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WIDER Working Paper 2015/100

Income and price elasticities of demand in South Africa

An application of the linear expenditure system

Rulof Burger, Wicus Coetzee, Friedrich Kreuser, and Neil Rankin*

October 2015

Abstract: This paper investigates the expenditure patterns of South African households using detailed cross-sectional expenditure and price data. Linear expenditure system (LES) parameter estimates are used to calculate income and price elasticities for a number of product categories at different points of the income distribution. We find substantial variation in the price and income elasticity of demand of items across the income distribution, with the bottom quartile being extremely sensitive to increases in the price of food and clothing items, and the top quartile being as sensitive as households in developed countries.

Keywords: demand elasticity, household food demand, income and price elasticity, linear expenditure system

JEL classification: D12, D31

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1 Introduction

This paper investigates the expenditure patterns of South African households by estimating a linear expenditure system (LES) using the 2010 Income and Expenditure Survey (IES) and detailed price data from Statistics South Africa (StatsSA 2012). Products are aggregated using the Central Product Classification (CPC) categories, to facilitate the use of the estimates in computable general equilibrium (CGE) or dynamic stochastic general equilibrium (DSGE) modelling. Price data are averaged within product categories and provinces in order to exploit regional price variation for identification of the model parameters.

The paper is structured as follows. Section 2 provides a literary review and Section 3 an overview of the Linear Expenditure System (LES). Section 4 discusses the econometric approach used in our analysis. Section 5 proceeds to describe the data and the results are presented in Section 6. Section 7 concludes.

2 Literature review

Few topics in economics have been studied as extensively as demand systems in the last four decades. Consumer demand estimation models can be grouped into two categories, namely primal and dual models (Sarntisart and Warr 1994). The Almost Ideal Demand System (AIDS), as developed by Deaton and Muellbauer (1980), is one of the most well-known dual models and remains one of the most widely applied estimation models in empirical demand studies.

Primal models, on the other hand, date back to the LES of Stone (1954). Conceptually, the LES was first introduced by Klein and Rubin (1948), while Samuelson (1948) and Geary (1949) developed a corresponding system of demand equations. Stone was the first to apply the concept empirically and developed the model further in Stone (1964) and Stone et al. (1964). Prior to Stone, empirical demand studies were characterized by the use of single equation methodologies that ignored the demand restrictions of adding-up, homogeneity, and Slutsky symmetry. The LES satisfies these restrictions as it is derived from a strongly separable utility function and it implies linear Engel curves, or constant marginal budget shares. In this context, the LES is often criticized for its confinement to proportional income and price elasticities, and its inability to account for complementary relationships between goods (Sola 2012). In response to increasing evidence indicating that additive separability is false (Deaton 1974), a number of non-additive generalizations¹ of the LES were proposed. These generalizations were of the Gorman polar form.² Many of these models retained weak separability of the utility function and continued to imply linear Engel curves (Blundell and Ray 1982). They were followed by non-separable generalizations of the LES, for example Carlevaro (1976), which often did not meet all of the theoretical requirements of consistent aggregation implied by the representative agent used in economic modelling. Howe et al. (1980) derive a class of theoretically plausible demand functions that are quadratic in expenditure, or quadratic expenditure systems (QES), and illustrate the estimation of one such function on United States (US) per capita time series data. Blundell and Ray (1982) presents another non-separable generalization of the LES which permits

¹ See for example: Pollak (1971); Brown and Heien (1972); and Blackorby et al. (1978).

² Generated by the cost function $C(p,U) = a(p) + b(p)U$, where $a(p)$, $b(p)$ are homogeneous functions of degree one in price p and U is a utility function.

non-linear Engel curves. They demonstrate the empirical usefulness of their model by estimating it on two sets of data,³ and find that their results on the cross-section data reject linear Engel curves, while their results on the longitudinal data reject separability of preferences. Currently, other demand systems, such as the AIDS, are favoured above the LES, although LES models are often used for the purpose of estimating parameters as inputs for Computable General Equilibrium (CGE) models.⁴

In the South African context, most demand system analyses are variations on the AIDS model, with most focusing on the demand for food or meat.⁵ Koch and Bosch (2009) analyse the welfare implications of inflation in South Africa using an AIDS model and find that non-poor households are generally affected more strongly by inflation, but that food inflation has a larger welfare cost for poor households. A small number of authors have studied CGE models using South African data, which required LES estimation as a sub-component.⁶ Case (2000) investigated consumption patterns in South Africa in order to examine the potential effects of trade liberalization on household behaviour and wellbeing. The study was based on the 1993 South African Living Standards Survey (SALSS), which included data from which a food price index could be constructed. From this index the price and expenditure elasticity for all other commodity groups could be estimated. She finds that food, fuel, alcohol/tobacco, and other goods are necessities for the African population group, and that food, fuel, and alcohol/tobacco are also price inelastic for this group. Necessities for the white population group are food, fuel, alcohol/tobacco, clothing, personal items, and other goods, with food, fuel, and alcohol/tobacco also being price inelastic. She finds that, overall, the African population group are more price sensitive than the white population group for the majority of items. The present paper aims to update this study, using new price and expenditure data to provide new estimates for use in CGE models in the South African economy.

3 The LES

The LES was first introduced by Stone (1954) to study the consumption patterns of British households with a system of demand equations that was directly derived from consumer theory. In this model a household's preferences are represented by a utility function of the form:

$$U(q) = \prod_{i=1}^n (q_i - \gamma_i)^{\beta_i}$$

where i denotes a generic product, q_i represents the quantity of this product consumed by the household and n is the number of products in the demand system. It is assumed that every household must consume at least the subsistence quantity of product i , γ_i , and that the

³ A time series of United Kingdom (UK) Family Expenditure Surveys (1968-79), for which only data for couples without children is considered, and a pure time series of unadjusted quarterly UK data (1955(1)-1980(2)).

⁴ See Selvanathan and Clements (1995) and Edgerton et al. (1996) for comprehensive reviews of further alternative specifications and functional forms.

⁵ See for example: Balyamujura et al. (2000); Agbola et al. (2003); Selvanathan and Selvanathan (2003); Taljaard et al. (2003); a study by the Human Sciences Research Council (2004); Bopape (2006); Bopape and Meyers (2007); and Dunne and Edkins (2008).

⁶ For example, Alton et al. (2012) uses LES estimation as a sub-component in a CGE model studying the implication of carbon taxes, while Maisonnave and Decaluwé (2010) use the model to investigate whether South Africa's affirmative action policy has been efficient.

preference parameters β_i must sum to 1. The system can be solved in order to find the consumption quantities that maximize the household's utility subject to the budget constraint that total expenditure not exceed the household's income M . Provided that an interior solution exists, the demand for commodity i can be expressed as:

$$q_i(p, M) = \gamma_i + \frac{\beta_i}{p_i} (M - \sum_{j=1}^n p_j \gamma_j)$$

This function can be more conveniently written in terms of expenditure by multiplying by prices:

$$p_i q_i = p_i \gamma_i + \beta_i (M - \sum_{j=1}^n p_j \gamma_j) \quad (1)$$

The income elasticity for product i is then simply calculated as:

$$\eta_i = \frac{\beta_i \bar{M}}{\bar{p}_i \bar{q}_i} \quad (2)$$

at specified values of income, price and commodity expenditure. Similarly, the price elasticity for product i is calculated as:

$$\varepsilon_i = -1 + \frac{\bar{p}_i \gamma_i}{\bar{p}_i \bar{q}_i} (1 - \beta_i) \quad (3)$$

The LES has a few advantages over other demand systems. First, unlike most other demand systems it satisfies all the theoretical restrictions imposed by consumption theory, and hence provides an internally consistent system for household consumption behaviour. Second, it conveniently expresses q_i as a linear function of real total expenditure and of relative prices, which simplifies the estimation and interpretation of the model estimates. However, these advantages come at the cost of strong assumptions about how consumers behave. For example, the LES is very limited in the types of product substitutability or complementarity that it allows for.

4 Estimation strategy

Equation (1) indicates that the demand for product i depends directly on its own subsistence quantity γ_i and indirectly on the subsistence levels of all other commodities γ_j . Incorporating these cross-equation restrictions requires estimating the model parameters via a systems estimator. In our analysis we use a seemingly unrelated non-linear least squares approach.⁷ Following the estimation step, we report the point estimates and standard errors of the income elasticities as calculated in equation (2).

⁷ Our analysis is implemented via Stata 13's *nlsur* command, which uses the iterative feasible non-linear least squares estimator.

The simplest way to estimate the income elasticity in equation (2) is to use the β_i parameter estimated for the entire population, and the sample means for household income⁸ \bar{M} and total expenditure on product i , $\bar{p}_i \bar{q}_i$. This provides an estimate of the expected relative change in expenditure on the product following a 1 per cent increase in household income for a household that currently earns the average income, pays the average price and consumes the average quantity of this product.

It is straightforward to use the same β_i parameter estimate with different values of household income and product expenditure to also estimate the income elasticity for other sub-groups. Specifically, we will use the average incomes for the different income deciles in order to investigate how this income elasticity varies as households move up the income distribution. According to equation (2), this elasticity should increase monotonically in household income if product expenditure remains constant. However, it is also possible—and arguably more sensible—to allow some additional flexibility in household behaviour by also letting the product expenditure vary by income deciles. An even less restrictive approach would be to estimate the preference parameter β_i separately for different income groups, and to use these values to calculate the income elasticities. These different techniques are compared in our analysis.

As will be discussed in Section 4, we do not have price data available for all of the product categories. This means that income elasticities cannot be estimated directly according to equation (1) for these categories. Following Case (2000), the income and price elasticities of these items will be estimated by replacing $p_i \gamma_i$ in (1) by Γ_i . Γ_i is then the coefficient on the subsistence expenditure, and not the subsistence quantity of a given item.

Finally, it should also be clear that the equation cannot be estimated where total expenditure on each item is equal to total household expenditure as the covariance matrix of the errors will be singular. In order to estimate all of the parameters directly we use total rent, either reported as the actual or imputed rent from the IES, as a residual category so that total household expenditure, which we assume to be equal to total household income, can be written as follows:

$$M = \sum_{i=1}^N p_i q_i + \text{total rent} \quad (4)$$

This approach is advantageous as total rent is non-zero for all households and is not a CPC category.

5 Data

5.1 Household survey data and the CPC

There are several recent household survey datasets that one could potentially use to investigate household expenditure patterns. The IES, conducted by StatsSA in 1990, 1995, 2000, 2005/06 and 2010/11 contains detailed information on household expenditure on education, health, dwellings and services, clothing, footwear, expenditure when away from home, domestic workers, furniture, computers and telecommunications equipment, and transport. The surveys

⁸ Since households are dynamic rather than static optimizers and have access to financial markets, total income need not equal total expenditure in every period. We will therefore use total household expenditure $\sum_{i=1}^N p_i q_i$ as our measure of M in this study.

also ask questions on the composition and structure of households, household income, finance, and banking. Another recent candidate household survey is the National Income Dynamics Study (NIDS) conducted by the Southern African Labour and Development Research Unit (SALDRU) at the University of Cape Town. This is a panel dataset with three waves—2008, 2010 and 2012. Only 76 variables capturing expenditure are available for this dataset, as opposed to the 721 variables released with the IES data. Unfortunately, none of the available surveys asked any questions regarding product prices, meaning that external price data is required. This data is discussed in Section 5.2.

The primary purpose of this study is to estimate the income and price elasticities for the products identified in the CPC version 2, which is closely associated with the production structure of the economy.⁹ Table 1 reports the one- and two-digit categories of the CPC for which both price and expenditure data are available. It should be noted that the expenditure items in the IES household questionnaire were formulated using the Classification of Individual Consumption According to Purpose (COICOP). Although the NIDS dataset does not use any specific classification scheme, the specified household expenditure items are also more similar to the typical household consumption items encountered in the COICOP system than to the product categories in the CPC. This poses some challenges for our analysis, which requires translating the COICOP items into CPC categories.¹⁰ As discussed later, the same issue arises in constructing price indices, since our price data is also collected for COICOP product categories.

According to the official correspondence tables¹¹ several COICOP product categories appear in more than one CPC category, which complicates—and sometimes prohibits—analysis of specific product categories. For example, many of the detailed food products that are included in COICOP category 01 are simultaneously included in both the CPC category 0 (agriculture) and CPC category 2 (food). However, due to the adding-up restriction of consumer behaviour and the LES model, we cannot include the same expenditure item in multiple categories, so we were required to make a number of additional categorization decisions. A further issue is that some of the product categories suffered from a high share of zero expenditures or a lack of price data, even at the two-digit categories.

These issues limit our analysis in two ways. First, we cannot sensibly perform our analysis at a CPC product classification that is more disaggregated than the two-digit level, as there are simply too few variables and too many zero expenditures to apply a method that does not explicitly allow for corner solutions. Second, we were forced to omit or group together some of the two-digit product categories for which no price data were available. Since the NIDS data contain fewer household expenditure categories than the IES data, these problems are exacerbated when performing the analysis on the NIDS data, and all our estimates below make use of the IES data only.

Even in the very rich IES data, there are no expenditure data for the following categories: live-animals (CPC category 02), forestry and logging products (03) fish and other fishing products

⁹ This is done in order for the parameters to be consistent with those required in a CGE or DSGE model for the South African economy.

¹⁰ Table A1 (Appendix A) shows the precise COICOP codes along with the number of non-zero expenditure observations per item.

¹¹ Published on the United Nations website: <http://unstats.un.org/unsd/cr/registry/regso.asp?Ci=7&Lg=1>. It should be noted that the official correspondence tables only match the CPC v.1. with the COICOP. All attempts have been made to ensure consistency of the correspondence between the COICOP and CPC v.2.

(04), yarn, thread, and other tufted textile fabric (26), wood, cork, and straw products (31), wastes or scraps products (39), basic metals (41), fabricated metal products (42), construction services (54), wholesale (61) or retail (62) trade services, electricity, gas, and water distribution services on own account. The low response rates for certain products required us to group together the following categories: ores and minerals; basic chemicals (34), other chemical products (35), and rubber and plastic products (36); all transport categories; general-purpose (43), special-purpose (44), and electrical machinery (46); radio-television and communication equipment (47), medical appliances, precision watches and clocks (48). It should be noted that the latter category only contains information on cameras, jewellery, and clocks.

5.2 Expenditure data

Table 2 summarizes the expenditure data for the CPC one- and two-digit categories. The impact of low response rates and a high proportion of zero-expenditures can be seen from the sudden changes in certain product expenditure categories for households in adjacent income deciles. This effect appears to be most pronounced for agricultural items, transport equipment, tobacco products, furniture items, and office machinery. Furthermore, the fact that expenditure per item is exponentially increasing as households move up the income distribution results in failure to converge in the models for the two-digit categories. Thus, the two-digit sample contains stricter conditions on the levels of specific expenditure items. These items are also those for which prices are unavailable. In most cases the sample is restricted to either the bottom 99 per cent, 95 per cent, or 90 per cent of expenditure on a specific item. The impact of this restriction is clearly observed as having the most significant impact on households at the top of the income distribution.

Table 1: CPC categories

1-digit	Name	2-digit	Name
0	Agriculture	01	Products of agriculture, horticulture, and market gardening
1	Ores and minerals	11	Coal and lignite; peat
2	Food	21	Meat, fish, fruit, vegetables, oils, and fats
		22	Dairy products and egg products
		23	Grain mill products, starches and starch products; other food products
		24	Beverages
		25	Tobacco products
		27	Textile articles other than apparel
		28	Knitted or crocheted fabrics; wearing apparel
		29	Leather and leather products; footwear
3	Transportable goods	32	Pulp, paper, and paper products; printed matter and related articles
		33	Coke oven products; refined petroleum products; nuclear fuel
		34	Basic chemicals
		37	Glass and glass products and other non-metallic products n.e.c.
		38	Furniture; other transportable goods n.e.c.
4	Metals	42	Fabricated metal products, except machinery and equipment
		45	Office, accounting, and computing machinery
		47	Radio, television, and communication equipment and apparatus
		49	Transport equipment
5	Construction	53	Constructions
6	Distributive trade	63	Accommodation, food, and beverage services
		64	Passenger transport services
		68	Postal and courier services
7	Finance	71	Financial and related services
8	Business and production services	84	Telecommunications, broadcasting, and information supply services
		87	Maintenance, repair and installation (except construction) services
9	Community and social services	92	Education services
		93	Human health and social care services
		94	Sewage and waste collection, treatment and disposal, and other environmental protection services
		96	Recreational, cultural, and sporting services
		97	Other services

Note: n.e.c.—not elsewhere classified.

Source: Authors and UN (2015).

Table 2: Mean product expenditure, by income decile and product category (IES 2010)

Variable	Mean	0% - 10%	10%- 20%	20%- 30%	30%- 40%	40%- 50%	50%- 60%	60%- 70%	70%- 80%	80%-90%	90%-100%
Agriculture items – 1-digit	130.6	11.6	16.3	23.8	19.1	30.2	40.6	63.1	116.0	190.8	670.0
Agriculture items – 2-digit	46.9	12.3	17.8	17.4	29.6	24.6	23.3	40.2	68.3	114.5	114.9
Ores and minerals – 1-digit	3257.5	1010.6	1333.1	1671.4	1855.1	2122.8	2425.9	3104.8	3588.8	5415.9	8549.9
Ores and minerals – 2-digit	2263.4	966.5	1274.0	1561.1	1735.3	1920.4	2176.8	2322.8	2966.9	3402.5	4117.0
Food and clothing	17250.3	5500.1	8557.5	10629.6	12619.4	14592.3	16664.4	19869.3	22818.3	26186.2	30314.5
Meat	4475.8	1595.1	2434.2	3014.6	3712.3	3918.3	4521.1	4966.5	5765.6	6651.6	7809.1
Dairy	889.6	318.3	477.7	564.7	712.5	753.0	876.1	1002.2	1116.0	1402.7	1597.5
Grain and starch	4506.2	1715.4	2706.9	3225.2	4124.8	4467.9	4617.1	5233.2	5680.8	6617.9	6343.5
Beverages	1268.7	390.0	576.6	890.3	799.4	1061.3	1152.1	1467.7	1510.6	2314.2	2395.4
	321.6	177.8	222.1	211.0	168.3	296.6	278.3	339.9	357.1	499.7	638.4
Textiles	723.5	245.0	309.2	421.0	573.3	603.1	739.0	817.8	1023.3	1242.7	1191.4
Apparel	1712.6	425.3	756.3	897.8	1227.7	1319.4	1692.3	1931.7	2304.3	2688.8	3707.6
Footwear	902.3	283.8	439.0	481.0	659.4	759.7	952.2	1043.4	1197.8	1431.2	1688.9
Transportable goods	5372.3	662.1	1026.9	1433.5	1956.2	2746.1	4000.0	4496.9	7179.2	10010.2	16906.1
Paper	175.8	40.0	61.5	93.0	104.8	138.2	135.0	179.0	231.8	313.0	440.6
Fuel	963.3	11.2	33.6	51.3	12.2	175.9	571.8	948.6	1466.9	2389.5	3786.7
Chemical items	1540.0	504.4	757.3	922.5	1214.6	1413.7	1388.2	1704.7	1989.2	2405.3	2957.5
Glass items	88.2	44.7	46.7	56.0	66.2	71.8	76.4	101.5	127.0	142.6	142.0
Furniture	407.7	23.8	82.5	152.6	185.6	273.3	490.7	694.4	490.7	692.2	944.0
Metals and machinery	2870.5	264.2	607.3	756.8	979.0	1321.9	1549.0	1974.1	3594.8	4756.1	10845.6
Office machinery	80.4	24.0	10.8	24.9	24.4	39.6	57.2	71.1	179.9	159.5	200.1
Metals and machinery	619.5	89.5	259.9	339.9	398.7	640.1	699.4	798.0	887.9	916.4	1094.3
Radio and television	544.7	151.4	209.4	326.3	369.7	483.6	460.6	579.8	670.5	839.2	1298.2
Transport equipment	143.0	0.0	1.9	21.8	3.9	17.2	57.3	98.7	178.0	463.1	558.0
Construction – 1-digit	691.8	40.1	53.2	130.2	219.6	271.5	415.4	485.4	771.3	1816.1	2221.6
Construction – 2-digit	359.1	35.7	47.5	83.9	187.9	243.9	249.7	442.2	447.7	558.0	1248.2
Distributive trade services	4365.3	891.7	1669.0	2081.1	2842.8	3493.8	4006.9	4715.0	6368.8	7200.8	8808.1

Variable	Mean	0% - 10%	10%- 20%	20%- 30%	30%- 40%	40%- 50%	50%- 60%	60%- 70%	70%- 80%	80%-90%	90%-100%
Accommodation and restaurants	763.6	158.0	292.6	492.0	519.7	605.7	586.7	735.8	944.2	1444.6	1765.9
Transport services	2608.8	673.6	1187.5	1406.3	1768.1	2232.9	2856.4	3344.0	3396.2	4019.1	4948.7
Postal services	763.6	158.0	292.6	492.0	519.7	605.7	586.7	735.8	944.2	1444.6	1765.9
Financial services – 1-digit	3172.4	333.5	558.0	639.7	912.6	1078.4	1324.7	1841.3	2661.9	5263.0	14409.0
Financial services – 2-digit	1350.1	325.5	516.7	634.3	769.6	949.5	1121.5	1359.6	1779.8	2207.6	3677.5
Business and production services	1571.4	317.2	452.7	572.0	674.2	895.4	1033.5	1430.2	1604.7	2605.3	5183.7
Business and telephone services	886.5	269.2	440.0	461.0	572.1	714.9	863.5	992.4	1254.5	1462.6	1742.7
Maintenance	32.7	0.0	1.0	0.3	1.2	9.4	4.2	12.0	77.4	81.8	132.2
Community and social services	2842.4	163.2	359.0	528.1	629.4	787.5	1352.5	1953.0	3066.1	4886.8	12338.4
Education	336.5	18.0	47.3	85.0	102.2	144.2	197.9	368.7	523.4	735.7	1088.7
Medical services	297.5	76.6	125.3	158.9	181.5	178.6	280.2	366.3	389.2	563.0	624.5
Community services	114.3	21.9	43.1	67.0	70.4	53.5	109.2	130.2	144.6	191.5	299.7
Recreation and culture	148.2	16.0	40.2	80.9	117.2	79.8	145.2	141.9	224.2	278.8	339.7
Domestic services	206.6	5.9	45.1	51.1	72.2	82.8	132.4	204.1	280.4	346.2	815.4
Total rent – 1-digit	20074.2	3038.9	4461.3	5879.6	7262.3	8780.9	12136.9	15957.4	21361.5	36845.3	71390.0
Total rent – 2-digit	11093.3	2901.2	4159.1	5400.0	6113.3	7670.0	9192.2	11757.1	15052.7	18890.0	28500.9

Source: Authors' calculations using IES 2010/2011 data.

5.3 Price data

Like most household surveys, the IES did not ask any questions about prices. To remedy this we construct a price level series based on product level price data obtained from StatsSA for 2010. The price level for a given product category is constructed by calculating the mean price level in each province for all the detailed products within that category. In order to ensure data consistency, only the households surveyed in 2010 of the 2010/2011 IES are used. Official correspondence tables were used to translate the COICOP products to CPC categories. Unfortunately, prices for several commodities are completely unavailable, even at higher levels of aggregation. Furthermore, there is a shift in the coding conventions between 2008 and 2010, after which several categories were no longer available. Due to these problems, we do not have price information for certain products, in which case we use the technique outlined in Section 3 to estimate the income elasticities. At the two-digit level we do not have price data for transport equipment, postal services, financial services, business and telephone services, maintenance, education, medical services, community and social services, recreation and culture, or domestic services.

There are several product categories for which we have expenditure data but no price data, which limits our ability to identify certain LES parameters. The categories are: financial services (CPC category 71); real estate services (72); leasing or rental services without operator (73); all business and production services except for telecommunications and broadcasting services (84) and maintenance and repair services (87); education services (92); human health and social care services (93); sewage and waste collection (94); recreational and cultural services (96); and domestic services (98).

Unlike Case (2000), we do not have access to specific price data for population sub-groups so we are unable to calculate how much of the price variation is due to product quality differences. Table 3 reports the average price levels, as well as the distribution of prices by income decile. While the average price for items such as food items, paper items, glass items, furniture, metal products, and transport services are in general increasing over the total expenditure distribution, these differences are relatively small and do not present enough consistent variation to adjust the estimates for quality differentials.

Table 3: Mean product price, by income decile and product category

Variable	Mean	0%- 10%	10%- 20%	20%- 30%	30%- 40%	40%- 50%	50%- 60%	60%- 70%	70%- 80%	80%- 90%	90%- 100%
Agriculture items – 1-digit	36.8	37.5	37.6	37.1	37.1	37.2	36.9	37.0	36.1	35.9	35.8
Agriculture items – 2-digit	37.0	37.4	37.8	37.1	37.2	37.2	37.1	37.0	36.9	36.3	36.0
Ores and minerals – 1-digit	28.7	27.3	27.2	27.0	27.9	27.6	28.3	29.4	29.1	30.4	32.1
Ores and minerals – 2-digit	28.1	27.3	27.4	27.3	27.2	27.8	27.4	28.3	29.4	29.3	29.4
Food and clothing	92.4	88.0	89.7	88.2	90.4	90.0	89.8	93.4	93.6	97.6	100.9
Meat	23.7	23.6	23.7	23.7	23.6	23.7	23.7	23.6	23.9	24.0	24.0
Dairy	20.8	20.5	20.6	20.5	20.5	20.6	20.7	20.8	21.2	21.1	21.3
Grain and starch	14.5	14.5	14.4	14.4	14.5	14.5	14.5	14.6	14.6	14.5	14.6
Beverages	15.0	14.9	14.9	15.0	14.9	14.9	15.0	15.0	15.1	15.2	15.3
Tobacco	30.2	29.7	30.3	30.1	30.2	30.3	30.3	29.5	30.4	30.8	30.8
Textiles	1555.8	1452.4	1523.4	1512.3	1513.2	1528.0	1533.1	1505.1	1601.3	1665.4	1709.8
Apparel	105.4	104.4	104.7	104.5	104.4	104.9	105.3	105.2	106.7	106.7	107.4
Footwear	88.7	88.2	87.7	87.5	88.9	88.5	88.8	89.3	89.3	89.0	89.5
Transportable goods	2048.5	1926.2	1987.9	1919.9	1975.3	2005.8	1966.0	2082.1	2077.4	2212.9	2259.7
Paper	10.0	9.9	10.0	9.9	9.9	10.0	10.0	10.0	10.2	10.2	10.3
Fuel	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Chemical items	33.9	34.0	32.9	33.0	33.4	33.8	33.1	35.3	35.4	34.4	34.1
Glass items	89.4	87.2	89.3	89.7	90.4	88.7	90.3	88.2	87.5	90.4	92.6
Furniture	6795.3	6724.7	6621.2	6655.0	6603.4	6693.2	6831.6	6840.6	6963.7	6887.8	7108.1
Metals and machinery	1402.9	1351.5	1355.6	1353.0	1363.8	1379.6	1386.4	1400.2	1420.4	1489.6	1495.0
Office machinery	2288.6	2386.5	2273.0	2263.8	2244.2	2305.6	2297.8	2380.2	2323.3	2184.4	2231.8
Metals and machinery	1275.5	1264.6	1256.5	1257.4	1273.4	1269.5	1279.3	1287.5	1279.6	1278.7	1306.5
Radio and television	1598.0	1542.9	1578.2	1568.7	1585.1	1579.0	1604.2	1575.4	1613.1	1642.5	1684.3
Construction – 1-digit	122.2	122.9	119.7	123.3	121.9	121.5	125.1	122.5	121.9	121.0	122.2
Construction – 2-digit	122.1	123.6	121.0	120.9	122.2	122.2	121.1	125.6	123.4	121.0	120.5
Distributive trade services	101.7	102.0	101.5	101.3	101.2	102.1	102.1	101.2	101.7	102.9	101.1
Accommodation and restaurants	107.9	109.4	107.5	108.1	107.8	108.2	108.8	108.6	107.6	106.4	107.3
Transport services	34.9	34.4	34.8	34.8	34.9	34.8	34.8	34.7	34.8	35.3	35.6

Source: Authors' calculations based on IES 2010/11.

6 Results

We start our empirical analysis by estimating the LES on the CPC categories using the IES expenditure data and StatsSA price data. The sample is restricted to the bottom 90 per cent of the income distribution as the rapid increase in income above this threshold alters the estimated elasticities dramatically.¹² Table 4 reports the income elasticities for both the one-digit and two-digit product categories, calculated at the sample mean values of income and product expenditure. The results are broadly consistent with the estimates of Case (2000) and Dunne and Edkins (2008: 114).¹³ Food has the lowest income elasticity of 0.6, while financial services have the highest elasticity of 1.84. Although Case's (2000) study is not directly comparable in data,

¹² The results obtained from the top 10 per cent of the population are reported in Table 6.

¹³ It should be noted that Dunne and Edkins (2008) estimate the income elasticity of food using time series data.

methodology or expenditure categories, it is worth noting that she estimated very similar income elasticities for food of 0.66 and 0.73 for African and white households respectively. Furthermore, she found that insurance—which is captured in our financial services category—was the most income elastic expenditure product for African households. Full regression results are reported in Tables B1 and B2 (Appendix B).

Table 4: Income elasticity estimates

CPC 1-digit item	CPC 1 Inc. Elast.	CPC 2 Inc. Elast.	CPC 2-digit item
Agriculture	1.879*** (0.1936)	1.504*** (0.2699)	Products of agriculture
Ores and minerals	0.856*** (0.037)	0.751*** (0.038)	Coal and lignite
Food and clothing items	0.482*** (0.0205)	0.747*** (0.0298) 0.774*** (0.0353) 0.574*** (0.0283) 0.933*** (0.0789) 0.736*** (0.1055) 0.973*** (0.0525) 1.06*** (0.118) 0.904*** (0.0529)	Meat, vegetables, oils Dairy and egg products Grains, starches; other food Beverages Tobacco products Textile articles Wearing apparel Leather products and footwear
Transportable goods	1.132*** (0.032)	1.2*** (0.1095) 2.219*** (0.139) 0.845*** (0.04) 0.907*** (0.0892) 1.338*** (0.1587)	Paper and related products Fuel products Basic chemicals Glass and non-metallic products Furniture and other products
Metals	1.35*** (0.1161)	0.896*** (0.0784) 1.352*** (0.2524) 1.109*** (0.1226) 2.505*** (0.4748)	Metal and machinery Office machinery Communication equipment Transport equipment
Construction	1.261*** (0.1625)	1.344*** (0.186)	Construction
Distributive trade	0.634*** (0.0398)	1.62*** (0.228) 1.151*** (0.1011) 0.874*** (0.0462)	Accommodation and food services Passenger transport services Postal services
Financial services	1.706*** (0.0639)	1.301*** (0.0634)	Financial services
Business and production services	1.145*** (0.0577)	0.964*** (0.0825) 2.427*** (0.4514)	Communication services Maintenance services
Community and social services	1.598*** (0.0733)	1.764*** (0.1695) 1.039*** (0.0944) 1.17*** (0.1182) 1.231*** (0.1067) 1.895*** (0.2188)	Education services Health and social care Waste disposal services Recreational services Domestic services
Property and rent	1.645*** (0.039)	1.153*** (0.0303)	Property and rent

Note: Standard errors in parentheses; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Source: Authors' calculations based on IES 2010/11.

6.1 Income elasticities

The income elasticities for the two-digit product categories reveal substantial heterogeneity in these elasticities within each broad category. While all food and clothing items are necessity products the higher income elasticities on clothing items clearly indicate that higher incomes would go proportionally more to clothing than food items. Within food itself, meat, vegetables, oils, dairy products, eggs, and beverages have higher estimated income elasticities than grains and starches. This result is in contrast to the elasticities found for Tanzania (Chongela et al. 2013: 46),

but more consistent with the results for Malawi (Ecker and Qaim 2008: 23) and India (Kumar et al. 2011: 11) for meat and dairy products.¹⁴

Within transportable goods there is substantial variation, with basic chemical products and glass and non-metallic products being normal necessity goods, while the rest of the items are luxury goods. This should be expected as the basic chemicals category consists mostly of personal care, household cleaning, and basic medicine items, while glassware and other products consists of basic tableware items. Within metals, substantial variation is again observed, with basic household appliances, in the metal and machinery category, being a normal necessity item. Transport equipment, including vehicles, is found to be a luxury item, consistent with the international literature (McCarthy 1996). Within distributive trade services, accommodation and food services are found to be luxury items, consistent with the international literature; interestingly, passenger transport services are not found to be inferior items, but rather luxury goods. The result that South Africans will tend to spend proportionally more on passenger transport services as their income increases may be due to the pervasiveness of the taxi industry in the country, but deeper analysis into this is beyond the scope of the present paper. The estimate of the income elasticity of tobacco demand is similar to that found by Boshoff (2008), using time-series techniques, for South Africa between 1999 and 2006. All social services are luxury items, with expenditure on domestic workers and education having the highest income elasticities. While the estimates are significant we argue that the elasticities on products of agriculture, fuel products, office machinery, transport equipment, construction, and furniture should be interpreted with caution as these categories contain many zero-expenditure households.

Income elasticities over the expenditure distribution

In Table 5 the income elasticities per decile are reported.¹⁵ In this table both mean total expenditure and mean expenditure per item are calculated for the mean within the respective section of the expenditure distribution. In this table some sudden fluctuations between adjacent deciles are observed, which may be symptomatic of greater sampling variation in our estimates rather than actual behavioural responses to income fluctuations. Such variation notwithstanding, we also observe more systematic features in the data with the income elasticities of several products now appearing to decrease as households move up the income distribution. While these estimates do appear to exhibit some variation, the fact that the same LES parameters are assumed for all deciles may obscure shifts in the underlying elasticities as we move across the expenditure distribution.

Tables 6 and 7 correct for this by comparing the estimated income elasticities for various income groups obtained from estimating separate regressions for each of the specified income groups. This approach is more flexible as we now also allow the preference and subsistence parameters from the LES to vary across income groups. This flexibility can allow specific features of household behaviour to reveal themselves in a way that may not have been possible in the previously reported estimates, but we would also expect the estimates to be much more vulnerable to sampling variability.

¹⁴ It should be noted that these papers use different classifications so that the results are not directly comparable.

¹⁵ The income elasticities for two-digit categories are reported in Tables C1-C2 (Appendix C).

Table 5: Income elasticity estimates, by income decile

CPC 1-digit item	0%-10%	10%-20%	20%-30%	30%-40%	40%-50%	50%-60%	60%-70%	70%-80%	80%-90%	90%-100%
Agriculture	5.58	5.31	4.51	6.79	5.26	4.84	3.97	2.94	2.70	1.51
Ores and minerals	0.73	0.74	0.73	0.80	0.85	0.92	0.92	1.08	1.08	1.35
Food items	0.40	0.34	0.34	0.35	0.37	0.40	0.43	0.51	0.67	1.13
Transport. goods	2.42	2.10	1.86	1.65	1.44	1.22	1.38	1.18	1.28	1.49
Metals	3.86	2.26	2.24	2.10	1.90	2.01	2.01	1.50	1.71	1.48
Construction	5.75	5.82	2.94	2.11	2.09	1.69	1.84	1.58	1.01	1.63
Distributive trade	0.82	0.59	0.58	0.52	0.51	0.55	0.60	0.60	0.81	1.30
Financial services	4.28	3.43	3.71	3.15	3.25	3.28	3.01	2.83	2.16	1.55
Bus. and prod. serv.	0.03	1.14	1.49	1.41	1.38	1.42	1.30	1.40	1.29	1.56
Com. and soc. serv.	7.32	4.47	3.77	3.83	3.73	2.69	2.38	2.06	1.95	1.52

Source: Authors' calculations based on IES 2010/2011.

Table 6: Income elasticity estimates, by income quartile for separate regressions

CPC 1-digit item	0%-25%	25%-50%	50%-75%	75%-95%	90%-100%
Agriculture	0.91* (0.4452)	1.076 (0.7905)	1.518*** (0.4237)	1.395*** (0.2809)	0.97*** (0.2237)
Ores and minerals	0.704*** (0.0534)	0.667*** (0.073)	0.794*** (0.0896)	1.098*** (0.1468)	0.653*** (0.0457)
Food items	0.964*** (0.0274)	0.868*** (0.0492)	0.628*** (0.0553)	0.501*** (0.064)	0.312*** (0.0857)
Transportable goods	0.986*** (0.0676)	1.489*** (0.131)	1.2*** (0.0746)	0.878*** (0.0568)	0.476*** (0.0743)
Metals	1.392*** (0.145)	1.405*** (0.2071)	1.346*** (0.1549)	1.711*** (0.236)	2.117*** (0.2516)
Construction	1.678** (0.5523)	1.011** (0.3687)	2.053** (0.605)	1.003** (0.3336)	2.683*** (0.7705)
Distributive trade	1.089*** (0.0846)	0.685*** (0.1353)	0.546*** (0.111)	0.307** (0.1179)	1.322*** (0.2195)
Financial services	1.021*** (0.1089)	1.027*** (0.1876)	1.585*** (0.1603)	1.672*** (0.0997)	0.781*** (0.1535)
Business and production services	0.898*** (0.148)	1.004*** (0.213)	1.04*** (0.2)	1.049*** (0.1332)	1.067*** (0.246)
Community and social services	1.493*** (0.1667)	1.898*** (0.2808)	1.512*** (0.1954)	1.304*** (0.1478)	0.737*** (0.1061)
Total rent	1.036*** (0.0422)	1.1*** (0.0605)	1.216*** (0.0564)	0.937*** (0.0459)	0.851*** (0.0838)

Note: Standard errors in parentheses; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Source: Authors' calculations based on IES 2010/2011.

Table 7: Income elasticity by quartile for separate regressions

CPC 2-digit item	0%-25%	25%-50%	50%-75%	75%-95%	>90%
Products of agriculture	0.786 (0.5291)	2.179* (0.8627)	1.039 (0.6908)	1.966** (0.6232)	1.456** (0.4575)
Coal and lignite	0.659*** (0.0581)	0.895*** (0.1227)	0.776*** (0.1025)	1.198*** (0.1126)	0.962*** (0.1713)
Meat, vegetables, oils	1.027*** (0.0685)	0.746*** (0.1092)	0.833*** (0.1183)	0.546*** (0.1034)	0.093 (0.0765)
Dairy and egg products	0.904*** (0.1235)	0.847*** (0.1908)	0.831*** (0.1577)	0.428** (0.1433)	0.177 (0.1118)
Grains, starches; other food	1.02*** (0.0667)	0.768*** (0.1386)	0.738*** (0.1251)	0.153 (0.1329)	-0.001 (0.0762)
Beverages	1.225*** (0.2882)	1.281** (0.369)	0.9** (0.2843)	0.838^ (0.4613)	0.59* (0.2799)
Tobacco products	0.348* (0.1762)	0.762* (0.3311)	0.155 (0.3659)	0.232 (0.4158)	0.115 (0.2826)
Textile articles	1.201*** (0.133)	1.39*** (0.1377)	1.479*** (0.1505)	1.057*** (0.1394)	0.919** (0.2773)
Wearing apparel	1.109*** (0.1079)	1.008*** (0.1987)	1.24*** (0.1763)	1.099*** (0.1987)	0.401** (0.1482)
Leather products and footwear	0.77*** (0.0936)	0.882*** (0.1333)	1.046*** (0.1595)	1.092*** (0.1573)	0.785** (0.2657)
Paper and related products	1.155*** (0.288)	1.254^ (0.6548)	0.705 (0.4599)	0.832** (0.2962)	0.723*** (0.1869)
Fuel products	0.865 (0.7401)	7.148*** (1.8636)	2.537*** (0.5797)	1.273*** (0.2458)	0.915*** (0.1385)
Basic chemicals	0.867*** (0.0815)	0.831*** (0.0893)	0.933*** (0.0984)	0.762*** (0.2135)	0.292** (0.106)
Glass and non-metallic products	0.977*** (0.2458)	1.187*** (0.2398)	1.906*** (0.3054)	1.433*** (0.2448)	0.868* (0.4328)
Furniture and other products	2.000*** (0.4849)	1.523*** (0.4085)	0.998* (0.406)	1.005** (0.2901)	0.559 (0.344)
Office machinery	-0.685 (1.2981)	0.242 (0.5028)	0.836^ (0.4785)	1.425*** (0.3837)	0.719** (0.2715)
Metal and machinery	1.525*** (0.27)	1.155* (0.4525)	0.856** (0.2722)	0.875** (0.3096)	0.649* (0.2692)
Communication equipment	1.35*** (0.2086)	1.033** (0.3245)	1.314*** (0.2504)	0.946*** (0.195)	0.832** (0.3082)
Transport equipment	1.931 (1.8949)	2.054 (4.3245)	2.721* (1.0535)	2.254** (0.6827)	0.491^ (0.2628)
Construction	0.686^ (0.3753)	1.234** (0.4009)	0.446 (0.4076)	1.311** (0.4148)	1.141* (0.5394)
Accommodation and food services	1.595*** (0.3118)	0.995* (0.4548)	1.638*** (0.3194)	1.124*** (0.3027)	0.935** (0.3488)
Passenger transport services	1.115*** (0.12)	1.206*** (0.1984)	0.483* (0.1988)	0.279 (0.1768)	-0.03 (0.1316)
Postal services	2.52** (0.9279)	0.223 (1.6669)	1.102 (1.0786)	1.207^ (0.7316)	0.587 (0.4769)
Financial services	1.09*** (0.1388)	1.099*** (0.307)	1.111*** (0.223)	1.546*** (0.2671)	0.854*** (0.1467)
Communication services	1.34** (0.4806)	1.575 (1.108)	-0.023 (0.7317)	1.417 (0.9187)	0.805* (0.3402)
Maintenance services	0.104 (0.122)	6.954* (3.5225)	3.892** (1.1426)	2.943* (1.1766)	2.156** (0.7185)
Education services	1.908*** (0.477)	1.224 (0.8879)	1.303* (0.5981)	1.973*** (0.5283)	1.4*** (0.3992)
Health and social care	0.987*** (0.2535)	-0.12 (0.7438)	0.723 (0.4602)	0.921 (0.608)	2.347* (1.0526)
Waste disposal services	1.34** (0.4806)	1.575 (1.108)	-0.023 (0.7317)	1.417 (0.9187)	0.805* (0.3402)
Recreational services	2.304*** (0.4288)	0.651 (0.7536)	1.292^ (0.7743)	1.731*** (0.4624)	2.045*** (0.5305)
Domestic services	1.602** (0.5193)	0.969 (1.387)	1.194 (0.8182)	1.396** (0.4962)	1.387*** (0.356)
Total rent	0.926*** (0.0466)	1.049*** (0.0722)	1.083*** (0.07)	1.193*** (0.0832)	1.205*** (0.1007)

Note: Standard errors in parentheses; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ^ < 0.1 .

Source: Authors' calculations based on IES 2010/2011.

In Table 6 the income elasticities for the CPC one-digit categories across the expenditure distribution are reported. Consistent with economic theory, the income elasticity of food decreases as households move up the income distribution, a result also confirmed for India (Kumar et al. 2011: 11). The impact of this disaggregation on the elasticities of the CPC two-digit products are clearly observed in Table 7, with the income elasticity of demand for grains and starch items, tobacco products, leather products and footwear, as well as metals and machinery items exhibiting some discreet discontinuities. In general, however, decreases in the expenditure elasticity for food items are observed for meat, vegetable, and oil products, as well as dairy and egg products, in a manner consistent with the findings of Bopape and Myers (2007), who used a quadratic almost ideal demand system (QUAIDS) model on the KwaZulu-Natal Income Dynamic Survey. Furthermore, the elasticities at the lower end of the income distribution are closer to those estimated for the entire income distribution for low-income countries such as Tanzania and Malawi (Chongela et al. 2013; Ecker and Qaim 2008). Interestingly, tobacco products have an increasing income elasticity for the bottom two quartiles, while they have a very low, statistically insignificant, elasticity for all higher quartiles. This finding is broadly consistent with Huang and Yang's (2006) finding of a positive and significant income elasticity of cigarette demand for people at the bottom of the income distribution, with an insignificant elasticity for people in the top parts of the income distribution in the US. Within wearing and apparel items, the shift of clothes from a luxury good to a necessity good is consistent with the finding of Case (2000) as well as results from Ethiopia using an AIDS model (Tafere et al. 2010: 14). We further find high, and very imprecise, income elasticities for items such as education, health care, and recreational services. It is unclear if these shifts are due to underlying trends or sampling variation. This is again the case with the discreet drop in the income elasticities of glass and non-metallic products, leather and footwear products, maintenance services, financial services, and transport equipment at the top of the income distribution.¹⁶ The elasticities of these items should thus be interpreted with some caution.

In Table 8, we estimate the income elasticity of demand for the CPC products for each income decile separately. In this table, the impact of the fine disaggregation reveals implausibly large fluctuations due to small changes in the income levels, suggesting that the sample size does not allow a sensible analysis of such small sub-groups.

¹⁶ The jump in income elasticity in passenger transport services is most likely driven by the fact that only people at the top of the income distribution would spend money on airline tickets.

Table 8: Income elasticity estimates, by income decile (from separate regressions)

CPC 1-digit item	0-10%	10-20%	20-30%	30-40%	40-50%	50-60%	60-70%	70-80%	80-90%	90-92%	92-94%	94-96%	96-98%	98-100%
Agriculture	-0.565 (1.154)	1.563 (1.378)	3.433** (1.468)	-0.512 (1.394)	2.566* (1.498)	1.754** (0.86)	1.591 (0.997)	1.795 (1.112)	1.893** (0.605)	0.014 (1.573)	1.803 (1.435)	1.526** (0.69)	0.843 (0.843)	0.745*** (0.22)
Ores and minerals	0.547*** (0.076)	0.585*** (0.11)	0.432*** (0.118)	0.873*** (0.127)	0.507*** (0.13)	0.56*** (0.134)	0.839*** (0.131)	1.144*** (0.182)	1.163*** (0.128)	0.818*** (0.247)	1.216*** (0.297)	1.049*** (0.206)	1.187*** (0.204)	0.589*** (0.04)
Food items	0.964*** (0.034)	1.179*** (0.072)	1.409*** (0.085)	1.14*** (0.092)	1.046*** (0.102)	1.217*** (0.096)	1.035*** (0.102)	1.124*** (0.12)	0.723*** (0.098)	0.887** (0.281)	1.067*** (0.252)	0.768** (0.264)	0.96*** (0.287)	0.264** (0.135)
Transport. goods	1.054*** (0.105)	1.018*** (0.188)	0.543*** (0.132)	0.785*** (0.14)	1.197*** (0.258)	0.877*** (0.16)	1.074*** (0.16)	0.774*** (0.134)	1.044*** (0.12)	1.022*** (0.195)	0.729*** (0.169)	0.977*** (0.244)	0.801*** (0.147)	0.554*** (0.055)
Metals	1.422*** (0.224)	0.713* (0.382)	0.481** (0.225)	0.884** (0.314)	1.3** (0.449)	1.451*** (0.263)	1.547*** (0.274)	1.334*** (0.277)	1.592*** (0.302)	0.964 (0.837)	0.465 (0.571)	1.966*** (0.488)	1.063** (0.493)	2.558*** (0.259)
Construct.	1.296** (0.587)	-0.208 (0.854)	-0.235 (0.353)	1.894** (0.761)	-0.228 (0.699)	0.543 (0.588)	0.851 (0.824)	1.303 (0.944)	0.335 (0.878)	-2.19 (3.609)	0.909 (1.83)	2.009 (1.285)	2.396 (1.498)	2.205*** (0.258)
Distrib. trade	1.446*** (0.156)	0.698** (0.255)	0.361* (0.21)	0.718** (0.277)	0.895** (0.322)	0.517** (0.207)	0.477* (0.272)	0.099 (0.22)	0.633** (0.211)	1.469** (0.577)	0.911* (0.493)	1.05*** (0.321)	2.538*** (0.535)	1.112*** (0.113)
All inferred	1.252*** (0.13)	0.884*** (0.108)	0.64*** (0.118)	0.837*** (0.105)	1.096*** (0.114)	0.872*** (0.104)	1.13*** (0.114)	1.19*** (0.135)	1.173*** (0.071)	1.146*** (0.173)	1.134*** (0.138)	0.842*** (0.097)	0.805*** (0.075)	0.554*** (0.087)

Note: Standard errors in parentheses; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Source: Authors' calculations based on IES 2010/2011.

6.2 Own price elasticities

Table 9 reports price elasticities for different items and Table 10 shows own price elasticities at the CPC one-digit level. The price elasticity of agricultural items is once again in question as it is extremely high. Consistent with the international literature the price elasticities of food items is within the -1 and 0 interval. We find a price elasticity for food of around -.492, lower than the findings of Case (2000) and Bopape and Myers (2007), but broadly in line with those found by Dunne and Edkins (2008). Within food items, households are more sensitive to increases in the prices of meat, vegetables, and oils, dairy and egg products, and beverages than the prices of grains and starches. This finding is consistent with findings from India (Kumar et al. 2011: 12), Malawi (Ecker and Qaim 2008: 23), as well as those of several low- and middle-income countries (Cornelsen et al. 2014). The price elasticity of tobacco products is found to be extremely close to the -.62 found by Boshoff (2008) for South Africa for the period between 1999 and 2006. The price elasticity of textiles, apparel, and footwear items are again smaller, in absolute terms, than those found by Case (2000) or those found for the US (Kim 2003).

In Table 11, households at the top of the income distribution are shown to be less sensitive to price changes than households at the bottom of the income distribution for almost all items save the items for which data is sparse, for example agriculture and office machinery. The near negative unity price elasticity for all food items in the bottom 25 per cent of South Africa's households indicates the sensitivity of these households to increases in food prices, suggesting that an increase in food prices would result in a proportional decrease in food consumption by people in these groups. These elasticities for the poor are also high internationally with the price elasticity of meats, wheat, and dairy being -0.908, -0.480, and -0.850 for India (Kumar 2011); -0.448, -0.207, and -0.529 in the US (Park et al. 1996) and -0.53, -0.71, and -0.29 for Indonesia (Jensen and Manrique 1998) respectively for persons at the lower end of the income distribution. The estimates are generally higher than those estimated by Bopape and Myers (2007), however.

Table 9: Price elasticities of demand

CPC 1-digit item	CPC 1 Price Elast.	CPC 2 Price Elast.	CPC 2-digit item
Agriculture	-1.543*** (0.0991)	-1.367*** (0.1691)	Products of agriculture
Ores and minerals	-0.719*** (0.0213)	-0.686*** (0.0305)	Coal and lignite
Food and clothing items	-0.492*** (0.0173)	-0.7*** (0.0253) -0.699*** (0.0321) -0.553*** (0.0241) -0.845*** (0.0595) -0.64*** (0.0741) -0.933*** (0.0384) -0.965*** (0.0846) -0.826*** (0.0413)	Meat, vegetables, oils Dairy and egg products Grains, starches; other food Beverages Tobacco products Textile articles Wearing apparel Leather products and footwear
Transportable goods	-0.94*** (0.023)	-1.063*** (0.0879) -1.919*** (0.0877) -0.767*** (0.0306) -0.877*** (0.0683) -1.219*** (0.0986)	Paper and related products Fuel products Basic chemicals Glass and non-metallic products Furniture and other products
Metals	-1.099*** (0.0525)	-0.826*** (0.06) -1.158*** (0.176) -1.003*** (0.0807) -2.229*** (0.288)	Metal and machinery Office machinery Communication equipment Transport equipment
Construction	-1.021*** (0.0867)	-1.415*** (0.1433)	Construction
Distributive trade	-0.545*** (0.0265)	-1.033*** (0.0682) -0.793*** (0.0372) -0.863*** (0.1508)	Accommodation and food services Passenger transport services Postal services
Financial services	-1.362*** (0.0372)	-1.153*** (0.0459)	Financial services
Business and production services	-0.943*** (0.0356)	-0.868*** (0.0624) -2.151*** (0.2878)	Communication services Maintenance services
Community and social services	-1.286*** (0.0413)	-1.554*** (0.1052) -0.923*** (0.0643) -1.032*** (0.085) -1.105*** (0.0853) -1.669*** (0.1399)	Education services Health and social care Waste disposal services Recreational services Domestic services
Property and rent	1.645*** (0.039)	1.153*** (0.0303)	Property and rent

Note: Standard errors in parentheses; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Source: Authors' calculations based on IES 2010/11.

Table 10: Own price elasticities for CPC one-digit categories

CPC 1-digit item	0%-25%	25%-50%	50%-75%	75%-95%	90%-100%
Agriculture	-0.865* (0.4245)	-0.991 (0.6688)	-1.308*** (0.3199)	-1.489*** (0.254)	-1.202*** (0.1901)
Ores and minerals	-0.683*** (0.0502)	-0.631*** (0.0682)	-0.674*** (0.0701)	-1.166*** (0.1106)	-0.814*** (0.0887)
Food items	-0.955*** (0.0291)	-0.87*** (0.0495)	-0.625*** (0.052)	-0.588*** (0.0669)	-0.416*** (0.0861)
Transportable goods	-0.938*** (0.0606)	-1.313*** (0.1039)	-0.997*** (0.0654)	-0.948*** (0.0669)	-0.619*** (0.0995)
Metals	-1.311*** (0.1241)	-1.282*** (0.1872)	-1.104*** (0.1207)	-1.679*** (0.2035)	-2.046*** (0.2462)
Construction	-1.581*** (0.439)	-0.902** (0.3084)	-1.637*** (0.4012)	-1.069*** (0.3066)	-3.024*** (0.841)
Distributive trade	-1.033*** (0.078)	-0.65*** (0.135)	-0.482*** (0.103)	-0.344* (0.1361)	-1.568*** (0.2767)
Financial services	-0.976*** (0.1064)	-0.945*** (0.1811)	-1.297*** (0.1246)	-1.672*** (0.1044)	-0.941*** (0.121)
Business and production services	-0.858*** (0.1295)	-0.924*** (0.1964)	-0.87*** (0.1543)	-1.12*** (0.1308)	-1.281*** (0.3116)
Community and social services	-1.414*** (0.1419)	-1.706*** (0.2521)	-1.24*** (0.152)	-1.357*** (0.1414)	-0.904*** (0.0906)

Note: Standard errors in parentheses; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Source: Authors' calculations based on IES 2010/2011.

Table 11: Own price elasticities for CPC two-digit categories

CPC 2-digit item	0%-25%	25%-50%	50%-75%	75%-95%	>90%
Products of agriculture	-0.834 (0.594)	-2.154** (0.7768)	-0.907 (0.5662)	-1.723*** (0.4789)	-1.042*** (0.266)
Coal and lignite	-0.715*** (0.0591)	-0.884*** (0.1012)	-0.706*** (0.0842)	-1.035*** (0.0768)	-0.71*** (0.0972)
Meat, vegetables, oils	-1.085*** (0.0762)	-0.757*** (0.1132)	-0.775*** (0.1107)	-0.504*** (0.0927)	-0.076 (0.0623)
Dairy and egg products	-0.967*** (0.1268)	-0.832*** (0.1863)	-0.754*** (0.144)	-0.381** (0.1273)	-0.136^ (0.0782)
Grains, starches; other food	-1.081*** (0.0703)	-0.783*** (0.1435)	-0.695*** (0.1186)	-0.156 (0.1212)	-0.014 (0.0688)
Beverages	-1.298*** (0.2316)	-1.253*** (0.3422)	-0.815** (0.2514)	-0.744* (0.3632)	-0.431* (0.1892)
Tobacco products	-0.378* (0.1889)	-0.742* (0.3053)	-0.141 (0.3425)	-0.18 (0.3268)	-0.062 (0.2081)
Textile articles	-1.296*** (0.1236)	-1.364*** (0.1074)	-1.331*** (0.1074)	-0.968*** (0.1075)	-0.703*** (0.1374)
Wearing apparel	-1.176*** (0.1072)	-0.986*** (0.1928)	-1.112*** (0.1613)	-0.975*** (0.1606)	-0.298** (0.0997)
Leather products and footwear	-0.824*** (0.1004)	-0.863*** (0.1273)	-0.949*** (0.1431)	-0.97*** (0.1405)	-0.571*** (0.1525)
Paper and related products	-1.225*** (0.268)	-1.223^ (0.6255)	-0.625 (0.4348)	-0.706** (0.2476)	-0.502** (0.1452)
Fuel products	-0.936 (0.6883)	-6.718*** (1.6924)	-2.197*** (0.4923)	-1.093*** (0.2105)	-0.663*** (0.0988)
Basic chemicals	-0.923*** (0.0744)	-0.818*** (0.0851)	-0.844*** (0.0768)	-0.67*** (0.1195)	-0.258* (0.1125)
Glass and non-metallic products	-1.074*** (0.2747)	-1.177*** (0.2281)	-1.715*** (0.2204)	-1.294*** (0.1822)	-0.649* (0.2547)
Furniture and other products	-2.141*** (0.3979)	-1.498*** (0.3552)	-0.928* (0.3728)	-0.875** (0.2866)	-0.424^ (0.2315)
Office machinery	0.737 (1.7963)	-0.247 (0.5643)	-0.727^ (0.3901)	-1.208*** (0.2673)	-0.557* (0.2217)
Metal and machinery	-1.6*** (0.2342)	-1.116** (0.4124)	-0.783** (0.2457)	-0.798** (0.2726)	-0.483** (0.1744)
Communication equipment	-1.445*** (0.1972)	-1.019** (0.3065)	-1.183*** (0.2111)	-0.828*** (0.1657)	-0.621** (0.1826)
Transport equipment	-2.046 (1.42)	-2.001 (4.2172)	-2.43* (0.9496)	-1.952** (0.6004)	-0.359^ (0.2052)
Construction	-0.715^ (0.3923)	-1.206** (0.368)	-0.396 (0.3802)	-1.122** (0.3381)	-0.773* (0.3246)
Accommodation and food services	-1.686*** (0.2864)	-0.984* (0.4441)	-1.467*** (0.2707)	-0.971*** (0.251)	-0.674** (0.2142)
Passenger transport services	-1.167*** (0.1337)	-1.157*** (0.1866)	-0.451* (0.182)	-0.264 (0.1618)	0.015 (0.1028)
Postal services	-2.382** (0.6978)	-0.023 (1.5408)	-0.817 (0.9058)	-1.207* (0.4732)	-0.027 (0.1993)
Financial services	-1.183*** (0.1378)	-1.082*** (0.2808)	-0.964*** (0.1922)	-1.555*** (0.181)	-0.544*** (0.0778)
Communication services	-0.945*** (0.1448)	-1.123*** (0.3071)	-0.986*** (0.2268)	-1.107*** (0.1842)	-0.532*** (0.0836)
Maintenance services	-0.741** (0.252)	-6.701* (3.1749)	-3.318*** (0.8208)	-2.75*** (0.7257)	-1.366* (0.5733)
Education services	-1.939*** (0.4078)	-1.188 (0.8122)	-1.031* (0.4956)	-1.336*** (0.3758)	-0.726*** (0.1837)
Health and social care	-1.067*** (0.2373)	-0.109 (0.685)	-0.711^ (0.3822)	-0.725^ (0.3816)	-0.678** (0.2)
Waste disposal services	-1.645*** (0.4256)	-1.175 (0.9879)	-0.159 (0.5683)	-1.033* (0.5033)	-0.538** (0.1742)
Recreational services	-2.437*** (0.3695)	-0.556 (0.758)	-1.218* (0.6174)	-1.43*** (0.3176)	-0.895*** (0.1817)
Other services	-1.798*** (0.3657)	-0.854 (1.2348)	-1.412* (0.7069)	-1.266*** (0.3406)	-0.785*** (0.1471)

Note: Standard errors in parentheses; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ^ < 0.1 .

Source: Authors' own calculations based on IES 2010/2011.

7 Conclusion

This paper investigates the expenditure patterns of South African households using the 2010 IES household expenditure data and StatsSA price data. The LES estimates are used to calculate income elasticities at the sample mean values of income and product expenditure for the CPC one- and two-digit categories. These estimates appear to be sensible and in line with previous estimates for South Africa and other developing countries. Data limitations suggest caution in interpreting the estimates pertaining to agricultural products, industrial machinery and items, and certain service categories. We find that in obtaining income elasticities for different income groups we face a trade-off between the greater stability and statistical efficiency that comes from more restrictive specifications against a more flexible specification that allows subtle behavioural features in the data to emerge at the cost of being more vulnerable to sampling variation. While the elasticities calculated in a separate decile approach are likely to be overly restrictive, the elasticities estimated from separate quartile regressions are arguably an accurate representation of the underlying pattern across the expenditure distribution.

In terms of the estimated elasticities, we find substantial variation in the price and income elasticity of demand of necessity items across the income distribution, with the bottom quartile being extremely sensitive to increases in the price of food and clothing items, while the top quartile is as sensitive as households in developed countries. According to our analysis South Africans view food, personal care, and energy goods as necessity items, while they are willing to spend proportionally more on financial services, medical and social care, education, and domestic worker's services as total income increases.

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Appendix A

Table A1: Correspondence of CPC and COICOP categories in IES data

CPC		COICOP		Non-zero obs
Code	Description	Code	Description	
01	Products of agriculture, horticulture, and market gardening	0933	gardens_plants	1002
		0934	pets_products	1021
		0935	other_recr_gardens	225
11	Coal and lignite; peat	0453	liquid_fuels	1129
		0454	solid_fuels	1142
		0451	electricity	6832
		0452	other_electricity	96
		0441	water_supply	3025
		0440	other_1_water	585
21	Meat, fish, fruit, vegetables, oils and fats	0112	meat	8125
		0113	fish	3121
		0115	oils	5137
		0116	fruit	4061
		0117	vegetables	8249
22	Dairy products and egg products	0114	milk	7326
23	Grain mill products, starches and starch products; other food products	0111	bread	9188
		0118	sugar	6304
		0119	other_food	5562
		0121	coffee	3430
24	Beverages	0199	other_bev.	1419
		0122	mineral_waters	6338
		0211	spirits	263
		0212	wine	472
		0213	beer	1280
25	Tobacco products	0221	tobacco	2458
27	Textile articles other than apparel	0521	household_textiles	5623
		1232	personal_effects	4375
28	Knitted or crocheted fabrics; wearing apparel	0311	other_clothing	687
		0312	garments	8255
		0313	other_2_clothing	2425
		0314	other_3_clothing	789
29	Leather and leather products; footwear	0321	footwear	8223
		0322	other_footwear	745
32	Pulp, paper, and paper products; printed matter and related articles	0951	books	1262
		0952	newspapers_periodicals	4120
		0953	other_newspapers	251
		0954	stationary_materials	1244
33	Coke oven products; refined petroleum products; nuclear fuel	0722	fuels_lubricants	2470
34	Basic chemicals	0931	games_toys	683
		0561	non-durab_goods	6233
		0611	pharmaceutical_products	6503
		0612	other_1_medical_products	293
		0613	other_2_medical_products	193
		1213	other_appliances	5254
37	Glass and glass products and other non-metallic products n.e.c.	0541	glassware_tableware	3154
38	Furniture; other transportable goods n.e.c.	0511	furniture_furnishings	1225
		0512	carpets_other	608
		0513	other_furniture	89
43	Fabricated metal products, except machinery and equipment	0531	major_hh_apprice	2647
		0532	small_hh_apprice	3102
		0533	other_hh_appliances	923
		0551	other_hh_tools	155
		0552	small_tools	906
		0932	sport_equipment	638
45	Office, accounting, and computing machinery	0913	information_equipment	1968

CPC		COICOP		Non-zero obs
Code	Description	Code	Description	
47	Radio, television, and communication equipment and apparatus	0911	equipment_pictures	1996
		1231	jewellery_clocks	1705
		0821	telephone_equipment	2324
		0912	other_photo_eq	256
		0914	recording_media	1788
49	Transport equipment	0711	motor_cars	463
		0712	other_1_vehicles	14
		0713	other_2_vehicles	28
		0721	spare_parts	1439
53	Constructions	0431	materials_maintenance	1241
		0432	other_maintenance	1260
63	Accommodation, food, and beverage services	1111	restaurants_cafe	1904
		1112	other_catering_services	3965
		1121	accommodation_services	996
		1211	other_1_personal_care	142
		1212	other_2_personal_care	38
64	Passenger transport services	0724	trans_other_services	2315
		0731	transport_railway	565
		0732	transport_road	6832
		0733	transport_air	180
		0734	other_1_transerv	30
		0736	other_2_transerv	545
68	Postal and courier services	0811	postal_services	1011
71	Financial and related services	1252	insurance_dwelling	974
		1253	insurance_health	1689
		1254	insurance_transport	727
		1255	other_insurance	5399
		1262	financial_services	5928
84	Telecommunications, broadcasting, and information supply services	0831	telephone_services	8160
87	Maintenance, repair, and installation (except construction) services	0723	maintenance_repair	1051
92	Education services	1011	primary_education	1810
		1021	secondary_education	1531
		1041	tertiary_education	569
		1051	other_educ	370
93	Human health and social care services	0631	hospital_services	146
		0623	other_patient_services	349
		0621	medical_services	3514
		1241	social_services	875
		0622	dental_services	447
94	Sewage and waste collection, treatment and disposal, and other environmental protection services	0442	refuse_collection	1599
		0443	sewerage_collection	1361
		0444	other_services	1737
96	Recreational, cultural, and sporting services	0941	recreational_services	638
		0942	cultural_services	3519
		0943	#N/A	715
		0961	other_4_enter	96
		0921	other_1_enter	12
		0922	other_2_enter	52
		0923	other_3_enter	107
97	Other services	0562	domestic_services	901
		1271	other_2_services	

Note: n.e.c.—not elsewhere classified.

Source: Authors' compilation.

Appendix B: Regression results for bottom 90 per cent of income distribution

Table B1: Regression output for CPC one-digit regression

Item	Gamma	Beta	R 2
Agriculture	-1.936*** (0.3540)	0.00398*** (0.0004)	0.145
Ores and minerals	33.35*** (2.4805)	0.0453*** (0.0020)	0.632
Food and clothing	109.6*** (3.1234)	0.135*** (0.0057)	0.755
Transportable goods	0.175** (0.0666)	0.0988*** (0.0028)	0.655
Metals and machinery	-0.217^ (0.1156)	0.0629*** (0.0054)	0.280
Construction	-0.118 (0.4981)	0.0142*** (0.0018)	0.0811
Distributive trade	20.46*** (1.1484)	0.0449*** (0.0028)	0.440
Financial services	-1260.3*** (133.2616)	0.0879*** (0.0033)	0.595
Business services	92.58 (57.4346)	0.0292*** (0.0015)	0.464
Community and social services	-879.1*** (129.3749)	0.0737*** (0.0034)	0.472
Beta for total rent	0.40412		
Observations	6321		

Note: Standard errors in parentheses; *** p<0.001; ** p<0.01; * p<0.05; ^ <0.1.

Source: Authors' own calculations based on IES 2010/2011.

Table B2: Regression output for CPC two-digit categories

	Gamma	Beta	R 2
Products of agriculture	-0.467* (0.215)	0.00177*** (0.0003)	0.0397
Coal and lignite	26.41*** (2.5142)	0.0426*** (0.0022)	0.624
Meat, vegetables, oils	61.69*** (5.0252)	0.0838*** (0.0033)	0.684
Dairy and egg products	13.11*** (1.3907)	0.0173*** (0.0008)	0.515
Grains, starches; other food	148.5*** (7.5994)	0.0649*** (0.0032)	0.641
Beverages	13.47** (5.1489)	0.0297*** (0.0025)	0.248
Tobacco products	3.853*** (0.7895)	0.00594*** (0.0009)	0.132
Textile articles	0.0316^ (0.0182)	0.0177*** (0.001)	0.315
Wearing apparel	0.593 (1.437)	0.0455*** (0.0051)	0.426
Leather products and footwear	1.803*** (0.4268)	0.0204*** (0.0012)	0.441
Paper and related products	-1.114 (1.5478)	0.00529*** (0.0005)	0.192
Fuel products	-115.8*** (11.3986)	0.0536*** (0.0034)	0.203
Basic chemicals	10.95*** (1.4205)	0.0326*** (0.0015)	0.492
Glass and non-metallic products	0.121^ (0.0675)	0.00200*** (0.0002)	0.124
Furniture and other products	-0.0133* (0.006)	0.0137*** (0.0016)	0.0894
Metal and machinery	0.0856** (0.0295)	0.0139*** (0.0012)	0.0333
Office machinery	-0.00556 (0.0062)	0.00273*** (0.0005)	0.166
Communication equipment	-0.00108 (0.0279)	0.0151*** (0.0017)	0.201
Transport equipment	-177.4*** (41.862)	0.00898*** (0.0017)	0.0749
Construction	-1.238** (0.4299)	0.0146*** (0.0021)	0.194
Accommodation and food services	-0.237 (0.4939)	0.0220*** (0.0019)	0.468
Passenger transport services	16.44*** (2.9043)	0.0572*** (0.003)	0.0479
Postal services	1.283 (1.4168)	0.000230*** (0.00004)	0.0348
Financial services	-216.4*** (65.1849)	0.0440*** (0.0021)	0.455
Communication services	119.4* (56.3366)	0.0214*** (0.0018)	0.413
Maintenance services	-37.72*** (9.4464)	0.00199*** (0.0004)	0.0327
Education services	-189.1*** (36.1716)	0.0149*** (0.0014)	0.135
Health and social care	23.06 (19.2677)	0.00775*** (0.0007)	0.173
Waste disposal services	-3.709 (9.752)	0.00335*** (0.0003)	0.112
Recreational services	-15.65 (12.7112)	0.00458*** (0.0004)	0.125
Domestic Services	-139.5*** (29.3378)	0.00982*** (0.0011)	0.0821
Beta total rent		0.33498	
Observations		5045	

Note: Standard errors in parentheses; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ^ < 0.1 .

Source: Authors' own calculations based on IES 2010/2011.

Appendix C: Results for regressions by quartile

Table C1: Regression output for separate quartile regression—CPC one-digit categories

	0%-25%		25%-50%		50%-75%		75%-95%		90%-100%	
	Gamma	Beta	Gamma	Beta	Gamma	Beta	Gamma	Beta	Gamma	Beta
Agriculture	0.0624 (0.1962)	0.000843* (0.0004)	0.00655 (0.5126)	0.000828 (0.0006)	-0.868 (0.9016)	0.00211*** (0.0006)	-10.86^ (5.6571)	0.00541*** (0.0011)	-16.12 (15.2188)	0.00556*** (0.0013)
Ores and minerals	16.49*** (2.5565)	0.0506*** (0.0038)	29.27*** (5.2955)	0.0386*** (0.0042)	43.24*** (9.1324)	0.0405*** (0.0046)	-55.39 (37.2316)	0.0540*** (0.0072)	116.2* (55.2748)	0.0253*** (0.0018)
Food items	7.374 (4.6185)	0.427*** (0.0121)	31.95** (11.3752)	0.343*** (0.0194)	110.6*** (13.2315)	0.192*** (0.0169)	139.8*** (21.3413)	0.0775*** (0.0099)	266.8*** (37.4786)	0.0282*** (0.0077)
Transport. goods	0.0350 (0.0343)	0.0552*** (0.0038)	-0.517** (0.1766)	0.117*** (0.0103)	0.0126 (0.2358)	0.110*** (0.0068)	0.455 (0.5812)	0.0797*** (0.0052)	5.289*** (1.3571)	0.0311*** (0.0049)
Metals	-0.133* (0.0535)	0.0413*** (0.0043)	-0.274 (0.1835)	0.0485*** (0.0071)	-0.253 (0.2967)	0.0599*** (0.0069)	-8.089** (2.5783)	0.132*** (0.0182)	-64.90*** (18.0547)	0.295*** (0.0350)
Construction	-0.353 (0.2676)	0.00662** (0.0022)	0.247 (0.7779)	0.00844** (0.0031)	-5.241 (3.3438)	0.0272*** (0.0080)	-1.514 (6.7105)	0.0129** (0.0043)	-229.1* (99.8644)	0.0684*** (0.0196)
Distributive trade	-0.555 (1.3171)	0.0908*** (0.0070)	12.69** (4.7286)	0.0642*** (0.0127)	31.01*** (5.9012)	0.0433*** (0.0088)	58.53*** (11.8584)	0.0136** (0.0052)	-102.7* (50.8758)	0.0484*** (0.0080)
Finance	12.80 (56.4058)	0.0282*** (0.0030)	62.65 (205.0548)	0.0306*** (0.0056)	-901.3* (383.9934)	0.0615*** (0.0062)	-14126.1*** (2314.1790)	0.147*** (0.0088)	3414.8 (6954.8880)	0.0836*** (0.0164)
Business and	-152.2** (52.5920)	0.0286*** (0.0032)	-675.3** (245.8829)	0.0470*** (0.0069)	-775.8 (498.3429)	0.0625*** (0.0081)	-5568.8* (2263.2208)	0.0907*** (0.0103)	4020.0 (3755.4293)	0.0584*** (0.0084)
Community and social	65.57 (59.6349)	0.0218*** (0.0036)	66.75 (171.7859)	0.0233*** (0.0049)	232.7 (275.8164)	0.0248*** (0.0048)	-706.0 (772.4909)	0.0294*** (0.0037)	-3637.5 (4053.0749)	0.0271*** (0.0062)
Beta total rent		0.249		0.279		0.376		0.358		0.329
R 2										
Agriculture	0.0259		0.0209		0.0467		0.192		0.331	
Ores and minerals	0.648		0.587		0.589		0.589		0.664	
Food items	0.895		0.860		0.791		0.722		0.657	
Transport. goods	0.514		0.455		0.571		0.752		0.749	
Metals	0.237		0.291		0.277		0.354		0.709	
Construction	0.0470		0.0666		0.0817		0.100		0.463	
Distributive trade	0.468		0.514		0.491		0.414		0.574	
Finance	0.397		0.449		0.459		0.737		0.807	
Business services	0.205		0.280		0.341		0.558		0.677	
Community and social services	0.313		0.419		0.415		0.541		0.660	
N	1921		1839		1744		1029		407	

Note: Standard errors in parentheses; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ^ < 0.1 .

Source: Authors' own calculations based on IES 2010/2011.

Table C2: Regression output for separate quartile regression—CPC two-digit categories

Income quartile	0%-25%		25%-50%		50%-75%		75%-95%		90%-100%	
Item	Gamma	Beta	Gamma	Beta	Gamma	Beta	Gamma	Beta	Gamma	Beta
Products of agriculture	0.0684 (0.2452)	0.000737 (0.0005)	-0.814 (0.549)	0.00194* (0.0008)	0.116 (0.7056)	0.00101 (0.0007)	-3.157 (2.0947)	0.00350** (0.0011)	-0.668 (4.1903)	0.00501** (0.0016)
Coal and lignite	13.60*** (2.7668)	0.0494*** (0.0044)	8.398 (7.2613)	0.0571*** (0.0078)	27.79*** (7.8086)	0.0423*** (0.0056)	-5.57 (12.3496)	0.0612*** (0.0058)	79.80** (26.0902)	0.0489*** (0.0087)
Meat, vegetables, oils	-9.688 (8.734)	0.143*** (0.0096)	43.04* (19.4173)	0.0958*** (0.014)	56.11* (26.8148)	0.0944*** (0.0134)	163.9*** (29.1773)	0.0469*** (0.0089)	338.7*** (21.6225)	0.00507 (0.0042)
Dairy and egg products	0.735 (2.786)	0.0242*** (0.0033)	6.146 (6.7703)	0.0211*** (0.0048)	12.55^ (7.3149)	0.0184*** (0.0035)	46.79*** (9.5054)	0.00777** (0.0026)	78.07*** (6.9693)	0.00214 (0.0014)
Grains, starches; other food	-16.26 (14.2106)	0.152*** (0.0099)	71.01 (45.5517)	0.110*** (0.0199)	124.6** (46.6607)	0.0847*** (0.0144)	374.4*** (50.2398)	0.0111 (0.0097)	426.1*** (28.6659)	-0.0000456 (0.003)
Beverages	-12.85 (10.1242)	0.0456*** (0.0107)	-16.15 (22.0687)	0.0399*** (0.0115)	18.93 (25.6117)	0.0285** (0.009)	43.89 (61.5997)	0.0243^ (0.0134)	130.0** (42.4986)	0.0126* (0.006)
Tobacco products	4.182*** (1.2622)	0.00425* (0.0022)	2.01 (2.3751)	0.00604* (0.0026)	9.609* (3.8054)	0.0011 (0.0026)	17.19* (6.7993)	0.00171 (0.0031)	30.06*** (6.6248)	0.000706 (0.0017)
Textile articles	-0.0635* (0.0266)	0.0228*** (0.0025)	-0.143*** (0.0426)	0.0275*** (0.0027)	-0.202** (0.0659)	0.0287*** (0.0029)	0.0236 (0.0799)	0.0152*** (0.002)	0.285* (0.1312)	0.00981*** (0.003)
Wearing apparel	-1.181 (0.7236)	0.0451*** (0.0044)	0.178 (2.4808)	0.0441*** (0.0087)	-2.34 (3.3998)	0.0549*** (0.0078)	0.854 (5.4041)	0.0433*** (0.0078)	26.58*** (3.6858)	0.0101** (0.0037)
Leather products and footwear	0.788^ (0.448)	0.0180*** (0.0022)	1.144 (1.0626)	0.0218*** (0.0033)	0.659 (1.8399)	0.0246*** (0.0038)	0.593 (2.7309)	0.0213*** (0.0031)	11.19** (3.9318)	0.0114** (0.0039)
Paper and related products	-1.359 (1.619)	0.00419*** (0.001)	-2.779 (7.7875)	0.00523^ (0.0027)	7.234 (8.3692)	0.00289 (0.0019)	13.13 (11.0516)	0.00437** (0.0016)	37.34*** (10.858)	0.00353*** (0.0009)
Fuel products	0.171 (1.8316)	0.00113 (0.001)	-138.6** (42.6867)	0.0454*** (0.0118)	-177.4* (75.5005)	0.0602*** (0.0138)	-46.38 (105.7737)	0.0551*** (0.0106)	350.7*** (100.5787)	0.0450*** (0.0068)
Basic chemicals	1.717 (1.658)	0.0375*** (0.0035)	7.258* (3.3772)	0.0366*** (0.0039)	8.279* (4.0583)	0.0350*** (0.0037)	29.55** (10.5117)	0.0263*** (0.0074)	81.36*** (12.1481)	0.00708** (0.0026)
Glass and non-metallic products	-0.0394 (0.1466)	0.00280*** (0.0007)	-0.135 (0.175)	0.00277*** (0.0006)	-0.919** (0.2841)	0.00452*** (0.0007)	-0.465 (0.288)	0.00236*** (0.0004)	0.721 (0.5234)	0.00100* (0.0005)
Furniture and other products	-0.0117** (0.0041)	0.00827*** (0.002)	-0.0185 (0.0132)	0.0126*** (0.0034)	0.00645 (0.0334)	0.0129* (0.0053)	0.0163 (0.0373)	0.0105*** (0.003)	0.0992* (0.0397)	0.00435 (0.0027)

Income quartile	0%-25%		25%-50%		50%-75%		75%-95%		90%-100%	
Item	Gamma	Beta	Gamma	Beta	Gamma	Beta	Gamma	Beta	Gamma	Beta
Metal and machinery	-0.109* (0.043)	0.0208*** (0.0037)	-0.0481 (0.171)	0.0203* (0.0079)	0.14 (0.1579)	0.0146** (0.0047)	0.172 (0.231)	0.0110** (0.0039)	0.527** (0.1766)	0.00543* (0.0023)
Office machinery	0.0118 (0.0122)	-0.000652 (0.0012)	0.011 (0.0082)	0.000273 (0.0006)	0.0131 (0.0187)	0.00196^ (0.0011)	-0.0262 (0.0338)	0.00462*** (0.0012)	0.148* (0.0739)	0.00340** (0.0013)
Communication equipment	-0.0616* (0.0275)	0.0175*** (0.0027)	-0.00526 (0.0832)	0.0149** (0.0047)	-0.0726 (0.084)	0.0172*** (0.0033)	0.121 (0.116)	0.0126*** (0.0026)	0.376* (0.18)	0.00876** (0.0032)
Transport equipment	-1.904 (2.5853)	0.000213 (0.0002)	-23.73 (100.0011)	0.00165 (0.0035)	-195.5 (130.379)	0.00778** (0.003)	-677.1 (430.7469)	0.0179*** (0.0054)	866.8** (275.918)	0.00407^ (0.0022)
Construction	0.113 (0.1553)	0.00200^ (0.0011)	-0.358 (0.6419)	0.00888** (0.0029)	1.977 (1.2386)	0.00378 (0.0035)	-1.135 (3.154)	0.0166** (0.0052)	3.833 (5.4547)	0.0143* (0.0068)
Accommodation and food services	-1.938* (0.8196)	0.0288*** (0.0056)	0.0859 (2.3262)	0.0188* (0.0086)	-3.643^ (2.1303)	0.0283*** (0.0055)	0.543 (4.6227)	0.0247*** (0.0066)	10.42 (6.7719)	0.0193** (0.0072)
Passenger transport services	-5.571 (4.4963)	0.0725*** (0.0078)	-10.23 (12.2855)	0.0851*** (0.014)	53.49** (16.9836)	0.0333* (0.0137)	95.67*** (20.1727)	0.0145 (0.0092)	134.0*** (13.1654)	-0.000865 (0.0038)
Postal services	-4.084* (2.0627)	0.000398** (0.0002)	7.83 (12.3448)	0.00000742 (0.0004)	2.149 (10.6274)	0.000226 (0.0002)	-4.198 (9.5775)	0.000321* (0.0001)	30.28*** (6.2048)	0.00000483 (0.00004)
Financial services	-89.37 (67.5584)	0.0318*** (0.0038)	-74.01 (252.8728)	0.0327*** (0.0088)	55.95 (297.9946)	0.0339*** (0.0068)	-2418.9** (814.9872)	0.0842*** (0.011)	4061.2*** (673.18)	0.0392*** (0.0051)
Communication services	22.02 (57.4192)	0.0209*** (0.0033)	-80.04 (200.9777)	0.0249*** (0.0071)	15.53 (260.3614)	0.0259*** (0.0061)	-209.8 (361.9155)	0.0277*** (0.0048)	1668.8*** (294.5009)	0.0159*** (0.0025)
Maintenance services	0.259 (0.252)	0.00000578 (0.00000758)	-32.83^ (18.3021)	0.00134* (0.0007)	-84.20** (29.8852)	0.00283*** (0.0008)	-392.3* (163.6844)	0.00808** (0.0025)	-299.5 (470.7855)	0.00979* (0.0048)
Education services	-41.90* (18.2544)	0.00492*** (0.0012)	-24.58 (106.018)	0.00537 (0.0036)	-11.93 (192.7884)	0.00937* (0.0046)	-440 (495.1765)	0.0226*** (0.0067)	854.4 (568.8255)	0.0190*** (0.0052)
Health and social care	-7.373 (26.1139)	0.00663*** (0.0016)	175.3 (133.9762)	0.000748 (0.0046)	109.9 (144.8168)	0.00629^ (0.0035)	186.9 (259.0776)	0.00644^ (0.0038)	463.3 (286.6433)	0.00821* (0.0032)
Waste disposal services	-27.31 (18.049)	0.00396*** (0.0012)	-12.38 (69.9705)	0.00287 (0.0025)	112.6 (75.9141)	0.000523 (0.0018)	-9.85 (149.3172)	0.00403^ (0.0021)	266.7** (100.2589)	0.00274** (0.0009)
Recreational services	-62.91*** (16.2409)	0.00604*** (0.001)	43.1 (73.4641)	0.00187 (0.0024)	-41.79 (118.4701)	0.00545^ (0.0029)	-175.2 (129.8347)	0.00760*** (0.0018)	113.5 (196.7611)	0.00837*** (0.002)
Domestic services	-20.08* (9.2104)	0.00256*** (0.0008)	12.91 (108.9368)	0.00261 (0.0039)	-92.33 (158.6498)	0.00741^ (0.0038)	-209.6 (268.617)	0.0130*** (0.0038)	496.9 (339.0403)	0.0158*** (0.0032)
Beta for total rent	0.23271		0.26223		0.3194		0.39928		0.66779	

Standard errors in parentheses; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ^ < 0.1 .

Source: Authors' own calculations based on IES 2010/2011.