and White's robust standard errors. The coefficients of the variables RST and RRA were not statistically different from zero. An F-test on the joint significance of the two coefficients returned a F-Stat = 0.441, with a p-value of 0.643. An F-test on the equality of the coefficients of the variables RST and RRA failed to reject the null hypothesis. Consequently, we conclude that the data do not support an In-Store Effect in remote areas. After controlling for shopping behaviour, social and demographic characteristics and deprivation, it was found no significant difference in the AHEI for food between remote and non-remote areas.

On average, and keeping all other factors constant, shopping behaviour affects the AHEI for food. As the number of weekly trips increases (TRIPW), the expected value of AHEI decreases by 1.7 per trip. The result is consistent with expectations because frequent shoppers are more likely to benefit from the variation discounts and sales over time (same store) and space (different stores). Concentration of expenditure in one chain (HHI), on average, is associated with higher values of AHEI. This result also was consistent with expectations; consumers buying most of their food from a single retailer are less likely to benefits from sales from

[3] Measured by a Herfindahl index (Martin, 2002)
[4] In the Kantar Worldpanel, this is the person doing the purchases.

different stores (the so called 'cherry-picking' shopping strategy). Instead, households spreading their purchases across multiple retail chains can compare prices and select the best deal, with a direct impact on the food expenditure. After controlling for expenditure concentration, the mere number of visited stored does not affect the AHEI.

Demographic characteristics had a statistically significant effect on AHEI. On average, women pay less than men for the same food basket, keeping all other variable constant. The AHEI on average decreases with the number of children in the household. The coefficient of the MARRIED variable is not statistically significant different from zero, suggesting that marital status does not affect the AHEI. Households with income lower than £30,000 on average pay less than others for the same food basket. The relationship between AHEI and the age of the head of the household is quadratic-convex. Younger and older people pay higher prices than those around 33 years old who pay the least.[5]

The differences in the age structure and income (Table 2) might concur to explain the higher expenditure for the food basket in RRA than in NRA that was detected in **Error! Reference source not found.**.

Table 3: Weighted regression of food expenditure index

Dependent variable: AHEI for food **Observations**: 2,636				
Variable	**Coefficient**	**St. error**	**t-ratio**	**p-value**
TRIPW	-1.727	0.399	-4.332	0.000
NSTORE	0.073	0.120	0.609	0.543
HHI	8.284	1.941	4.268	0.000
RST	-0.669	2.659	-0.252	0.801
RRA	1.188	1.314	0.903	0.366
AGE	-0.199	0.161	-1.232	0.218
AGE^2	0.003	0.002	1.878	0.060
FEMALE	-1.666	0.722	-2.307	0.021
CHILD	-1.187	0.339	-3.506	0.000
MARRIED	0.479	0.647	0.740	0.460
INCLOW	-1.624	0.670	-2.424	0.015
SIM2	0.391	0.936	0.418	0.676
SIM3	1.143	0.960	1.191	0.234
SIM4	1.970	1.106	1.782	0.075
SIM5	2.550	1.028	2.480	0.013
CONSTANT	1002.900	4.049	247.700	0.000
R^2	0.076			

[5] This result contrasts with Aguiar and Hurst (2007), where the middle age household pay the highest prices due to time constraints to search for lower prices. The difference can be explained by two factors: the difference age span in the two samples and the fact that the model controls for shopping habits. Aguiar and Hurst considered household heads from 25 to 75 years of age, while the age in this sample ranged from 18 to 89. The high values of AHEI of over 80 years old households influence the result. Also, this model computes the AHEI expectation controlling for the number of shopping trips, expenditure concentration and number of visited stores. These variables control for the consumers' opportunity cost of time. As a consequence, middle age consumers' time constraints are already accounted for in the model.

Adj. R^2	0.070
F-Stat	14.302 (p-val: 0.000)

In addition, the SIMD (i.e., area deprivation) was found to affect the AHEI; the model concluded that households in the fourth and fifth quintiles of the SIMD index, on average, pay more for the same basket than those in the first.

4.2 Measuring the Access effect

Living in remote areas might have an indirect effect on the AHEI through the consumers' shopping behaviour. In fact, remoteness can impose constraints in the choice of the stores and even in the number of shopping trips due to the higher transportation costs and the limited number of available chains. In this section, we test such constraints.

Table 4: Weighted regressions of shopping behaviour variables

	Dependent variables								
Variable	**TRIPW**			**NSTORE**			**HHI**		
	Coeff.	St. err.	p-value	Coeff.	St. err.	p-value	Coeff.	St. err.	p-value
RST	-0.320	0.083	0.000	-1.011	0.405	0.013	0.049	0.025	0.047
RRA	-0.378	0.091	0.000	-1.984	0.356	0.000	0.071	0.023	0.002
AGE	0.027	0.012	0.021	0.205	0.043	0.000	-0.006	0.003	0.029
AGE2	0.000	0.000	0.982	-0.001	0.000	0.010	0.000	0.000	0.178
CHILD	0.084	0.027	0.002	0.107	0.105	0.308	0.002	0.006	0.757
FEMALE	0.157	0.054	0.004	0.897	0.198	0.000	-0.029	0.012	0.014
MARRIED	0.015	0.050	0.762	0.258	0.180	0.151	0.001	0.011	0.915
NOINT	-0.008	0.004	0.038	0.030	0.007	0.000	0.000	0.000	0.698
INCLOW	0.033	0.051	0.513	0.013	0.185	0.944	0.012	0.011	0.269
BYCAR	-0.109	0.055	0.047	0.427	0.191	0.026	-0.004	0.011	0.706
SIM2	-0.069	0.076	0.362	-0.181	0.267	0.498	0.013	0.016	0.440
SIM3	-0.028	0.077	0.711	-0.078	0.273	0.774	0.015	0.017	0.354
SIM4	-0.075	0.079	0.340	-0.196	0.291	0.500	0.005	0.017	0.766
SIM5	-0.117	0.077	0.126	-0.463	0.294	0.116	0.025	0.017	0.140
CONSTANT	0.943	0.273	0.001	0.797	1.041	0.444	0.650	0.069	0.000
Adj. R^2	0.095			0.108			0.023		
F-stat	20.853	(p-val: 0.000)		23.889	(p-val: 0.000)		5.460	(p-val: 0.000)	

To this purpose, each shopping behaviour variable (TRIPW, NSTORE and HHI) was regressed on a vector of social and demographic variables, the deprivation variables (SIM2 to SIM5) and

two binary variables identifying households located in RST and RRA. Compared to the vector of social and demographic variable in section 4.1, two additional binary variables identifying households using car for their shopping activities and those with no internet access (BYCAR and NOINT, respectively) were used in the estimation of shopping behaviours. The use of car was expected to increase the number of visited stores (consumers can travel further away) and reduce the number of trips (as they can carry more food with one trip). Lack of internet access may limit the knowledge of discount and sales, reducing the incentive to shop. Table 4 reports the results of the regressions of the shopping behaviour variables on the vector of explanatory variables. The regressions were weighted as explained and used White's robust standard errors.

The models rejected the null hypothesis that remoteness did not affected shopping behaviour. On average, and keeping all other variables constant, households located in remote areas exhibited a lower number of shopping trips, visit a lower number of chains and have a higher expenditure concentration index than those living in NRA. Combining these results with the outcome of the analysis of the In-Store Effect, it was obtained that the higher AHEI for food in remote areas can be explained in part by the Access Effect. Living in remote areas limits the adoption of effective shopping strategies.

Noticeably, the coefficients of RSA and RST variables had the same sign in all regression. This result supports the conclusion of a consistent effect of 'remoteness' on shopping behaviour, although with different intensity. The coefficients of the two variables in the TRIPW and HHI regressions are not statistically different at 90 per cent confidence level. Instead, it is possible to reject the null hypothesis that households in RRA visit less stores than those living in SMT with 90 per cent confidence level.

Social and demographic variables affect shopping behaviour. On average, elder consumers shop more frequently and diversify more than younger ones. Female consumers are expected to buy from more chains, diversify more and shop more often than males. The number of children is positively correlated with the average number of trips per week. The data do not support any effect of marital status and income on shopping behaviour. On average, consumers shopping by car visit more stores and have a lower average number of trips per week. Lack of internet access is negatively associated with TRIPW and positively associated with NSTORE.

In addition, the results also showed that the area deprivation (i.e., SIMD) did not affect shopping behaviour. An F-test on the joint significance of variables SIM2 to SIM5 could not reject the null hypothesis of all coefficients were equal to zero at 90 per cent confidence level.

5 Summary and Conclusions

The research confirmed that a 'remoteness premium' is paid by people leaving in remote rural areas of Scotland. The finding is of particular importance given the lower purchasing power for the remote rural population.

Comparing the average AHEI computed for remote rural areas (RRA) with the one for non-remote areas (NRA), it was found that the difference was small (2.5 points on an average value of the index of 1000) but statistically significant at 90 per cent confidence level. It was not possible to reject the null hypothesis that the average AHEI for remote small towns (RST) was equal to the average for NRA.

This research concluded that the difference in the AHEI was driven by a different demographic structure (higher share of elder population, in particular), higher levels of area deprivation and less active shopping behaviour. After controlling for these effects, it was found no evidence of further differences between remote and non-remote areas.

Households concentrating their food expenditure in few trips and/or few stores were expected to pay more for their food basket than 'more active' shoppers on average. The result was consistent with expectations and reflected the price benefits obtained from a cherry-picking shopping strategy versus a one-stop-shopping strategy. It was also found systematic differences in the shopping behaviour between RRA, RST and NRA. The models conclude that, on average, people living in remote areas shop less frequently than those in NRA, buy from a lower number of chains and diversify their expenditure across chains less, keeping all other factors constant. The difference in habits can be explained by the constraints on the shopping strategy of people living in remote areas. Higher transportation costs, lower density of stores in remote and possibly cultural factors. The consequence was a less active shopping behaviour and ultimately higher prices for the food basket. The combination of the two results (shopping intensity affecting prices and remoteness affecting shopping intensity) was defined as the Access Effect.

The empirical evidence of the Access Effect supports the conclusion that a 'remoteness premium' was paid by Scotland's rural citizens because of reduced shopping opportunities. The model suggested that – keeping all other factors constant – consumers with similar shopping behaviour would pay for their basket prices that are not significantly different regardless whether they live in remote or non-remote areas.

In addition, it was found that women and households with children, on average, spend less for their baskets than other households. The two extremes of the lifestage (i.e., young households and retired households) spend more for the basket than others. It was found both an Access Effect (elder, male with no children consumers shop less actively) and an In-Store effects (higher average AHEI after controlling for shopping habits) for demographic variables.

The link between demographics and food prices may have particular implications for the welfare of a population that is getting older. In fact, according to the National Register of Scotland, the country is facing a demographic time bomb in the coming decades with a sharp rise in the older population, prompting fears over how hard-pressed services will cope. The number of pensioners is expected to soar by 28 per cent in just 25 years (NRS, 2017). The estimated model predicts that ageing consumers will shop less actively and will spend more to buy their food. As a consequence, the 'remoteness premium' paid by Scotland's consumers living in RRA is expected to increase over time. Higher prices coped with less mobility for shopping may bring lower welfare levels.

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