

**An analysis of the relationship between school meal  
take-up and prices**

**prepared for the  
School Food Trust**

**by**

**London Economics**



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## Executive Summary

London Economics were commissioned by the School Food Trust to identify, gather and analyse information relating to the price and take-up of school meals in England to better understand the elasticity of demand for school meals with respect to price.

Our methodological approach consisted of five strands of activity. Four of these strands of research rely on existing economic analyses of secondary data, with the other element of the research involving some primary data collection from a number of Local Authorities.

The five strands of research involved undertaking

- a review of existing estimates of the elasticity of demand;
- an analysis of School Food Trust data relating to price and take-up at LA level;
- an analysis of individual LA information relating to take-up and prices;
- an analysis of the cost of producing a packed lunch; and
- an analysis of secondary data relating to costs of raising children.

### *Theoretical Background*

The price elasticity of demand is defined as the percentage change in the quantity demanded for a good divided by the percentage change in the price charged. In other words,

$$\text{Price Elasticity of Demand: } \epsilon = \% \Delta (\text{Quantity Demanded}) / \% \Delta (\text{Price})$$

The *price elasticity of demand* is always negative. A good is defined as being *price inelastic* if there is a less than proportionate change in the quantity demanded following a given change in price. For instance, if the price of a good (e.g. petrol) increases by 10% and the reduction in quantity demanded is 3%, then the elasticity of demand is -0.3. A good is defined as being *price elastic* if there is a greater than proportionate change in the quantity demanded following a given change in price. For instance, if the price of a good (e.g. holidays) increases by 10% and the reduction in quantity demanded is 25%, then the price elasticity of demand is -2.5.

Goods with a price elasticity of less than minus 1 are defined as 'elastic' or responsive to changes in prices. Goods with an elasticity between 0 and -1 are defined as 'inelastic' or relatively non-responsive to changes in price.

The *income elasticity of demand* is the percentage change in the demand for a good divided by the percentage change in income. If a good has an income elasticity of demand between zero and one (i.e. a 10% increase in income increases demand by 5%), then it is defined as being a *necessity* good. If a

good has an income elasticity of demand greater than one (i.e. a 10% increase in income increases demand by 20%), then it is defined as being a *luxury* good. Finally, if a good has a negative income elasticity of demand (i.e. there is a reduction in demand following an increase in income), then it is defined as an *inferior* good.

### Literature Review

Our literature review of the price and income elasticity of various food groups, including food consumed away from home, offers the following insights. In Table 1, we provide some summary information on estimates of the elasticity of demand for food.

Table 1: Summary of price elasticities of demand for food					
	Huang and Lin (2000)	Tiffen and Tiffen (1999)	Bouamra-Mechemache et al. (2008)		Reed et al (2005)
Country	US	UK	Various	France	US
Staple foods*	-0.78				
Dairy		-0.57	-0.57		-0.86
<i>Drinking milk</i>			-0.53	-0.17	
<i>Fresh dairy products</i>			-0.74		
<i>Butter</i>			-0.47		
<i>Cheese</i>			-0.60		
<i>Other dairy products</i>	-0.18		-0.18	-0.13	
Meat	-0.26 to -0.63	-0.95			-0.60
Fish	-0.36				
Vegetables	-0.74	-0.31			
Fruit	-0.66	-0.21			-0.98
Cereal and bakery	-0.31 to -0.52				-0.61
Other food at home					-0.74
Food away from home					-0.86

\*Including milk, cheese, bread, eggs

First, the price elasticity of demand strongly depends on the level of aggregation of food products. In particular, the higher the level of aggregation, the more inelastic is the price elasticity of demand for food. This finding is driven by lack of available substitutes at high levels of aggregation. For instance, the demand for dairy produce may be relatively inelastic (price elasticity between zero and minus one) but the demand for some specific types of cheese may be fairly elastic (price elasticity is less than minus one).

In all cases, the literature indicates that even at disaggregated levels, the price elasticity of demand is between 0 and minus 1. Although there is some

variation between the studies, there is a good deal of consistency with the majority of estimates in the range of -0.25 to -0.75.

Second, *income* elasticity of demand for food is generally less than one, confirming the idea that most food items are *necessity* goods. However, for some food items (some meat items, some alcohol beverages, etc.), income elasticity is greater than one, suggesting that some food items are identified as *luxury* goods.

Finally, *food away from home* (in aggregate) and processed food tends to be more price elastic than raw food as the number of available substitutes is higher. One study in particular finds that if the price of meals away from home increases by 10% the decrease in the quantity demanded would be approximately 7% (equivalent to an elasticity of demand of -0.70). In addition, meals away from home are considered to be *luxuries* (with an income elasticity of demand greater than 1). As household income decreases (by 10% for instance), the findings suggest that there would be a 13.5% reduction in the demand for meals away from home.

### ***Analysis of School Food Trust Data***

The School Food Trust has (together with the Local Authority Caterers Association (LACA)) commissioned an annual survey of Local Authorities since 2006 to gather information on a number of issues including whether there has been any change in take-up of school meals. There are some important caveats relating to missing information and possible recollection error that are discussed in the main text. Although it is possible to consider the relationship between prices and take-up annually, we have considered the changes in price and associated take-up over the two-year period to eliminate some of the year-on-year fluctuations. The information presented in Table 2 indicates that there was on average a 9.7% change in the prices charged between 2006 and 2008 and a corresponding reduction in the take-up of *paid* school meals of 8.7%. This information suggests that the relationship between prices charged and quantity demanded (elasticity of demand) is in the range -0.88 to -0.90.

<b>Table 2: Changes in price and take-up in primary schools</b>						
	<b>Price</b>			<b>Take-up</b>		
	<b>Δ 2006-2007</b>	<b>Δ 2007-2008</b>	<b>Δ 2006-2008</b>	<b>Δ 2006-2007</b>	<b>Δ 2007-2008</b>	<b>Δ 2006-2008</b>
<b>Average</b>	5.0%	4.9%	9.7%	-2.1%	-4.9%	-8.7%
<b>Average (F.T.Y.R)</b>	4.7%	4.9%	9.8%	-3.3%	-4.9%	-8.6%

*Source: London Economics' analysis of School Food Trust Data. Note F.T.Y.R means 'full three year response' - i.e. Local Authorities that provided response information in all three years of the survey.*

### Econometric analysis

We have also undertaken a regression analysis using all linked observations over the three years (i.e. 2006-2007, 2007-2008 and 2006-2008) and regressed the natural logarithm of the price charged on the take-up rate<sup>1</sup>.

The results presented in Table 3 indicate that the elasticity of demand is estimated to be between -1.04 and -1.08.

<b>Table 3: Econometric Results relating to price and take-up at primary level</b>				
	<b>Coefficient on logarithm price (1)</b>	<b>Observations and R-squared</b>	<b>Take-up (2)</b>	<b>Price elasticity of demand = (1)/(2)</b>
<b>All observations</b>	-0.375	291 (.069)	0.348	-1.08
<b>Excluding outliers</b>	-0.356	271 (.114)	0.344	-1.04

*London Economics' analysis of School Food Trust data*

The implication of the findings is that as the price charged for school meals increases by 10%, we would expect to see a 10.4% to 10.8% reduction in the take-up rate amongst those pupils potentially *paying* for school meals. In aggregate, when incorporating those children eligible for free school meals, clearly the take-up of school meals will fall to a lesser extent.

It is also crucial to remember that this estimate considers the change in price on take-up holding all other factors constant - including the price of substitutes. In effect, the estimate provides the potential impact associated with an increase in the *real* price of school meals on take-up (i.e. the impact of the price of school meals increased and the price of all other substitute products remained the same).

### Assessment of a counterfactual<sup>2</sup>

According to the SFT Annual Surveys, take-up in primary schools stood at 44.9% in 2005, 42.3% in 2006, 41.3% in 2007 and 43.0% in 2008. What explains the decline and partial recovery in school meal take-up in the face of increasing prices and can this be reconciled with the econometric estimates?

The evidence suggests that over the period of this analysis there has been a *reduction* in the proportion of children eligible for free school meals (from

<sup>1</sup> The reason for using the natural logarithm of price is because the coefficient produced as part of the regression analysis simply needs to be divided by average take-up to generate an estimate of the elasticity of demand.

<sup>2</sup> The counterfactual is defined as what might have happened in the absence of a particular event. In this case, we consider what might have happened to the take up of school meals if prices had not increased.

16.9% in 2005 to 15.5% in 2008); however, this has been more than offset by the increase in the take-up rate amongst those eligible (79.3% in 2005 to 83.9% in 2008). The analysis also indicates that the proportion of primary school pupils taking up paid school meals has mirrored overall take up rates over the period (37.9% in 2005, 34.5% in 2006, 33.5% in 2007 and 35.5% in 2008).

To reconcile the headline results from the School Food Trust Annual Surveys and the econometric analysis, it is important to consider the counterfactual. Specifically, the information relating to the take-up rate amongst pupils registered for free school meals may provide an indication of what might have happened in the absence of price increases. In particular, take-up of free school meals amongst those registered increased by 4.6 percentage points from 79.3% to 83.9% between 2005 and 2008 (equivalent to a 5.8% increase in take-up). Take-up amongst those paying for school meals decreased from 37.9% to 35.5% (equivalent to a 6.3% reduction in take-up) over the same period. This analysis implies that following an average price increase of 12.9% over the period, take-up rates amongst those paying for school meals were 12.1% lower than might have been expected in the absence of price increases (equivalent to 7.0 percentage points). This explanation implies that the elasticity of demand is not as high as the estimate produced in the econometric analysis and is probably closer to -0.94<sup>3</sup>.

As previously mentioned, an alternative explanation as to why the headline data shows little change in take-up amongst those paying for school meals (2.4 percentage points between 2005 and 2008) is that the analysis presented only considers the impact of the price of school meals on paid take-up *holding all other factors constant*. In reality, the econometric analysis considers the impact of a *real* increase in the cost of school meals; while the headline information from SFT surveys only assesses a *nominal* change in prices. If the price of the closest substitutes to school meals (i.e. packed lunches) increased at the same rate as the cost of school lunches, then depending on the relative elasticity of demand of school meals and packed lunches we would expect to see a reduced change in the quantity demanded following the change in prices<sup>4</sup>. The results of the different analyses are presented below.

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<sup>3</sup> Note that we have attempted to assess the relationship between price and take up over a slightly extended period to reduce the impact of some individual year-on-year jumps in take-up and the fact that price increases often take place at different points throughout the school year rather than at one fixed point in time.

<sup>4</sup> For instance, if the price of school meals and packed lunches both increased by 10% and the elasticity of demand for school lunches was estimated to be -1.0 compared to an elasticity of demand for packed lunches of -0.2 (which would be expected given the lack of substitutes and relatively low elasticity for basic ingredients), then we would expect the quantity demanded of school meals to fall by 10% and the quantity demanded of packed lunches to fall by 2%. The real effect of the price increase is an 8% reduction in school meals – corresponding to an elasticity of demand of -0.8.

**Table 4: Summary Results relating to the elasticity of demand for school meals at primary level**

		Estimate of elasticity of demand
Literature Review	Food away from home	-0.70
SFT Annual Surveys	Simple Correlation	-0.88 to -0.90
	Econometric Analysis	-1.04 to -1.08
	Counterfactual	-0.94
Average		-0.89 to -0.90

*London Economics' analysis of School Food Trust data*

### Local Authority Analysis

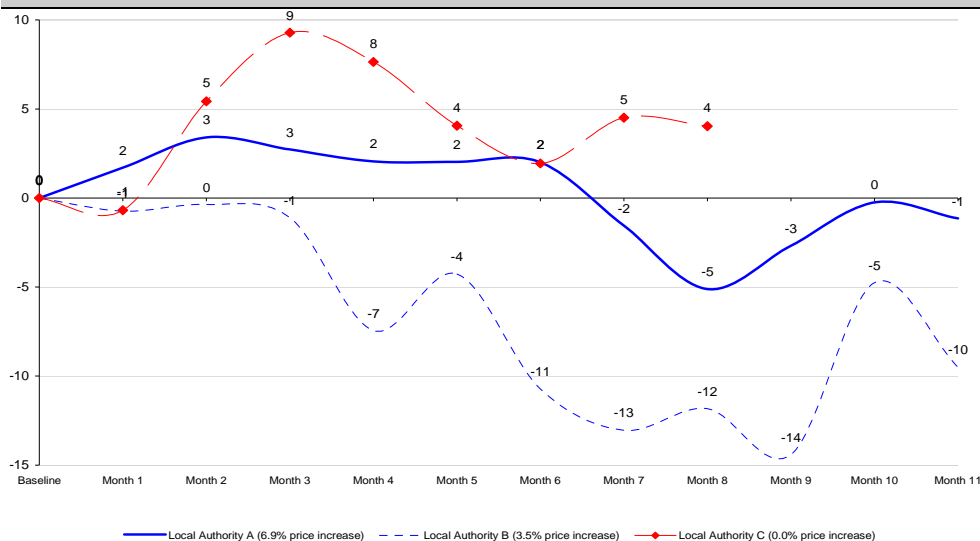
We contacted 9 Local Authorities that agreed to share management information relating to the take-up amongst those paying for school meals and eligible for free school meals. The rationale for undertaking this type of analysis was to assess the extent to which take-up rates changed in the short to medium term controlling for other Local Authority level characteristics (which are assumed *fixed* immediately pre and post the price change).

In Figure 1, we present the relative change in the index of take-up between those paying for free school meals and those eligible for FSM<sup>5</sup> over time following a series of price increases. Despite the lack of representativeness of the data; the figure illustrates that for Local Authorities A and B, the price increases (averaging 6.9% and 3.5% respectively) resulted in a relative reduction in take-up amongst those paying for meals. In the case of Local Authority A, the change is relatively minor, while the change for Local Authority B is approximately 10 percentage points. In Local Authority C, where no price increase was imposed during the period for which data was provided, take-up amongst those paying for school meals increased at a faster rate (or fell at a slower rate) compared to those eligible for free school meals.

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<sup>5</sup> In this example, take-up amongst those eligible for FSM and paying for school meals are indexed to 100 in the month prior to the price increase. In each subsequent month, the graph illustrates the difference in indexed take-up between those paying for school meals and eligible for FSM. Points above the horizontal axis imply that indexed take-up amongst those paying for school meals is rising more quickly (or falling more slowly) than take-up amongst those eligible for free school meals. Therefore, following price increases, we would expect the index to become negative (and be positioned below the horizontal axis)

**Figure 1: Index of take-up of paid and unpaid primary school meals following changes in prices charged- three Local Authorities**



Source: London Economics' calculations based on Local Authority data

However, as previously mentioned, there is a high degree of variability in the results at Local Authority level and extreme caution should be exercised in relation to these results.

### Opportunity Costs

As part of this analysis, we also estimated the cost associated with preparing a packed lunch. Using information from the Labour Force Survey and Annual Survey of Hours and Earnings, we estimated the labour cost associated with preparing a packed lunch. We have also gathered information from the Expenditure and Food Survey, School Food Trust and Food Stands Agency to estimate the ingredient cost associated with producing a packed lunch<sup>6</sup>. The analysis indicates that the cost of provision of a packed school lunch is in the range of £1.60 to £1.83 (in 2008 prices) depending on the assumptions in relation to the time necessary to prepare the packed lunch and the nutritional quality of the packed lunch.

The analysis indicates that since 2005, the expected cost of preparing a packed lunch has increased from between £1.40-£1.63 in 2005 to £1.60-£1.83 in 2008. This equates to an increase in the cost of producing packed lunch by approximately 14.3% over the three years. Information from the three Annual Surveys of school meal take-up indicates that the average price charged for a school meal stood at £1.48 in 2005 rising to £1.66 in 2008. This implies that the average price charged for a school meal has been inside the range of

<sup>6</sup> We have made no assumption in relation to the nutritional equivalency between packed lunch menus with school meals

estimated cost associated with the preparation of packed lunches. The increase in the price of school meals has been approximately 12.9% over the three years – marginally less than the increase in costs associated with packed lunches.

### The cost of raising children

We estimated the weekly cost associated with raising children using information from the Expenditure and Food Survey. The rationale for undertaking this analysis is to assess the extent to which there are economies of scale associated with bringing up children, which may have important implications in relation to the affordability of school meals compared to packed lunches for larger families.

Taking a specific example, the cost of bringing up a single child in a single parent household in the second income quintile (approximately £11,596 and just above the threshold for eligibility of free school meals) was estimated to be £73 per week. The total cost associated with bringing up 2 children (in the same type of household) was estimated to be £111 per week (or 53% more). The cumulative cost associated with a third child was estimated to be £139.60 per week (or 25% more than having two children). These estimates illustrate the significant economies of scale associated with having more than one child.

**Figure 2: Cumulative cost of and additional child by number of adults in family and income quintile**



Source: 2001/2-2006 Expenditure and Food Surveys, National Statistics and London Economics' calculations. Note, blue line represents weekly costs associated with raising one child, while green line represents weekly costs associated with raising two children.

For a two-parent household in the lowest income quintile (equivalent to a household income of approximately £17,628), the weekly cost of bringing up a child was estimated to be £81 per week, compared to £144 per week for two children and £194 for three children (not presented here).

In terms of economies of scale, the analysis indicates that the average cost *per child* decreases by 20% on moving from 1 child to 2; 15% on moving from 2 children to 3 (or 32% compared to 1 child); and approximately 11% on moving from 3 children to 4 (or 40% compared to the average weekly cost of raising 1 child). This is presented in Table 5 below.

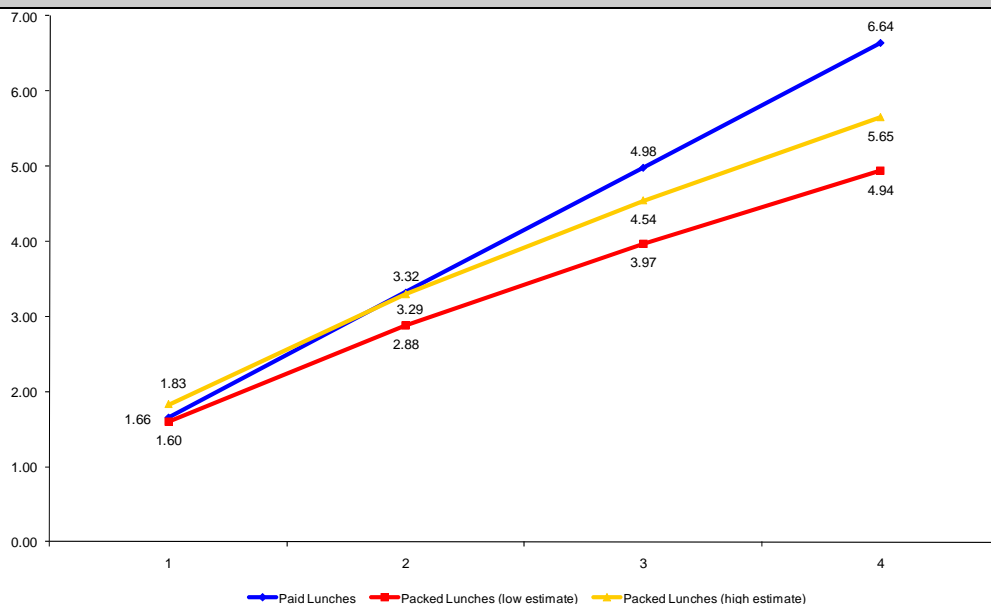
<b>Table 5: Economies of scale associated with raising more than one child by number of adults and income quintile (Dec 2008 prices)</b>			
Type of household	Marginal Cost 2 <sup>nd</sup> child	Marginal Cost 3 <sup>rd</sup> child	Marginal Cost 4 <sup>th</sup> child
Average one adult households	54%	24%	16%
Average two adult households	64%	29%	18%
Average all households	59%	26%	17%
Cost per child (£112.50 p.w. 1 child)	£67.20	£50.30	£42.00
Percentage reduction in average unit cost	20.1%	14.6%	11.3%

Source: 2001/2-2006 Expenditure and Food Surveys, ONS and London Economics' calculations

### *What might this imply in relation to school meals?*

The daily cost of purchasing school meals increases linearly from £1.66 per day for households with one child to £6.64 per day for households with 4 children. Although the cost of preparing a packed lunch for parents with one child was estimated to be between £1.60 and £1.83 per day, as the number of children in the household increase; total cost increases but at a significantly slower rate. In particular, for a household with 2 children, the expected cost of preparing packed lunches is between £2.88 and £3.29 per day compared to £3.32 per day for school meals, while for families with 3 children, the daily cost associated with packed lunches stands at between £3.97 to £4.54 per day compared to £4.98 for school meals. In the case of the three-child household, this difference is equivalent to between £83 and £191 per annum.

**Figure 3: Cumulative daily cost of school meals at primary level versus packed lunches by number of children**



Source: 2001/2-2006 Expenditure and Food Surveys, ONS and London Economics' calculations

Compared to the upper estimate of the cost preparing a packed lunch, for a family with 2 children, the price of school meals would need to be reduced by approximately 2% per child (3p per child) to reflect the economies of scale associated with home preparation, while for a family with 3 children, the price of school meals would need to be reduced by approximately 9% per child (15p per pupil) to reflect the economies of scale. The equivalent discounts based on the lower estimate of producing a packed lunch stand at 22 pence and 34 pence respectively.

### Conclusions

The analysis indicates that according to a number of alternative methodologies, the price elasticity of demand for school meals at primary level is inelastic in the range **-0.70 to -1.00**. The implication is that following a price increase of school meals by 10%, we would expect to see a change in take-up amongst those paying for school meal in the region of 7% to 10%. These findings are supported by the academic literature, which indicates that the price elasticity of demand for meals away from home is approximately minus 0.7.

In addition, the income elasticity of demand indicates that meals away from home are luxury items (income elasticity greater than 1.0). If we assume that schools meals are representative of 'meals away from home', then following a reduction in household income, we would expect a greater than

proportionate decline in demand for school meals (though this may be partially offset by changes in the eligibility for free school meals).

The average price of a school meal at primary level (£1.66) is in the middle of the cost range of preparing a packed lunch (£1.60-£1.83). Over time the change in the cost of preparing packed lunches has closely mirrored the change in price of school meals (approximately 12.9%) implying that there has been little deterioration in the relative value associated with school meals compared to packed lunches.

However, we have also undertaken an assessment of the costs associated with bringing up children to establish the extent of the economies of scale associated with having more than one child. The findings indicate that there are significant economies of scale. Overall, the average cost per child decreases by 20% on moving from 1 child to 2; 15% on moving from 2 children to 3; and approximately 11% on moving from 3 children to 4.

This implies that compared to the upper estimate of the cost preparing a packed lunch, for a family with 2 children, the price of school meals would need to be reduced by approximately 2 pence per child to reflect the economies of scale associated with home preparation. Meanwhile for a family with 3 children, the price of school meals would need to be reduced by approximately 15 pence per child to reflect the economies of scale associated with home preparation.

# 1 Background and context

## 1.1 Introduction

London Economics were commissioned by the School Food Trust to identify, gather and analyse information relating to the price and take-up of school meals in England to better understand the elasticity of demand for school meals with respect to price. Although the primary focus of the analysis relates to the relationship between prices and take-up, we also consider it important to provide some information on the relationship between incomes and take-up, especially given the current economic circumstances.

Our methodological approach consisted of five strands of activity. Four of these strands of research rely on existing economic analyses of secondary data, with one element of the research involving some primary data collection from individual Local Authorities.

The five strands of research involved undertaking

- a review of existing estimates of the elasticity of demand;
- an analysis of School Food Trust data relating to price and take-up at LA level;
- an analysis of individual LA information relating to take-up and prices;
- an analysis of the cost of producing a packed lunch; and
- an analysis of secondary data relating to costs of raising children.

The report is structured as follows: Section 2 provides a presentation of the findings from the literature review relating to the established estimates of the elasticity of demand. Section 3 provides an analysis of the relationship between take-up and price using information from the three SFT Annual Surveys. Section 4 provides some Local Authority analysis on the change in take-up experienced over time following changes in prices charged for school meals. Section 5 provides an analysis of the opportunity costs associated with school meals (i.e. the cost associated with the preparation of a packed lunch). Section 6 provides an analysis of the Expenditure and Food Survey on expenditure patterns in respect to school meals. Section 7 concludes.

## 1.2 Theoretical Context

The elasticity of demand is defined as the percentage change in the quantity demanded for a good divided by the percentage change in the price charged.

In other words,

$$\text{Price Elasticity of Demand: } \epsilon = \% \Delta (\text{Quantity Demanded}) / \% \Delta (\text{Price})$$

The elasticity of demand is always negative. A good is defined as being price inelastic if there is a less than proportionate change in the quantity demanded following a given change in price. For instance, if the price of a good (e.g. petrol) increases by 10% and the reduction in quantity demanded is 3%, then the elasticity of demand is -0.3 and the good is defined as being *inelastic*. A good is defined as being price *elastic* if there is a greater than proportionate change in the quantity demanded following a given change in price. For instance, if the price of a good (e.g. holidays) increases by 10% and the reduction in quantity demanded is 25%, then the elasticity of demand is -2.5.

Goods with an elasticity of less than minus 1 are elastic or responsive to changes in prices. Goods with an elasticity between 0 and -1 are inelastic or non-responsive to price.

### *Income elasticity of demand*

The income elasticity of demand is the percentage change in the quantity of a good demanded divided by the percentage change in income.

$$\text{Income Elasticity of Demand: } \epsilon = \% \Delta (\text{Demand}) / \% \Delta (\text{Income})$$

If a good has an income elasticity of demand between zero and one (i.e. a 10% increase in income increases demand by 5%), then it is defined as being a *necessity* good. If a good has an income elasticity of demand greater than one (i.e. a 10% increase in income increases demand by 20%), then it is defined as being a *luxury* good. Finally, if a good has a negative income elasticity of demand (i.e. there is a reduction in demand following an increase in income), then it is defined as an *inferior* good.

## 2 Literature Review

There are two main strands of the literature relating to the demand for food, or more generally, food consumption. The first strand of literature belongs to the wider area of economic development and investigates to what extent a change in available income leads to a change in expenditure on food, or calorie intake. The second strand of the literature develops various demand systems and examines the price and income elasticity of various food aggregates. Given the second strand of literature is more relevant to the current analysis, we provide a review of this strand of research in the following section with a brief discussion of the first strand of research in the Annex.

### 2.1.1 Price and income elasticity of various food aggregates

This strand of the literature investigates the relationship between food prices and the demand for food. In particular, the papers presented here estimate both the price and income elasticity of the demand for food and, as such, the focus of this work is more relevant to the current analysis of the relationship between the take-up of school meals and the price charged.

A key issue of this strand of analysis is that the price elasticity of demand strongly depends on the level of *aggregation* of food products and related to this the extent to which *substitutes* exist. In particular, the higher the level of aggregation, the more inelastic is the price elasticity of demand. This outcome is driven by the fact that as the level of aggregation increases, there are fewer substitutes available for the good in question. For example, if we consider food in general, the demand for food is highly inelastic as one cannot substitute away from food and purchase alternative products in its place. However, if one focuses on a certain type of cheese, e.g. a certain type of soft cheese, the price elasticity is much higher (demand is more elastic) as one could easily substitute in favour of a different type of cheese.

The existence and availability of substitutes is especially important when considering the relationship between school meal take-up and the price charged. Clearly, in relation to school meals, at primary level, the only real alternative to consuming a school meal is to consume a packed lunch. As such, we would expect the responsiveness of demand for school meals to price to be lower than at secondary level (where more substitutes exist outside the school premises). In addition, it is also likely to be the case that the responsiveness of school meal take-up to the price charged will depend on the geographic location of schools. For instance, secondary schools in urban areas are likely to provide greater opportunities to pupils to consume food off the premises during their lunch break compared to secondary schools in more remote areas.

Another main feature of price elasticity estimates is that demand for processed/prepared food is thought to be more elastic than demand for raw food, again due to the lack of close substitutes for raw food. We will look at papers investigating these two theoretical predictions in turn.

We start with reviewing the empirical work on estimating the price elasticity of demand for food at various aggregate levels. The most common method adopted is to jointly estimate the price and income elasticities of food and some subgroups of food through the estimation of an *almost ideal demand system* (AIDS) for food demand (or a linear approximation of this system).<sup>7</sup>

An example of this approach to estimating the elasticity of demand for food is presented by Tiffin and Tiffin (1999), who use a *multistage budgeting technique* applied on UK data (National Food Survey, 1972-1994). In particular, in the first stage they estimate an AIDS system of two equations relating to the food and non-food shares of total expenditure. In the second stage they divide food expenditure into expenditures on staple food (milk, cheese, bread, eggs), meat, vegetables and fruit and estimate the system explaining that allocation. Finally (in stage three), expenditure on each of these food groups is allocated between sub-groups within each of the main food groups and the derived system is estimated.

In the first stage of the estimation, the authors find that the income elasticity of demand is **0.52**, while the price elasticity is **-0.11**, which implies that as the price of food (in aggregate) increases (by 10% for instance), the quantity of food demanded decreases by 1.1% holding all other factors constant<sup>8</sup>. Similarly, as the income increases (by 10% for instance), the demand for food increases by 5.2% holding all other factors constant.

Unsurprisingly, these estimates imply that food is a necessary good (income elasticity between 0 and 1) and inelastic (price elasticity between 0 and -1).

<sup>7</sup> An almost ideal demand system (AIDS) is a set of demand equations, where the budget share of each product is a function of linear and quadratic terms in the logarithm of its own price and the prices of the other products and a linear term in the logarithm of the total expenditure. Its linear approximation, for  $n$  commodities, can be expressed by the following  $n$  budget share equations:

$$w_i = \alpha_i + \sum_{j=1}^n \gamma_{ij} \ln p_j + \beta_i \ln \left( \frac{X}{P} \right), \quad i = 1, \dots, n \quad (1)$$

where  $w_i$  is the expenditure share of the  $i$ th good,  $p_j$  is the  $j$ th good's price,  $X$  denotes total expenditure on the goods for which the system is estimated and  $P$  is a price index (Stone price index).

Note that for the above system, economic theory implies that the estimated parameters should satisfy a set of restrictions on adding-up, symmetry, homogeneity and negativity, which also need to be formalised. For more details on AIDS, see Deaton and Muellbauer (1980).

<sup>8</sup> In addition to the estimation of the Marshallian own price elasticity, the Hicksian own-price elasticity of food is also estimated and is equal to -0.04. There is a distinction in economic theory between Hicksian and Marshallian demand for a good. In particular, the Hicksian demand function describes demanded quantity as a function of prices and the utility to be attained by an agent, while the Marshallian demand function describes demanded quantity as a function of prices and income (expenditure). Hicksian demand is also called compensated demand as an increase in prices is always complemented (compensated) with an adjustment of the income to keep the consumer at his/her original utility level. If not noted otherwise, demand elasticity estimates in empirical work typically refer to estimates of the Marshallian demand elasticities.

The estimates for the price elasticities and the income elasticities for the food subgroups are shown in Table 6 below. It can be seen from this table that the estimated price elasticity for subgroups is larger (in absolute terms) than in the case of aggregate food elasticities derived during stage one of the estimation process. This supports the idea that own-price elasticities are higher (in absolute terms) at the more disaggregated level due to the availability of substitute products.

<b>Table 6: Price and income elasticity for food</b>		
	<b>Own-price elasticity</b>	<b>Income elasticity</b>
<b>Staple foods*</b>	-0.57	0.98
<b>Meat</b>	-0.95	1.59
<b>Vegetables</b>	-0.31	0.28
<b>Fruit</b>	-0.21	0.03

*Source: Tiffin and Tiffin (1999) \*Including milk, cheese, bread, eggs.*

The results indicate that the elasticity of demand for meat is -0.95, which implies that as the price of meat increases (by 10%) the quantity demanded decreases by 9.5%. It is interesting to note that in this example demand for fruit and vegetables is less price sensitive, and according to the estimates presented, the quantity of fruit and vegetables demanded would decline by 2.1% and 3.1% respectively following an increase in their respective prices by 10%. Staple foods (milk, cheese, bread and eggs) are estimated to have a price elasticity of demand of -0.57.

Information on the income elasticity of demand is also presented. The information in Table 6 suggests that the income elasticity of demand for staple food products is approximately 1 which implies that as income increases, the demand for staple food product increases proportionately. The income elasticity of demand for fruit and vegetables are more income inelastic, implying that as income increases there is a less than proportionate increase in the demand for these products (necessities). The high income elasticity of demand for meat (1.59) implies that on average households consider meat to be a luxury good.

Finally, although not presented here, the estimated price elasticities in the third stage (i.e. specific types of meat) are even higher, supporting the idea that the responsiveness of food to changes in price is greater at the more disaggregated level due to the availability of substitute products.

A more recent paper also employing a multi-stage budgeting version of the AIDS approach is Bouamra-Mechemache *et al.* (2008). This paper looks at the own and cross-price elasticities of various dairy products in France (INSEE and consumer panel SECODIP, 1994-2004) and Italy (National Accounting Statistics ISTAT and Nielsen, 1952-2003).<sup>9</sup>

The paper starts with a brief review of the empirical literature focusing on dairy products in the European Union. It summarises the price and income elasticities of dairy products, which we present in Table 7 below:

	<b>Average price elasticity</b>	<b>Average income elasticity</b>
<b>All dairy</b>	-0.57	0.86
<b>Drinking milk</b>	-0.53	0.56
<b>Fresh dairy products</b>	-0.74	0.92
<b>Butter</b>	-0.47	0.60
<b>Cheese</b>	-0.60	0.78
<b>Other dairy products</b>	-0.18	2.65

*Source: Bouamra-Mechemache et al. (2008)*

It can be seen from this table that dairy products are overall quite inelastic, with a price elasticity of -0.57 (comparable to the estimate of the elasticity of demand for staple foods presented in Table 6). In fact, most studies reviewed by the authors report price elasticities less than 1 in absolute value. Also, dairy products display relatively high income elasticities, approximating 0.86 for all dairy products, which again is similar to the estimate of the income elasticity of demand for staple foods presented in Table 6.

In developing their own estimates the authors also use multi-stage budgeting within the framework of the linear AIDS system. Accordingly, the authors first divide expenditures into food and non-food expenditures. Second, they divide food expenditures into cheese, fat products, fresh dairy products, meat and other products in France, while in Italy expenditure is divided into dairy, cereals, meat, fish, fat, fruits and vegetable, beverages and other. Then they divide Italian dairy products into fresh dairy products, cheese and butter. Finally, they divide all these dairy products into further subclasses of products.

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<sup>9</sup> The cross price elasticity of a product is the percentage change in quantity demanded for one product following a change in price for another product.

The estimation results confirm the previous findings that own-price elasticity is lower at the aggregate level compared to product or sub-product level due to substitutability.

The authors also find that the demand for fresh dairy products is inelastic – the own-price elasticity of fluid milk is -0.15 in France and -0.01 in Italy. For other fresh dairy products (e.g. yogurts), the elasticity of demand is estimated to be -0.13 in France and -0.03 in Italy. Income elasticities for fresh dairy products are higher in France, with values of 0.67 (versus 0.29) for milk and 1.12 (versus 0.33) for other fresh dairy products<sup>10</sup>.

**Table 8: Price and income elasticity for cheese products in France and Italy**

France			Italy		
	Own-price elasticity	Income elasticity		Own-price elasticity	Income elasticity
Fluid Milk	-0.15	0.67	Fluid Milk	-0.01	0.29
Other fresh dairy (yogurts)	-0.13	1.12	Other fresh dairy (yogurts)	-0.03	0.33

Source: Bouamra-Mechemache et al. (2008)

Reed et al. (2005) also recognise the importance of choosing the right level of aggregation and test accordingly<sup>11</sup>. By using US consumer data (Consumer Expenditure Survey, 1982-2000) they group 19 elementary food products consumed at home into five categories: (i) cereal and bakery products, (ii) meat, (iii) dairy, (iv) fruit and vegetables, and (v) other at-home food. In addition, the authors look at *food away from home*<sup>12</sup> and *non-food* as the main components of household expenditure.

The authors find that the price elasticities are slightly different from those presented in Table 9, though in all cases, the elasticity of demand for different food products remains inelastic.

<sup>10</sup> The price-elasticity of demand for the different cheese categories is higher than price-elasticity for fresh dairy products due to the higher substitutability across these products and they vary between -0.27 and -1.22 in France and between -0.20 and -0.91 in Italy. Similarly, the income elasticities are also higher for cheese products, ranging from 0.53 to 1.06 in France and 0.29 to 0.87 in Italy.

<sup>11</sup> This is tested using a generalisation of the composite commodity theorem. The Composite Commodity Theorem is attributed to Hicks and it states that if the prices of a group of goods change in the same proportion, that group of goods behaves just as if it were a single commodity.

<sup>12</sup> *Food away from home* consists of a number of very different products, namely food consumed in work canteens, schools restaurants, takeaways and snacks. The author treats food away from home as a substitute for food consumed at home but does not provide any estimates of the price or income elasticities of demand for different types of food away from home.

Specifically, the authors estimate that the elasticity of demand ranges from -0.60 (meat) to -0.98 (fruits and vegetable) for aggregate food products. The estimation results also show that composite food products are quite elastic with respect to income, with income elasticities ranging from 1.04 to 2.25 for various food products.<sup>13</sup>

	<b>Price elasticity</b>	<b>Income elasticity</b>
<b>Cereal and bakery</b>	-0.61	1.35
<b>Meat</b>	-0.60	1.81
<b>Dairy</b>	-0.86	2.25
<b>Fruit and vegetables</b>	-0.98	1.60
<b>Other at-home food</b>	-0.74	1.04
<b>Non-food</b>	-0.86	0.92

Source: Reed et al. (2005)

Another paper extending the AIDS analysis is Beatty and LaFrance (2005). The authors extend the almost ideal demand system approach and estimate an incomplete demand system.<sup>14</sup> By using US data between 1919 and 2000 they group 21 food items into four categories: (i) dairy products, (ii) meat, (iii) fruit and vegetables, and (iv) miscellaneous food.<sup>15</sup>

The authors find that all food products except butter are either income neutral or essentially independent of income, whereas butter is increasingly income inferior through the last half of the century (i.e. as income increases the demand for butter reduces). In addition, some food items display marked increases in income elasticity over the period. The authors find that red meat is sensitive to changes in its own price and that only poultry displays a significant trend in its own-price elasticity (specifically the quantity demanded has become less sensitive to changes in its own price over time). All other food products considered have own-price elasticities of demand less than one, which means that are inelastic, and do not display noticeable trends over this time period<sup>16</sup>.

<sup>13</sup> One must note at this point that Bouamra-Mechemache et al. (2008) and Reed et al. (2005) are both using panel data over a longer period. This implies that in order to avoid spurious regressions, the authors needed to make sure that they made the appropriate transformation (e.g. take first differences as in Bouamra-Mechemache et al. (2008)) of the variables under investigation or that the variables, if left untransformed, were cointegrated (as in Reed et al. (2005)).

<sup>14</sup> They define an incomplete demand system a demand system that only contains a certain group of goods consumed as there is no information available on the prices and quantities of all the goods consumed.

<sup>15</sup> For their dataset, see: <http://are.berkeley.edu/~lafrance>

<sup>16</sup> Note that whereas the AIDS system based estimation of demand elasticities presented above is fairly general, the narrower focus of our study, i.e. investigating the demand elasticity of school meals, implies

Finally in this section, we consider the work undertaken by Huang and Lin (2000) for the US Department of Agriculture. The authors follow a similar approach for those presented previously and estimate the price elasticity of demand for food depending on household incomes. The information again illustrates the difference in elasticity of demand for major food groups, but also illustrates the generally held belief that the elasticity of demand amongst low-income households is higher than for middle or high-income households. More specifically, the authors illustrate that low-income households display a greater sensitivity to the price for pork, other meat, fish, dairy, egg, fat, cereal and juice.

Table 10: Price and income elasticity for various food categories			
	Low	Medium	High
Beef	-0.29	-0.26	-0.40
Pork	-0.72	-0.63	-0.67
Poultry	-0.57	-0.63	-0.66
Other Meat	-0.51	-0.30	-0.30
Fish	-0.36	-0.47	-0.24
Dairy	-0.78	-0.81	-0.77
Egg	-0.18	-0.01	-0.05
Fat	-0.51	-0.33	-0.36
Cereal	-0.58	-0.52	-0.54
Bread	-0.34	-0.31	-0.40
Vegetables	-0.70	-0.74	-0.71
Fruit	-0.65	-0.66	-0.75
Juice	-1.05	-0.89	-1.03

Source: Huang and Lin (2000)

### 2.1.2 Prepared Food

We briefly review some papers on prepared food, for which economic theory predicts that there should be a higher price elasticity of demand compared to raw food given the lack of close substitutes for raw food. It is important to note that the literature on food away from home focuses on fast food and eating out in restaurants rather than school meals.

The paper by Reed *et al.* (2005) investigates the demand and income elasticity of prepared food and found the estimate of the own-price elasticity of

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that it will suffice to use a less general version of it in our analysis. In particular, as school meals make up a relatively small part of household income on the average, we will be able to use the following equation to estimate its price and demand elasticity:

$$w = \alpha + \gamma \ln p + \varphi \ln p_c + \beta \ln \left( \frac{X}{P} \right) \quad (2)$$

where  $w$  is the expenditure share of the school meals,  $p$  is its price,  $p_c$  is a general price index used as a proxy for non-school meal goods consumed by the household,  $X$  denotes total expenditure on the goods for which the system is estimated and  $P$  is a price index (Stone price index).

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demand for food away from home to be -0.69, while its income elasticity to be equal to 1.38. This implies that the elasticity of demand for food away from home is not substantially more elastic than demand for other food products.

The implication of these findings are that as the price of food purchased for consumption away from home increases, there is a less than a proportionate decrease in the quantity demanded. Specifically, if the price of meals away from home increased by 10%, the authors suggest that we would expect to see a decrease in the quantity demanded by approximately 7%. Perhaps of equal significance – given the current economic downturn – is the fact that meals away from home are considered to be luxuries (an income elasticity of demand greater than 1). For instance, if household income decreases by 10%, the authors suggest that there would be a 13.5% reduction in the demand for meals away from home<sup>17</sup>.

### *What does this mean?*

Our literature review of the price and income elasticity of various food groups, including food consumed away from home offers the following insights.

First, the own-price elasticity of demand strongly depends on the level of aggregation of food products. In particular, the higher the level of aggregation, the lower (or more inelastic) the price elasticity of demand for food as there are fewer available substitutes.

Second, total food expenditure is an increasing function of total expenditure; however, the income elasticity for food is generally less than one, confirming the idea that most food items are “necessity” goods. However, for some food items (some meat items, some alcohol beverages, etc.) the income elasticity is greater than one, suggesting that some food items classify as luxury goods.

Finally, food away from home and processed food and tends to be more price elastic than raw food as the number of available substitutes is greater. One study in particular finds that if the price of meals away from home increased by 10% the decrease in the quantity demanded would be approximately 7%. In addition, meals away from home are considered to be luxuries (with an income elasticity of demand greater than 1). As household income decreases (by 10% for instance), the findings suggest that there would be a 13.5% reduction in the demand for meals away from home<sup>18</sup>.

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<sup>17</sup> Another paper, by Richards and Padilla (2005), looks at the impact of promotion on fast food consumption. As part of their analysis they estimate the impact of price in making a certain fast food choice. Using Canadian household data (NPD, 2005), they estimate the price elasticity of certain fast food choices to be in the range of -1.74 to -1.65, which implies that the demand for fast food is more elastic than the demand for raw food discussed above.

<sup>18</sup> In the case of school meals, this analysis is complicated by the fact that changing household incomes would result in changes in benefit levels and Free School Meal eligibility.

## 3 Analysis of School Food Trust Data

In this section, we provide some initial analysis of the information collected as part of the three School Food Trust Annual Surveys in order to establish whether there is a relationship between the price charged for school meals and the take-up of school meals. As there is only detailed information relating to price and take-up, it is clear that this analysis will hide a number of specific factors that may be driving take-up in individual Local Authorities. Therefore, in Section 4 we have undertaken subsequent analysis with a small number of Local Authorities to understand better the intricacies of take-up controlling for some local level factors that might be affecting take-up.

### 3.1.1 Response rates

The School Food Trust has commissioned an annual survey of Local Authorities since 2005/06 to establish whether there has been any change in take-up of school meals. In each of the annual surveys, all Local Authorities have been contacted with the number of responses containing some information relating to prices charged for meals and/or take-up<sup>19</sup> in each year (at primary level) standing at **98** in 2005/06, **93** in 2007/08 and **97** in 2008.

However, given the nature of primary data collection, the same Local Authorities have not responded in all three years, which makes any analysis of the relationship between prices and take-up over time more difficult. In particular, we present in Table 11 below the breakdown of responses by year and the number of Local Authorities responding to the survey in more than one year. From the information presented, it is clear that there are some difficulties in relation to the generation of a suitable sample of Local Authorities given the fact that 13 Local Authorities have never responded to the surveys and 38 Local Authorities only responded to one of the three surveys.

Table 11: Number of SFT Annual Survey responses by year								
Year	None	2006 only	2007 only	2008 only	2006 and 2007 only	2007 and 2008 only	2006 and 2008 only	2006, 2007 and 2008
<b>Number</b>	13	17	7	14	15	15	10	59

Source: London Economics' analysis of School Food Trust Annual Surveys

<sup>19</sup> or the organisations undertaking the catering activity within that Local Authority

A second complication is that there may be some significant evidence gaps and missing information provided by those Local Authorities that have responded. In particular, the key element of information necessary to complete the analysis is the proportion of children taking up school meals that pay for those meals and the price paid by those children. It is less important to understand the actual take-up rate (incorporating those individuals paying for meals and receiving meals for free) as clearly any price change will only affect the former group. In addition, any assessment of the relationship between aggregate take-up and the prices charged will be heavily influenced by Local Authority fixed effects and specifically the proportion of the school population eligible, registered for and taking up Free School Meals.

Our analysis of school meal take-up using information contained in the three SFT Annual Surveys is based on *paid* take-up at primary level. In each of the three Annual Surveys, information has been requested in relation to either the proportion of paid school meals that have been provided in each Local Authority or the number of paid meals taken up. This information can be combined with secondary information on the proportion of children eligible for free school meals to establish the relevant paid meal take-up rate. In addition to information on paid meal take-up, the surveys also ask for information on the prices charged for a main meal in primary schools<sup>20</sup>. We present in Table 12 the specific questions relating to paid meal take-up.

<b>Table 12: Annual Survey questions in relation to paid meal take-up by year</b>	
<b>Year</b>	<b>Question</b>
2005/2006	What is the average daily number of main (lunch) meals your organisation provides in the areas you cater for (only those that are paid for)?
2006/2007	What was the average daily number of paid meals served in 2006/07
2007/2008	What was the % take-up of paid meals?

Source: School Food Trust Annual Surveys

However, as previously mentioned, although there are 99 Local Authorities that have provided responses relating to their school meal service at primary level in more than one of the three years, there is no guarantee that these Local Authorities will have provided specific responses to the relevant take-up and price questions mentioned above. However, crucially, the Annual Surveys also ask respondents for the equivalent take-up and price information from in the previous year. Therefore, depending on the responses

<sup>20</sup> Note that throughout this analysis, we concentrate on take-up in primary schools given the greater degree of consistency associated with school meals at primary level (the concept of a standard lunch rather than a self service canteen\_

provided by Local Authorities, it may be possible to fill in missing information provided by those Local Authorities.

This approach allows us to substantially increase the number of observations. However, it is important to note that in all cases where original information exists (i.e. a particular Local Authority responds in 2007 and 2008), we use the exact information provided in each individual survey. Only in cases where respondents have not provided information in a particular year (for instance in 2007), then we make use of the information provided in 2008 relating to the previous year.

For instance, to establish the impact of price changes on school meal take-up between 2006 and 2007 at primary level, we were able to derive 101 observations on take-up in 2006 (77 from the original 2006 survey and 24 responses from the 2007 survey relating to previous years take-up); 107 observations on take-up in 2007 (87 from the original 2007 survey and 20 responses from the 2008 survey relating to previous years take-up); and 98 responses from 2008.

We have presented the equivalent information relating to take-up between 2007 and 2008 and prices between 2007 and 2008 at primary level in Table 13 below.

<b>Table 13: Information sources for take-up and prices charged</b>				
	<b>Take-up</b>		<b>Price</b>	
	<b>Current</b>	<b>Previous</b>	<b>Current</b>	<b>Previous</b>
<b>2007</b>	<b>(2007)</b> 2006: - 2007: 87 2008: 20	<b>(2006)</b> 2006: 24 2007: 77 2008: -	<b>(2007)</b> 2006: - 2007: 96 2008: 22	<b>(2006)</b> 2006: 79 2007: 22 2008: -
<b>2008</b>	<b>(2008)</b> 2007: - 2008: 98	<b>(2007)</b> 2007: 27 2008: 82	<b>(2008)</b> 2007: - 2008: 100	<b>(2007)</b> 2007: 26 2008: 94

Source: London Economics' analysis of School Food Trust Annual Surveys

### **Caveats**

There is an issue in relation to the extent to which using data from different years to fill information gaps is valid. As such, we have also undertaken an analysis of survey respondents in the three years to assess the extent to which the information provided in a particular year (i.e. take-up in 2006 provided in 2006) tallies with the retrospective information provided in the subsequent year (i.e. take-up in 2006 provided in 2007). The analysis indicates that in relation to take-up, respondents *underestimate* take-up retrospectively by

between 3.1% and 3.6%. In other words, when individuals were asked in 2007 about paid meal take-up in 2006; they reported a figure that was approximately 3.6% lower than the actual figure reported in 2006. Similarly, when individuals are asked in 2008 about paid meal take-up in 2007; they report a figure that was approximately 3.1% lower than the actual figure reported in 2007.

A slightly different picture emerges in relation to the price charged for paid meals. When individuals were asked in 2007 about the price charged for paid meals in 2006; they reported a figure that was approximately 2.4% lower than the actual figure reported in 2006. However, when individuals were asked in 2008 about the price charged for paid meals in 2007, they report a figure that was approximately 4.7% higher than the actual figure reported in 2007.

With these caveats in relation to the robustness of the data, the approach adopted allows generates 84 linked observations of price and take-up between 2006 and 2007, 88 linked observations between 2007 and 2008 and 67 linked observations between 2006 and 2008.

### 3.1.2 Analysis over time

We undertook a number of analyses with the information derived from the three Annual Surveys. First, we have presented the average and median price and changes in take-up (amongst those paying for meals) between 2006 and 2007; 2007 and 2008; and 2006 and 2008, as well as the equivalent information for those Local Authorities where we have all three years of information. There are some advantages to looking at both the one year and two year relationship between changes in prices and take-up. Specifically, it may be possible to identify a slightly longer-term relationship between prices and take-up rather than just an instantaneous change or possible changes in take-up resulting from other characteristics of school meal provision that may have a very short-term effect.

The information presented in Table 14 indicates that between 2006 and 2007, respondents indicated that there was a 5.0% increase in the prices charged for school meals, a 4.9% change in the prices charged between 2007 and 2008 and a 9.7% change in the prices charged between 2006 and 2008. The corresponding change in the take-up of paid school meals was 2.1%, 4.9% and 8.7%. The estimates presented here do not alter significantly depending on whether all available information is used or whether we restrict the sample to just those Local Authorities providing information in all of the three years.

This information would suggest that the relationship between prices charged and quantity demanded (elasticity of demand) is in the range -0.88 to -0.90<sup>21</sup>.

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<sup>21</sup> We have also undertaken an equivalent analysis using median observations rather than averages (means). We find that although the estimated price increases are lower than when considering averages

**Table 14: Changes in Price and Take-up amongst those paying for school meals at primary level**

	Price			Take-up		
	$\Delta$ 2006-2007	$\Delta$ 2007-2008	$\Delta$ 2006-2008	$\Delta$ 2006-2007	$\Delta$ 2007-2008	$\Delta$ 2006-2008
<b>Average</b>	5.0%	4.9%	9.7%	-2.1%	-4.9%	-8.7%
<b>Average (F.T.Y.R)</b>	4.7%	4.9%	9.8%	-3.3%	-4.9%	-8.6%
<b>Median</b>	3.6%	3.6%	8.7%	-4.7%	-5.5%	-7.6%
<b>Median (F.T.Y.R)</b>	3.4%	3.2%	9.1%	-4.8%	-5.5%	-7.5%

Source: London Economics' analysis of School Food Trust Data. Note F.T.Y.R means 'full three year response'

### 3.1.3 Econometric analysis

We have also undertaken a univariate regression analysis using all linked observations over the three years (i.e. 2006-2007, 2007-2008 and 2006-2008) and regressed the natural logarithm of the price charged on the take-up rate. The reason for using the natural logarithm of price is because the coefficient produced as part of the regression analysis simply needs to be divided by average take-up to generate an estimate of the elasticity of demand.

Formally, we estimated the model:

$$y_{it} = a + \beta_1 p_{it} + \varepsilon_{it}$$

where  $y_{it}$  is the take-up of paid school meals in Local Authority  $i$  in year  $t$  (between 2006 and 2008),  $p_{it}$  is the logarithm of the average price of school meals in local authority  $i$  and period  $t$ , and  $\varepsilon_{it}$  is an error term.

This specification can be used to estimate the price elasticity of paid school meals, through dividing the estimate of the coefficient  $\beta_1$ , by the average take-up rate. However, in considering the results it is important to note that we are unable to control for a number of factors which we might expect to affect the take-up of school meals, and as a result the estimates may be biased. In particular, ideally we would account for average parental income, as we might expect that parents with higher income are more able to afford school

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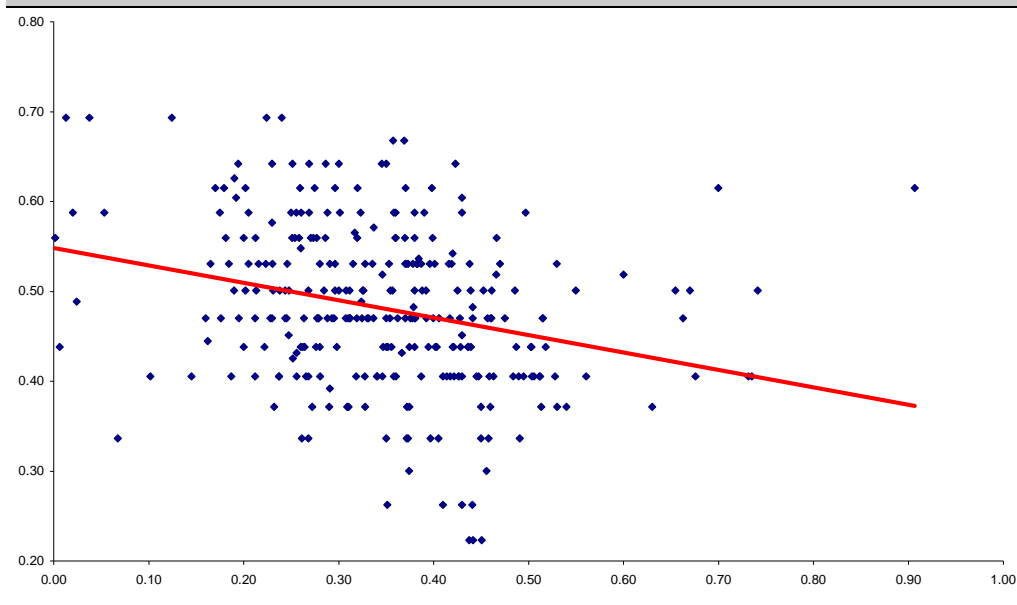
(8.7%, 9.1% between 2006 and 2008 compared to 9.7% and 9.6%), the estimates of the responsiveness of demand with respect to price are between -0.83 and -0.87.

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meals. If average parental income has tended to increase over time, for instance, this may have mitigated the impact of increasing school meal prices. As a result our estimate may underestimate the price elasticity. Similarly, the activities of the School Food Trust may have led to an increase in school meal take-up, keeping all other factors constant. Again, this would lead to an underestimate of the price elasticity in our simple model.

In Figure 4, we have presented a plot of the natural logarithm of prices and take-up amongst those pupils potentially paying for school meals. The analysis illustrates that the vast majority of observations are clustered in and around the mean. We have undertaken a number of different model specifications incorporating both all the information available as well as excluding some of the outlier information.

**Figure 4: Plot of take-up and price at primary level and estimated relationship**



*Source: London Economics' analysis of School Food Trust data. The natural logarithm of price is presented on the horizontal axis, while the take-up rate amongst pupils potentially paying for school meals is presented on the vertical axis.*

The results presented in Table 15 indicate that based on the entire sample of legitimate observations, the elasticity of demand is estimated to be approximately -1.08, while the estimate of the elasticity of demand based on the sample from which outliers have been removed is approximately -1.04.

<b>Table 15: Econometric results of elasticity of demand at primary level</b>				
	<b>Coefficient on logarithm price (1)</b>	<b>Observations and standard error</b>	<b>Take-up (2)</b>	<b>Elasticity of demand = (1)/(2)</b>
<b>All observations</b>	-0.375	291 (.069)	0.348	-1.08
<b>Excluding outliers</b>	-0.356	271 (.114)	0.344	-1.04

*London Economics' analysis of School Food Trust data*

This implies that as the price charged for school meals increases by 10%, we would expect to see a 10.4% to 10.8% reduction in the take-up rate amongst those pupils paying for school meals. In aggregate, when incorporating those children eligible for free school meals, clearly the take-up of school meals will fall to a lesser extent.

### *Does this make sense?*

The analysis presented in this section is a straightforward comparison of the prices charged for paid meals at primary level and take-up amongst those not eligible for free school meals. The estimates indicate that the elasticity of demand for school meals is in the region of -1.00. Considering the entire population of primary school pupils, according to the SFT Annual Surveys, take-up stood at 44.9% in 2005, 42.3% in 2006, 41.3% in 2007 and 43.0% in 2008. What explains the decline and partial recovery in school meal take-up in the face of increasing prices and the results from the econometric estimates?

One possible explanation is that there may have been a significant increase in the proportion of primary school pupils eligible for free school meals, which has negated the impact of possible decreases in take-up amongst those paying for meals (given that take-up amongst those eligible for free school meals is substantially higher than amongst those paying for meals). However, information from a variety of DCSF and LACA<sup>22</sup> sources indicates there has been a reduction in the proportion of primary school pupils registered for free school meals (from 16.9% of the cohort in 2005 to 15.5% in 2008). This is presented in Table 16 below.

Therefore, an increase in FSM eligibility does not appear to explain the increase in aggregate take-up rates.

<sup>22</sup> Local Authority Catering Association (LACA)

<b>Table 16: Registration and Take-up of Free School Meals in primary schools</b>				
	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>
<b>Total number of primary school pupils in England</b>	4,243,964	4,189,625	4,144,088	4,138,444
<b>Number (proportion) of pupils eligible for FSM</b>	717,230 (16.9%)	670,340 (16.0%)	658,910 (15.9%)	641,510 (15.5%)
<b>Number (proportion) of pupils NOT eligible for FSM</b>	3,526,734 (83.1%)	3,519,285 (84.0%)	3,485,178 (84.1%)	3,497,264 (84.5%)
<b>Proportion of those registered taking up school meal entitlement</b>	79.3	83.0	82.6	83.9
<b>Aggregate Take-up<sup>23</sup></b>	44.9	42.3	41.3	43.0
<b>Imputed take-up amongst those not eligible for FSM</b>	37.9	34.5	33.5	35.5

Source: London Economics' analysis of DCSF, LACA and SFT Annual Survey data

A second explanation might relate to an increase in the proportion of pupils eligible and registered for free school meals taking up their entitlement. The evidence suggests that there has been a very significant increase in take-up amongst those eligible for free school meals. In particular, take-up amongst those eligible for free school meals has increased from 79.3% in 2005 to 83.9% in 2008. Therefore, the reduction in take-up following from fall in the proportion of children eligible for free school meals has been more than offset as a result of the increase in the proportion eligible actually taking up their entitlement.

The implication is that in aggregate take-up by those eligible for free school meals has remained relatively constant. We have combined this information with data on aggregate take-up from the SFT Annual Surveys to generate an estimate of take-up amongst those that are not registered for free school meals. This analysis indicates that the proportion of primary school pupils taking up paid school meals has fallen between 2005 and 2008.

### *Assessment of a counterfactual*

Firstly, the information relating to the take-up rate amongst pupils registered for free school meals may provide an indication of what might have happened in the absence of price increases (or the *counterfactual*). In particular, take-up of free school meals amongst those registered increased by 4.6 percentage points from 79.3% to 83.9% between 2005 and 2008 (equivalent to a 5.8% increase in take-up). Take-up amongst those paying for school meals decreased by 2.4 percentage points (equivalent to 6.3%). This analysis

<sup>23</sup> The information relating to aggregate take up in 2003 and 2004 is derived for LACA data and may not be as reliable as the information relating to 2005-2008

implies that following an average price increase of 12.9%, take-up rates amongst those paying for school meals were 12.1% (or 7.0 percentage points) lower than might have been expected in the absence of price increases. This explanation implies that the elasticity of demand is not as high as the estimate produced in the econometric analysis and is probably closer to -0.94<sup>24</sup>.

### *Real and nominal price increases*

As previously mentioned, an alternative explanation as to why the headline data shows little change in take-up amongst those paying for school meals (2.4 percentage point decline between 2005 and 2008) is that the analysis presented only considers the impact of the price of school meals on paid take-up *holding all other factors constant*. In reality, the econometric analysis considers the impact of a *real* increase in the cost of school meals; while the headline information from SFT surveys only assesses a *nominal* change in prices. If the price of the closest substitutes to school meals (i.e. packed lunches) increased at the same rate as the cost of school lunches, then depending on the relative elasticity of demand of school meals and packed lunches we would expect to see a reduced change in the quantity demanded following the change in prices<sup>25</sup>.

The findings of the different strands of analysis are presented below.

<b>Table 17: Summary results of elasticity of demand at primary level</b>		
		<b>Estimate of elasticity of demand</b>
<b>Literature Review</b>	<b>Food away from home</b>	-0.70
<b>SFT Annual Surveys</b>	<b>Simple Correlation</b>	-0.88 to -0.90
	<b>Econometric Analysis</b>	-1.04 to -1.08
	<b>Counterfactual</b>	-0.94
<b>Average</b>		<b>-0.89 to -0.90</b>

### *London Economics' analysis*

<sup>24</sup> Note that we have attempted to assess the relationship between price and take up over a slightly extended period to reduce the impact of some individual year-on-year jumps in take-up and the fact that price increases often take place at different points throughout the school year rather than at one fixed point in time

<sup>25</sup> For instance, if the price of school meals and packed lunches both increased by 10% and the elasticity of demand for school lunches was estimated to be -1.0 compared to an elasticity of demand for packed lunches of -0.2 (which would be expected given the lack of substitutes and relatively low elasticity for basic ingredients), then we would expect the quantity demanded of school meals to fall by 10% and the quantity demanded of packed lunches to fall by 2%. The real effect of the price increase is a 8% reduction in school meals - corresponding to an elasticity of demand of -0.8.

## 4 An analysis of Local Authority take-up and prices charged

In this section we provide an analysis of the experiences of some individual Local Authorities that have agreed to share management information relating to the take-up amongst those paying for school meals and eligible for free school meals.

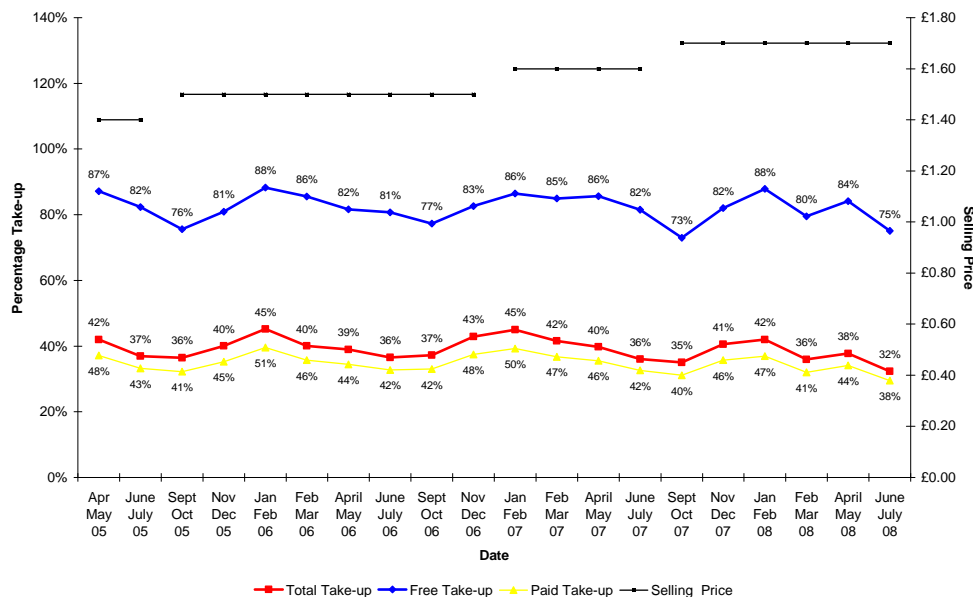
In particular, at the start of this project, we contacted 9 Local Authorities and requested information relating either the number or take-up amongst primary school pupils on a monthly or quarterly basis alongside information on price increases that may have occurred over time. The rationale for undertaking this type of analysis was to assess the extent to which take-up rates changed amongst those eligible for free school meals and those paying for meals in the short to medium term post the imposition of price increases. The advantage of asking for information from Local Authorities is that once price increases have been implemented, it is more reasonable to assume that there has not been any *other* independent effect on take-up in the period directly following the change in prices charged – allowing us to understand the relative change in take-up between those eligible for free school meals and those pupils affected by the price increases.

Of the 9 Local Authorities that responded, 6 responded with the relevant information or with information that was of use in the current context. We have not presented all the individual Local Authority information here and it is important to remember that the information presented may not be representative of the picture across the country as a whole.

As with the majority of the information collected, it is important to remember that there are significant seasonal trends within the data. In particular, take-up of school meals dips considerably during the final term of the academic year and (generally) recovers to ‘normal’ levels by the start of the subsequent academic year. For example, from the data provided by Local Authority A; from a high point of 45% take-up in primary schools in January 2006, take-up dropped by 8 percentage points between January and June 2006. In January 2007, take-up stood at 45% and again dropped by 9 percentage points between January and June 2007. In January 2008, take-up stood at 42% and dipped by 10 percentage points between January and June 2008.

In summary, the information from this Local Authority (and a number of the others considered) is characterised by a slight downward trend combined with strong seasonal effects. This is presented in Figure 5 overleaf.

Figure 5: Take-up of paid and unpaid school meals – Local Authority A

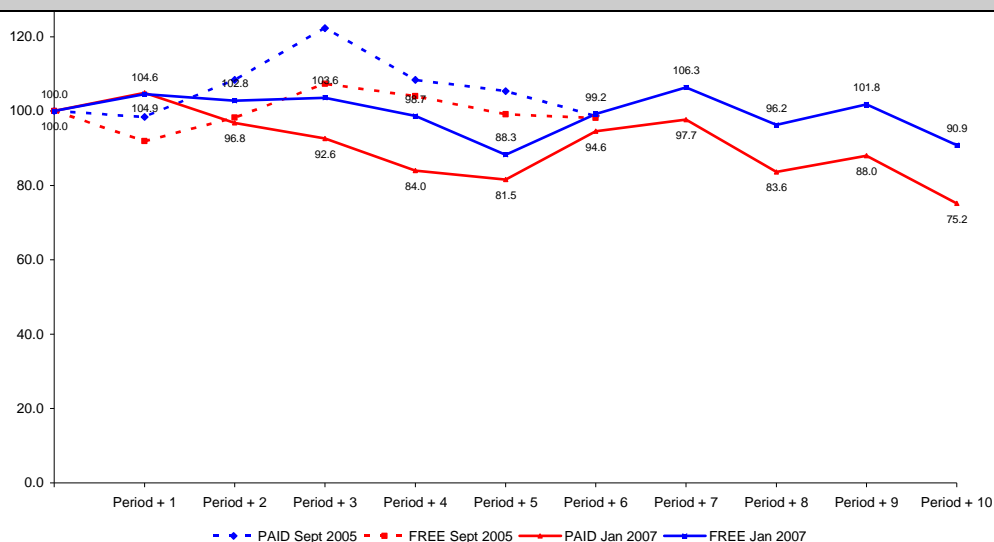


Source: London Economics' calculations based on Local Authority data

In Figure 6, we present the change in take-up that occurred in the months following changes in the prices charged for school meals. In particular, over the period for which we have data, there were three price increases: the first from £1.40 to £1.50 in September 2005; the second from £1.50 to £1.60 in January 2007 and the final increase from £1.60 to £1.70 in September 2007. For presentational purposes, we have split the data to illustrate the possible impact of prices on take-up following the price increase on 2005 and the two price increases in 2007. We have indexed the information such that take-up equals 100 in the period prior to the introduction of the price increases (September 2005 and January 2007) and illustrate the evolution of the index in Figure 6 overleaf.

There are fundamental differences in take-up following the price increases. Following the price increase in September 2005, take-up amongst those paying for meals dropped initially though recovered strongly. In fact take-up amongst those paying for school meals was relatively higher than take-up amongst those taking free school meals (compared to take-up rate prior to the price increase). By June 2006, take-up amongst both those paying and not paying for school meals was approximately 1-2 percentage points lower compared to the pre-price increase levels. This illustrates that the price increase appeared to have relatively little impact on take-up in either the short or medium term.

**Figure 6: Index of relative take-up of paid and unpaid school meals following changes in prices charged- Local Authority A**



Source: London Economics' calculations based on Local Authority data

However, the price increase in January 2007 appears to have had some effect on take-up. In particular, following the increase in prices in January 2007 (equivalent to a 6.7% increase in prices), paid meal take-up dropped 16% by September 2007. Although this might be in part due to seasonal factors, it is interesting to note that there was no equivalent reduction in take-up amongst those taking up free school meals. Following the second price increase in September 2007, take-up amongst those paying for school meals again fell more quickly than those taking free school meals. Specifically, by June 2008, take-up had fallen by 11% for those taking up school meals compared to 7% amongst those taking up free school meals.

In aggregate over the two price increases, take-up amongst those paying for school meals fell by 25% compared to just 9% for those taking free school meals. However, there is a significant seasonal component included in these estimates. Instead of comparing information November 2006 and June 2008, if we make a like for like comparison between June 2006 and June 2008, the fall in take-up amongst those paying for school meals was 12% compared to a fall of 7% for those taking free school meals. Therefore stripping out the seasonal trend and the counterfactual (i.e. the drop in take-up amongst those taking up free school meals), the information provided indicates that paid meal take-up fell by 3.4% in relative terms following a 13% increase in prices.

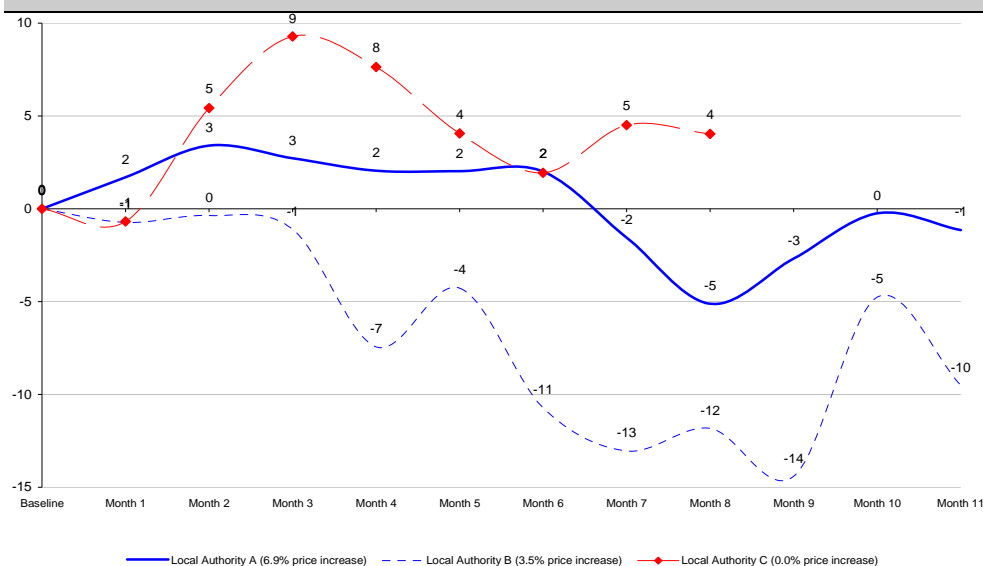
### Aggregate price impacts

In this final section, we have considered the aggregate impact of changes in the price charged for paid meals on the relative index of take-up between those paying for school meals and those eligible for free school meals. We

have presented the information for three of the Local Authorities for whom information exists. It is important to note that there is substantial variation in relation to the changes in take-up following price increases and these findings should be considered for illustrative purposes only.

In Figure 7 below, we present the relative difference in the indices of take-up between those paying for school meals and those eligible for FSM<sup>26</sup>. The figure illustrates that for Local Authorities A and B, the price increases (averaging 6.9% and 3.5% respectively) have resulted in a relative reduction in take-up amongst those paying for meals. In the case of Local Authority A, the change is relatively minor, while the change for Local Authority B is approximately 10 percentage points. We have also presented Local Authority C, where no price increase was implemented over the period for which data was provided. Interestingly, take-up amongst those paying for school meals increased at a faster rate (or fell at a slower rate) compared to those eligible for free school meals. However, as previously mentioned, caution should be exercised in relation to these results.

**Figure 7: Difference in indices of take-up of paid and unpaid school meals following changes in prices charged- three Local Authorities**



Source: London Economics' calculations based on Local Authority data

<sup>26</sup> In this example, take-up amongst those eligible for FSM and paying for school meals are indexed to 100 in the month prior to the price increase. In each subsequent month, the graph illustrates the difference in indexed take-up between those paying for school meals and eligible for FSM. Points above the horizontal axis imply that indexed take-up amongst those paying for school meals is rising more quickly (or falling more slowly) than take-up amongst those eligible for free school meals. Therefore, following price increases, we would expect the index to become negative (and be positioned below the horizontal axis)

## 5 Opportunity Cost of School Meals

In this section, we provide some information on the opportunity cost associated with school meal provision and assess the relative change in school meal prices of the last four years compared to an estimate of the cost of producing a packed lunch<sup>27</sup>. To determine the cost of a packed lunch, we have taken information from the Labour Force Survey (to understand the labour cost associated with the preparation of packed lunches), information on the average household expenditure on food for the Food Expenditure Survey, as well as information on price inflation from the ONS.

### Labour Costs

The first stage of the analysis is to generate an average labour cost associated with producing a packed lunch. We have provided the workings relating to 2005, but in a later table present the evolution of the estimate of cost associated with the production of packed lunches between 1997 and 2008. In Table 18 below, we present the proportion of the working age population employed (broken down by those in full time and part time employment), unemployed and economically inactive. This has been presented for men and women separately. We have also provided (in brackets) the average hourly wage rate associated with each labour market status. Rather than assuming that those individuals who are unemployed or economically inactive have a zero value of time, we have assumed that the value of their time is equivalent to the National Minimum Wage rate (£5.05 per hour in 2005).

Table 18: Deriving the labour cost of a packed lunch						
	Employed	<i>Full Time</i>	<i>Part Time</i>	Unemployed	Inactive	Ave. Hourly Rate
<b>Males</b>	78%	88.8% (£13.98)	11.2% (£10.02)	5.2% (£5.05)	16.6% (£5.05)	£11.69
<b>Females</b>	69%	57.3% (£11.63)	42.7% (£8.71)	4.5% (£5.05)	26.7% (£5.05)	£8.72

*London Economics' analysis of Labour Force Survey.*

<sup>27</sup> We are able to consider the prices charged over four years given the fact that the first Annual Schools Survey asked for information on the price of meals in 2005.

Generating a weighted average of the wage rate, the analysis indicates that the average wage rate of men of working age is approximately £11.69 per hour, while the average wage rate for women of working age is £8.72 per hour. This provides an estimate of the wage cost associated with production of packed lunches in 2005 and can be replicated using secondary data over the entire duration of the analysis.

We have assumed that females are primarily responsible for producing packed lunches (to the extent that 90% of packed lunches are made by women). Using the information presented above on average wage rates and the assumption listed below, we can estimate that the average relevant hourly wage rate stands at **£9.02** in 2005.

However, the standard wage rate is not generally taken to represent the opportunity cost of leisure. In practice, most studies estimate time cost as a proportion of the individual's wage in some way. Cesario and Knetsch (1976) first suggested approximating the opportunity cost (value) of time as some proportion of the wage rate. In relation with this approach, a key question is which proportion of the wage rate should be used as a proxy for the opportunity cost of time. 33% has probably been the most often chosen fraction<sup>28</sup>. For the purposes of this analysis, we have assumed that the opportunity cost associated with the time required to prepare a packed lunch is 33% of the average wage rate, which is equivalent to £2.98 per hour.

### *Preparation time*

The final assumption we have made relates to the length of time necessary to prepare a packed lunch. Clearly this is a difficult metric to estimate and depends entirely on the content of the packed lunch. However, we have assumed that the average length of time necessary to prepare the representative packed lunch is approximately 15 minutes. This implies that (assuming that the average effective tax rate stands at 27%) the average labour cost associated with preparing a packed lunch stands at £0.54p. There is some evidence to support this assumption in relation to preparation time. Specifically, the menus produced by the School Food Trust provide preparation times ranging from less than 15 minutes to more than 30 minutes. However, we have made no assumption in relation to the nutritional equivalency of packed lunches and school meals<sup>29</sup>.

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<sup>28</sup> For instance, Hellerstein (1993); Englin and Cameron (1996); Coupal *et al* (2001); Bin *et al* (2005); and Hagerty and Moeltner (2005) use 33%. Parsons *et al.* (2003) observe that the literature has more or less accepted 25% as the lower bound and the full wage as the upper bound, although neither value enjoys full support (Hynes *et al.*, 2004).

<sup>29</sup> Given the nature of some of the assumptions used in this analysis, we indicate the sensitivity of the estimate to alternative assumptions in relation to alternative employment and economic inactivity rates, the relative proportion of meals produced by males and females and the time taken to prepare a packed lunch.

### Food Costs

The second element of the analysis involves assessing the food costs associated with the provision of a packed lunch. Again assuming that 2005 is the baseline for this analysis, we have gathered information from the Expenditure and Food Survey and assessed the average weekly expenditure on food and beverages.

<b>Table 19: Deriving the food cost of a packed lunch</b>	
<b>Item</b>	<b>Amount</b>
School meals per annum (1)	190
Total number of meals per annum (2)	1095
Packed Lunches as a proportion of all meals (3)=(1)/(2)	17.4%
Average weekly expenditure on food/beverages (4)	£24.64
Average weekly expenditure on packed meal ingredients for children (5)= (3)*(4)	£4.24
Average daily expenditure on packed meal ingredients for children (6)= (5)/5	£0.85

*London Economics' analysis of Expenditure and Food Survey.*

In 2005, this estimate stood at approximately £24.64 per person per week. We have assumed that there are 190 school catering days per annum and that as such approximately 17.4% of meals are consumed in school. We have also assumed that the average expenditure on food/beverages for consumption at home is representative of the ingredients purchased for the preparation of packed lunches. Applying this percentage to the total average weekly expenditure on food and drink implies that the average expenditure on food and drink associated with packed lunches is £4.24 - equivalent to £0.86 per day (or £1.00 per day in 2008 prices).

Combining these estimates implies that the average cost of producing a packed lunch in 2005 stands at £1.40 (equivalent to £1.60 per day in 2008 prices).

### *Does this make sense?*

As previously mentioned, the information presented above estimates the cost of preparing a packed lunch where little or no consideration has been given to the nutritional content or quality of the food prepared.

There is some information available from the Food Standards Agency<sup>30</sup> on the ingredient cost and nutritional content associated with a range of possible packed lunches. For pupils aged between 5 and 8, the ingredient costs range from as little as £0.60 to more than £1.80 per packed lunch with the average standing at approximately £1.20. For pupils aged between 9 and 12, the average ingredient cost associated with the suggested menus stands at £1.26. However, there are no estimates provided in relation to the other non-monetary costs associated with the preparation of the packed lunch.

Similarly, the School Food Trust has prepared a number of sample menus that adhere to nutrient based standards. The average ingredient costs stands at £1.22 per lunch. However, the menus prepared by the SFT do provide an indication of the preparation time of the menus. The classification of preparation time includes a 'little' time (less than 15 minutes); 'more' time (16-30 minutes); and 'a lot of time' (31 minutes or more). Using the assumption that the average ingredient cost associated with the preparation of packed lunches stands at £1.22, and further assuming that the average preparation time stood at 15 minutes, this implies that the average cost of preparing a nutrient based packed lunch would approach £1.83 (in 2008 prices).

The analysis indicates that the cost of provision of a packed school lunch is in the range of £1.60 to £1.83 (in 2008 prices) depending on the assumptions in relation to the time necessary to prepare the packed lunch and the nutritional quality of the packed lunch.

### *Sensitivity Analysis*

In this section we provide some basic analysis of the sensitivity of the findings to changes in some of the underlying assumptions.

Increasing the proportion of both males and females that are unemployed or economically inactive (by 5 percentage points) has a relatively small impact on the overall price of preparing a packed lunch. Specifically, under this assumption, the cost of production falls by £0.02 on average. Increasing the proportion of meals prepared by men by 15 percentage points increases costs by £0.02 on average. Increasing the number of catering days annually (to 200) has no impact on the average cost of production.

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<sup>30</sup> <http://www.eatwell.gov.uk/agesandstages/children/lunchboxsect/?lang=en>

<b>Table 20: Sensitivity analysis relating to the cost of a packed lunch</b>	
<b>Changed factor</b>	<b>Cost</b>
Baseline assessment of cost of packed lunch in 2008 prices	£1.60-£1.83
Increase in proportion unemployed by 5 p.p.	£1.58-£1.81
Increase in proportion of men preparing lunches by 15 p.p.	£1.62-£1.85
Increase in average weekly expenditure on food/beverages by 10%	£1.70-£1.93
Number of school catering days equals 200	£1.60-£1.83
Length of time to prepare of packed lunch increases by 5 minutes	£1.81-£2.04
Average effective tax rate is 30%	£1.58-£1.81

*London Economics' analysis of Expenditure and Food Survey.*

The only relatively significant changes in the aggregate price of preparing a school meal relate to changing the assumptions relating to the aggregate average expenditure on ingredient costs and preparation time. Increasing average weekly expenditure by 10% increases the total estimated cost of preparing a packed lunch to between £1.70 and £1.93, while increasing the average length of time required preparing a packed lunch by 5 minutes increases the cost to between £1.81 and £2.04.

### *Evolution of costs over time*

To generate the evolution of the cost of packed lunches over time, we have used information from the Annual Survey of Hours and Earnings and Labour Force Survey to update the labour costs annually. In addition, we have gathered information from the Office for National Statistics in relation to the consumer price index in relation to the cost of food. We present the estimate of the cost of preparing a packed lunch over time. The analysis illustrates that since 2005, the expected cost of producing a packed lunch has increased from between £1.40 and £1.63 in 2005 to £1.60 and £1.83 in 2008. This equates to an average increase in the cost of producing packed lunch by between 3.9% and 5.7% per annum - or 14.7% over the three years in total.

**Table 21: Deriving the labour cost of a packed lunch**

	Labour cost	Food cost	Total Cost	School Meal
2005	0.54	0.85-1.09	£1.40-£1.63	£1.48
2006	0.59	0.87-1.10	£1.46-£1.69 (4.4%)	£1.54 (4.1%)
2007	0.60	0.91-1.15	£1.52-£1.75 (3.9%)	£1.63 (5.8%)
2008	0.61	1.00-1.22	£1.60-£1.83 (5.7%)	£1.66 (2.1%)

*London Economics' analysis of Expenditure and Food Survey.*

### *How does the price of a packed lunch compare with a school meal*

Information from the three SFT Annual Surveys of school meal take-up provides information on the average price charged by Local Authorities between 2005 and 2008. The information indicates that the average price charged for a school meal stood at £1.48 in 2005, £1.54 in 2006, £1.63 in 2007 and £1.66 in 2008. This implies that the average price charged for a school meal has been inside the range of economic cost associated with the preparation of packed lunches. The annual increase in the price of school meals has been between 2% and 6% in each of the three years for which information exists, which is equivalent to an increase in price over the three years of 12.9% (compared to an estimate of 14.7% for packed lunches).

The estimates indicate that the average cost of school meals (at primary level) are at the lower end of the range of estimate of the cost of preparing a packed lunch - and that the estimates of the change in the cost over time are more or less identical. There is no obvious cost saving associated with the preparation of packed lunches (i.e. the opportunity cost is not significantly lower), nor is it the case that the cost of preparing packed lunches is changing at a fundamentally different rate compared to the average school meal.

The fact that the increase in the cost of producing packed lunches has tracked the increased cost of school meal purchase so closely implies that it is important to consider the change in take-up amongst those paying for school meals relative to the counterfactual scenario relating to the change in take-up for those eligible for free school meals. In other words, although the price of school meals has increased by approximately 12.9% between 2005 and 2008, the price of packed lunches (the closest substitute to school meals in primary schools) has increased by between approximately 14%. At the same time, the take-up rate amongst those not paying for school meals has increased by 5.8% compared to a reduction of 6.3% for those paying for school meals. The implication is that effective take-up amongst those paying for school meals has fallen by approximately 12.1% following a 12.9% increase in price equating to an elasticity of demand of approximately **-0.94**.

## 6 An analysis of the cost of raising a child

In this section, we provide an assessment of the weekly cost associated with raising children using information from the Expenditure and Food Survey. The rationale for undertaking this analysis is to assess the extent to which there are economies of scale associated with bringing up children. Specifically, for families with more than one child, there are no economies of scale associated with the purchase of school meals (the cost of 2 meals is exactly twice the cost as that incurred for one child). However, for lunches prepared at home, there are economies of scale (the cost of preparing lunches for two children simultaneously is less than the cost associated with the preparation of two lunches separately). In this section, we assess to what extent lack of economies of scale for families with more than one child result in a wedge between eating school meals and bringing a packed lunch.

### 6.1.1 Approaches to costing the care of a child

There are two approaches that can be taken to assess the cost of caring for a child, each of which has its own shortcomings to be aware of.

The first is to construct an artificial budget, based on the items that are considered necessary to realise a given standard of living; however, the subjectivity of this approach is clear. Standard of living is subjective itself, as is the influence that different items of consumption have on an individual's standard of living.

The second approach is to consider the actual amount spent by households with children and to compare this with the amount spent by households without children. This approach must be undertaken carefully as the validity of the analysis rests on establishing the correct counterfactual. Broadly speaking, this means refining the sample of households without children to ensure they are as similar as possible to those with children in other respects.

Essentially, with either method, in order to arrive at the marginal cost of caring for a child, we need to compare the expenditure patterns of households with and without children, such that the two sets have the same standard of living. Put another way, we are looking to compare households that have similar behavioural patterns rather than similar incomes.

### 6.1.2 The Expenditure and Food Survey - Descriptive statistics

There were 41,676 households that responded to the six annual Expenditure and Food Surveys between 2001/02 and 2006. Of these, just one-third (13,546) contained at least one child. The average weekly total consumption expenditure for the whole of the UK was £401 (base 41,676; weighted for non-

response). Most responding households do not contain any children. Almost 90% (33,067) of the 37,213 index households in the survey contain one or two adults, of which 21,748 (58% of total) contain no children.

### 6.1.3 Household Income

Having controlled for differences in the standard of living across different households<sup>31</sup>, the average (mean) weekly household gross incomes for different income quintiles (broken down by the number of adults in the household) are shown in Table 22. The second quintile (£223 per week) for single adult households and the first quintile (£339 per week) for two adult households are the most appropriate quintiles to consider when focusing on the relative poverty threshold set by the UK Government. This serves two purposes. The first is that it satisfies the requirement for the child not to be in poverty. The second is that this expenditure relates to levels of income that are not as likely to be influenced by the effects of the welfare system, such as tax credits and benefits, designed to maintain minimum income levels.

Number of adults	Income quintile	Mean weekly gross income	Annual gross income equivalent	Number of households
<b>One adult</b>	<b>1 (low)</b>	£106	£5,512	1,038
	<b>2</b>	£223	£11,596	1,099
	<b>3</b>	£359	£18,668	1,030
	<b>4</b>	£511	£26,572	1,009
	<b>5 (high)</b>	£850	£44,200	961
<b>Two adults</b>	<b>1 (low)</b>	£339	£17,628	1,978
	<b>2</b>	£590	£30,680	1,948
	<b>3</b>	£763	£39,676	1,948
	<b>4</b>	£968	£50,336	1,908
	<b>5 (high)</b>	£1,351	£70,252	1,877

Note: Annual equivalent calculated as 52 times the weekly income.

Source: 2001/2-2006 Expenditure and Food Surveys, National Statistics and London Economics' calculations

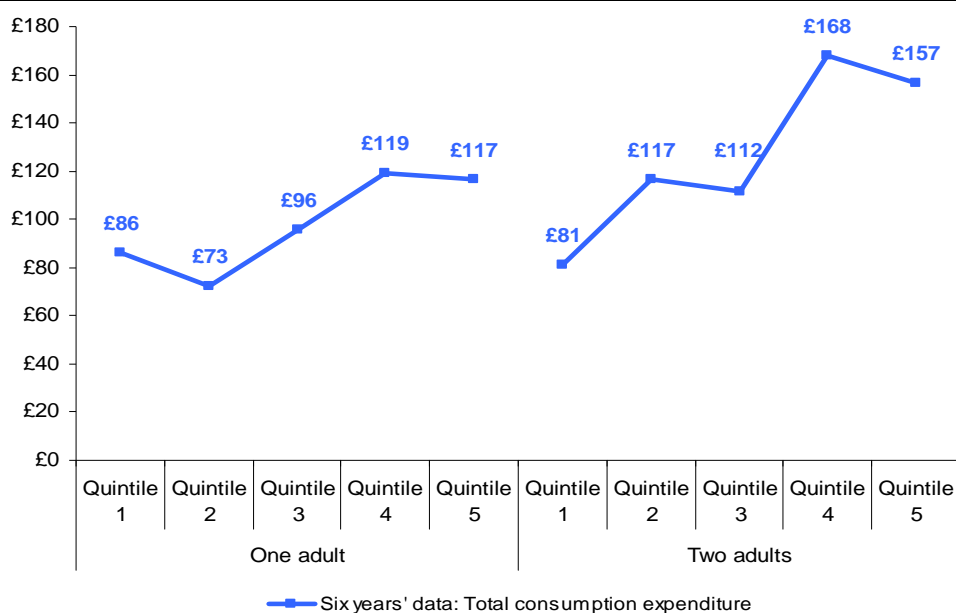
### 6.1.4 The additional cost of one extra school age child

This section provides an estimate of the additional weekly cost of one extra child of school age (5-15). The findings illustrate that the total cost of raising a child aged between 5 and 15 is approximately £79 per week (or £4,100 per annum) for those children brought up in single parent households in the

<sup>31</sup> A full description of the analysis is presented in Annex 1

bottom two income quintiles. As household income increases, the cost of child rearing increases to £6,206 per annum for a household in the fourth income quintile. The estimates of the cost of bringing up a child are marginally higher in two adult low-income households. Specifically, for those children in the bottom income quintile, the average cost associated with child rearing is £81 per week (or £4,209 per annum) rising to £168 per week for those dual adult households in the fourth income quintile (£8,745 per annum).

**Figure 8: Additional cost of a 5-15 year old child, by number of adults in family and income quintile**



Source: 2001/2-2006 Expenditure and Food Surveys, National Statistics and London Economics' calculations

### 6.1.5 Cumulative cost of several children

It is clear that the biggest economy of scale presents itself on moving from one child to two. It would appear that the benefits of economies of scale are greater for lone parents than for families with two adults. The results are shown in Figure 9 overleaf.

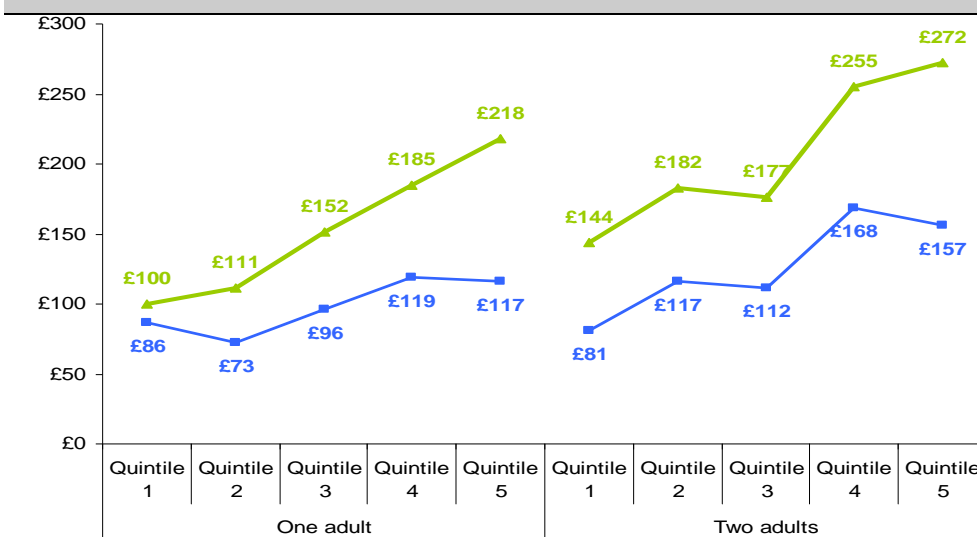
We consider the cumulative additional cost of several children, as well as the additional cost of a single child by age group. The purpose of this is to illustrate the role of economies of scale (for instance, shared travel arrangements, clothes or toys), which reduce the average cost per child.

For instance, the cost of bringing up a single child in a single parent household in the second income quintile was estimated to be £73 per week,

while the cumulative cost associated with bringing up 2 children (in a single parent household in the second income quintile) was estimated to be £111 per week (or 53% more). Although not presented in Figure 9, the cumulative cost associated with a third child was estimated to be £139.60 per week (or 25% more than having two children).

These estimates illustrate the significant economies of scale associated with having more than one child. For a two-parent household in the first income quintile, the weekly cost of bringing up a child was estimated to be £81 per week, compared to £144 per week for two children and £194 for three children. In terms of economies of scale, this implies that the marginal cost associated with the second child is 78% of the first child, while the marginal cost associated with the third child is 35%.

**Figure 9: Cumulative cost of and additional child by number of adults in family and income quintile**



Source: 2001/2-2006 Expenditure and Food Surveys, National Statistics and London Economics' calculations. Note, blue line represents weekly costs associated with raising one child, while green line represents weekly costs associated with raising two children

In Table 23 overleaf, we have presented information on the average increase in the cumulative weekly cost of raising more than one child – both for individual income quintiles and the number of adults in the household. It is interesting to note that the economies of scale are slightly greater for single adult households (i.e. the cumulative cost increase is less proportionately); however, the difference is not great. Overall, the average cost per child decreases by 20% on moving from 1 child to 2; 15% on moving from 2 children to 3 (or 32% compared to 1 child); and approximately 11% on moving from 3 children to 4 (or 40% compared to the average weekly cost of raising 1 child).

<b>Table 23: Economies of scale associated with raising more than one child by number of adults and income quintile (Dec 2008 prices)</b>				
<b>Number of adults</b>	<b>Income quintile</b>	<b>Marginal Cost 2<sup>nd</sup> child</b>	<b>Marginal Cost 3<sup>rd</sup> child</b>	<b>Marginal Cost 4<sup>th</sup> child</b>
<b>One adult</b>	<b>1 (low)</b>	15.8%	2.9%	0.3%
	<b>2</b>	53.5%	25.4%	17.0%
	<b>3</b>	58.2%	28.6%	19.4%
	<b>4</b>	55.2%	24.4%	15.4%
	<b>5 (high)</b>	87.3%	39.9%	25.8%
<b>Two adults</b>	<b>1 (low)</b>	77.5%	34.9%	21.7%
	<b>2</b>	56.6%	25.8%	16.6%
	<b>3</b>	58.4%	25.0%	14.9%
	<b>4</b>	51.7%	23.6%	15.3%
	<b>5 (high)</b>	73.7%	34.6%	22.4%
<b>Average one adult households</b>		54%	24%	16%
<b>Average two adult households</b>		64%	29%	18%
<b>Average all households</b>		59%	26%	17%
<b>Cost per child (£112.50 p.w. 1 child)</b>		£67.20	£50.30	£42.00
<b>Percentage reduction in average unit cost</b>		<b>20.1%</b>	<b>14.6%</b>	<b>11.3%</b>

Source: 2001/2-2006 Expenditure and Food Surveys, National Statistics and London Economics' calculations

### 6.1.6 What might this imply in relation to school meals?

In the previous section (Table 21), we provided an estimate of the opportunity costs associated with the preparation of a single school meal. Specifically, we illustrated that the cost of preparing a packed lunch was in the range of £1.60 to £1.83 per packed lunch compared to £1.66 per school meal in 2008.

Based on this information alone, it appears to be the case that there are minimal if any cost savings to parents from the purchase of school meals in school rather than the preparation of packed lunches at home. However, this might only be the case for those parents with just one child. We have illustrated the total cost that might be associated with the preparation of multiple packed lunches compared to the purchase of more than one school meal assuming that the economies of scale associated with rearing more than one child illustrated in the previous section apply to the preparation of packed lunches.

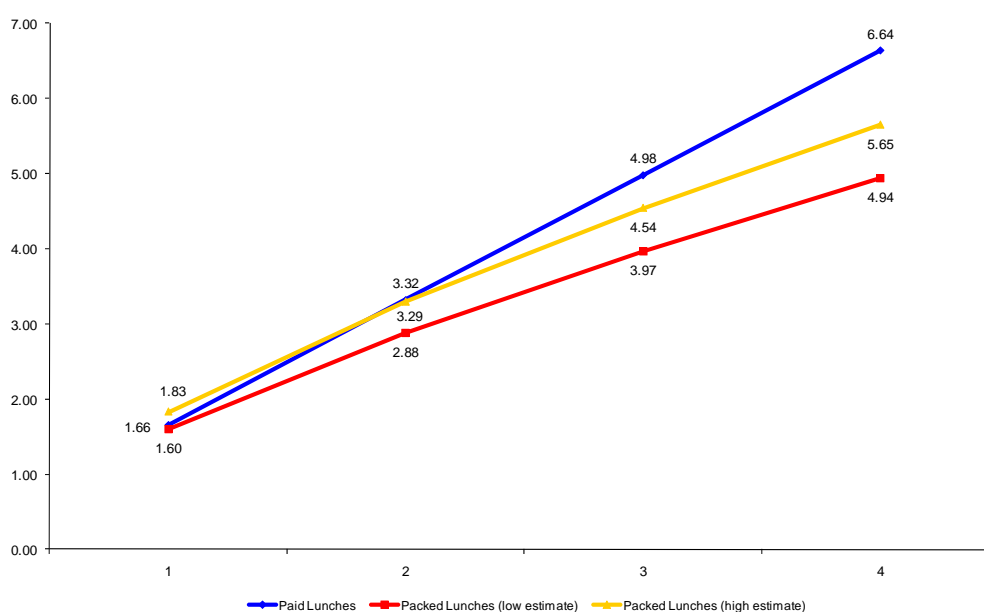
In Figure 10, we present the expected cost associated with taking up school meals at primary level compared to the preparation of a packed lunch. The

findings illustrate that the daily cost of taking up school meals increases linearly from £1.66 per day for parents with one child to £6.64 per day for parents with 4 children.

Although the cost of preparing a packed lunch for parents with one child is between £1.60 and £1.83 per day, as the number of children in the household increases; total cost increases but at a significantly slower rate. In particular, for a family with 2 children, the expected cost of preparing packed lunches is between £2.88 and £3.29 per day compared to £3.32 per day for school meals. The gap between the cost of school meals and a packed lunch increases as the number of children increases (which reflects the true opportunity cost associated with the purchase of school meals).

For families with 3 children, the daily cost associated with packed lunches stands at between £3.97 to £4.54 per day. This compares to £4.98 associated with the purchase of school meals. This gap of between £0.44 and £1.01 per day is equivalent to between £83 and £191 per annum for a three-child household.

**Figure 10: Cumulative daily cost of school meals versus packed lunches by number of children**



Source: 2001/2-2006 Expenditure and Food Surveys, National Statistics and London Economics' calculations

### What does this mean?

The analysis indicates that there are significant economies of scale associated with the provision of packed lunches relative to the purchase of meals in

schools. It is possible to estimate the reduction in the price of meals that would need to be applied to families with more than one child to ensure comparability between school meals and packed lunches as the number of children increases.

Specifically, compared to the upper estimate of the cost preparing a packed lunch, for a family with 2 children, the price of school meals would need to be reduced by approximately 1% per child (2p per pupil on average) to reflect the economies of scale associated with home preparation. Meanwhile for a family with 3 children, the price of school meals would need to be reduced by approximately 9% per child (15p per pupil on average) to reflect the economies of scale associated with home preparation. The equivalent discounts based on the lower estimate of producing a packed lunch stand at 22 pence and 34 pence respectively.

## 7 Conclusions

The analysis indicates that according to a number of alternative methodologies, the price elasticity of demand for school meals at primary level is inelastic and in the range -0.70 to -1.00. The implication is that following a price increase of school meals by 10%, we would expect to see a change in take-up amongst those paying for school meal in the region of 7% to 10%. These findings are supported by the academic literature, which indicates that the price elasticity of demand for meals away from home is approximately -0.7. In addition, the income elasticity of demand indicates that meals away from home are luxury items and that following a reduction in household income, there would be a greater than proportionate decline in demand for school meals (though this may be partially offset by changes in the eligibility for free school meals).

We have estimated that the cost of school meals (£1.66) is in the middle of the cost range of preparing packed lunches (£1.60-£1.83). In addition, over time the change in the cost of preparing packed lunches has closely mirrored the change in price of school meals (approximately 12.9%). The implication is that there is little economic advantage associated with the preparation of packed lunches.

However, we have also undertaken an assessment of the costs associated with bringing up children to establish the extent of the economies of scale associated with having more than one child. The findings indicate that there are significant economies of scale. Overall, the average cost per child decreases by 20% on moving from 1 child to 2; 15% on moving from 2 children to 3 (or 32% compared to 1 child); and approximately 11% on moving from 3 children to 4 (or 40% compared to the average weekly cost of raising 1 child).

This implies that compared to the upper estimate of the cost preparing a packed lunch, for a family with 2 children, the price of school meals would need to be reduced by approximately 1% per child (2 pence) to reflect the economies of scale associated with home preparation. Meanwhile for a family with 3 children, the price of school meals would need to be reduced by approximately 9% per child (15 pence) to reflect the economies of scale associated with home preparation.

## Annex 1 Income and Substitution Effects

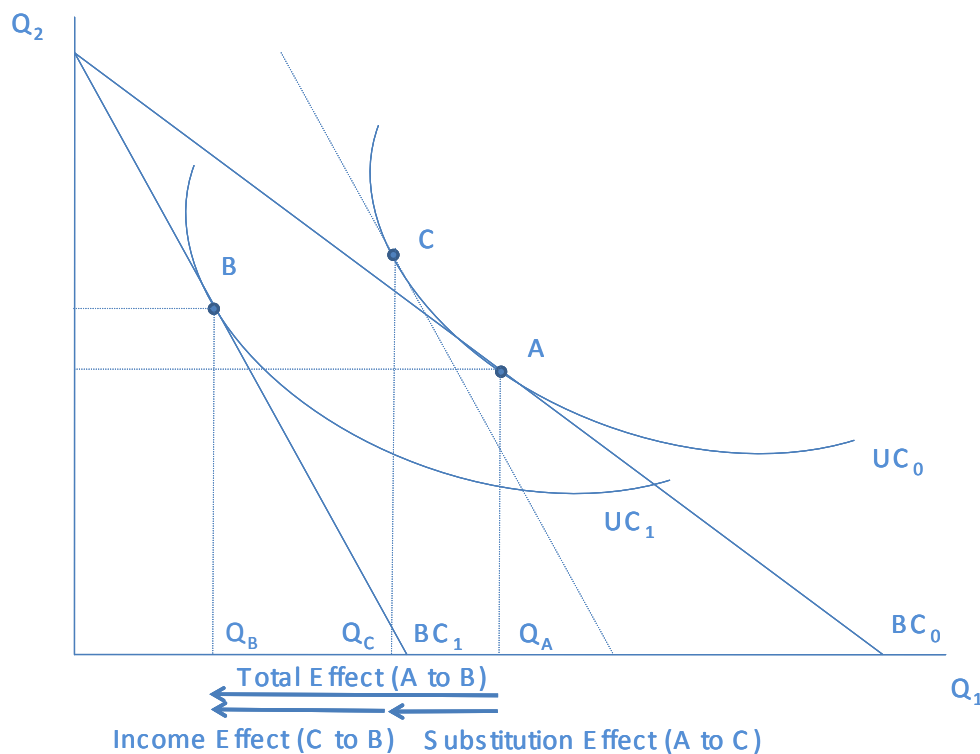
In Figure 11 overleaf, we have presented the basic economic analysis of changing consumer behaviour following a change in price for a good.

Specifically, rational individuals attempt to achieve the highest possible utility function (a measure of wellbeing) given the goods available (for instance  $Q_1$  might represent school meals and  $Q_2$  represents 'all other goods') and the budget constraints that they face. In this example, an individual might be able to achieve point **A** on utility curve  $UC_0$  given their initial budget constraint  $BC_0$ . Following a price increase in school meals, the budget constraint will pivot inwards (to  $BC_1$ ) reflecting the reduced ability to purchase combinations for school meals **and** all other goods (in this example). They will maximise their welfare at point **B**, which is associated with a lower level of utility ( $UC_1$  - closer to the origin). Therefore following an increase in the price associated with school meals, the individual should reduce the quantity of school meals demanded and increase the demand for 'all other goods' (point **B**). The movement from **A** to **B** following the price increase is known as the *total price effect*.

However, it is important to disaggregate this total price effect into the income and the substitution effect. Following the price rise for school meals, this good will appear to be worse value for money – even if their budget constraint were unchanged. Therefore, it is possible to simulate what might happen if consumers were compensated for the change in their income. This is done by shifting the new budget constraint ( $BC_1$ ) outwards until the original utility function is achievable ( $UC_1$ ). The optimal point occurs at point **C**. The movement from **A** to **C** illustrates the *pure price effect* or *substitution effect* – holding utility, income or purchasing power constant. The substitution effect is **always** negative (i.e. increasing the price of a good always makes that good less attractive than previously the case and will result in a reduction in the quantity demanded).

The second element involves the effect of increasing prices on an individual's budget (and reducing their purchasing power). The movement from point **C** to point **B** results in a reduction in the demand for both school meals **and** all other goods and the change in the demand for school meals (from  $Q_C$  to  $Q_B$ ) is known as the *income effect*. The income effect may be positive (working in the same direction as the substitution effect (normal goods) or negative (working in the opposite direction to the substitution effect (inferior goods)).

Figure 11: Income and Substitution effects



Therefore, in any analysis assessing the change in the quantity demanded following a change in price charged; it is crucial to understand both the total price effect, as well as the disaggregated income and substitution effects (if possible). The reason for this is that the appropriate classification of the good (as a normal good or an inferior good) is likely to have implications on the behaviour of individuals following changes in prices and subsequent policy decisions. Specifically, the change in the quantity demanded for that good following a price change will be greater for a normal good than an inferior good, holding other factors constant. Determining the nature of school meals will assist in understanding the likely change in consumer behaviour following changes in pricing.

## Annex 2 Determinants of food consumption

The first strand of the literature on the determinants of food consumption belongs to the wider area of economic development and investigates to what extent an improvement in a household's total income leads to an increase in food or calorie consumption.

One of the key papers on this topic is Subramanian and Deaton (1996) who estimate the elasticity of calorie consumption (nutrition) with respect to total expenditure using cross-sectional household survey data from rural India (National Sample Survey, 1983). Their analysis also takes into account the cost of calories, which is justified by the fact that consumers often move to higher quality food, i.e. from cheap to expensive calories.

The authors find that the demand for calories rises as income increases. The authors estimate an income elasticity of demand of about 0.45, with poorer households having a smaller income elasticity (0.40), while better-off households have a higher income elasticity (0.55). The authors also illustrate that the size of household matters, as when this variable is included in the analysis, the income elasticity of demand for calories falls to 0.40. In addition, when taking into account the price of calories, the authors estimate the expenditure elasticity of food (calorie quantity times calorie price) to be approximately 0.75, equally divided between the elasticity of calories and the elasticity of price per calorie. In other words, if household income increases by 10%, this implies that the total expenditure on calories increases by 7.5%, of which approximately 50% is associated with the purchase of additional calories and 50% is associated with the purchase of more expensive calories.

A subsequent paper, Deaton and Paxson (1998) focuses on the impact of household size on the demand for food. The authors follow earlier literature in looking at household size as at a measure of economies of scale for certain intra-household activities, e.g. housing. Economic theory uses this approximation to suggest that a larger household size (scale economies) would lead to lower costs of public goods (housing) within the household, which in turn would increase individual available income and would result in larger consumption of private goods, e.g. food.<sup>32</sup>

By looking at cross-sectional household survey data from the US (Consumer Expenditure Survey, 1990), Britain (Family Expenditure Survey, 1992), France (Family Budget Survey, 1989), Taiwan (Survey Of Personal Income Distribution, 1990), Thailand (Socioeconomic Survey, 1992), Pakistan (Living Standards Survey, 1991) and South Africa (Living Standards Survey, 1993),

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<sup>32</sup> This finding relies on the implicit assumption that the income effect arising from the fall in the cost of household public goods more than offsets the substitution effect, which is highly likely to hold for food products that are not easily substitutable.

the authors find evidence contradicting the theoretical argument presented above as they estimate that per capita demand for food decreases with household size and that this effect is stronger in developing countries. While the authors suggest some explanations to solve this puzzle they admit that more research is needed in this area.<sup>33</sup>

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<sup>33</sup> Benin (1999) suggests that there might be substantial monitoring and allocation costs associated with sharing food in larger families and that in this case the price effect will be similar to the own-price (substitution) effect and may more than offset the income effect. He uses data cross-sectional household survey data from Ghana (Living Standards Survey, 1991/92) to support his theory.

## Annex 3 The Expenditure and Food Survey

The Expenditure and Food Survey (EFS) is an annual survey commissioned by the Social Survey Division (SSD) of the Office for National Statistics (ONS) and by the Department for Environment, Food and Rural Affairs (DEFRA).

Information for the EFS is collected from people living in private households. The survey is made up of:

- a comprehensive household questionnaire which asks about regular household bills as well as expenditure on major, but infrequent, purchases;
- an individual questionnaire for each adult, which asks detailed questions about their income;
- a diary of all personal expenditure kept by each adult for two weeks, and of home grown and wild food brought into the home; and
- a simplified diary kept by children aged 7 to 15 years, also kept for two weeks.

Approximately 6,000 households respond each year, with the latest data being published about two years after the responses are collected. The survey is conducted on a calendar year basis, as of 2006 (which is also the most recent issue of data available). Prior to this, the survey was conducted on a financial year basis, with data available from 2001/02 to 2005/06.

Surveys are conducted with households throughout the year, so there should be no seasonal bias in the data when considering averages for the year. However, outliers may affect the results if the sample sizes are too small, as potentially could be the case when we look at particular household compositions.

The household is the main unit of interest to this analysis. The EFS records the composition of each household surveyed. Firstly, the composition records the number of adults and the number of children in each household, with details of their genders and of their ages (grouped into bands)<sup>34</sup>.

We excluded households from *wealthy* households and *pensioner* households from the analysis (essentially outliers in the analysis). With the remaining

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<sup>34</sup> Of particular interest to our analysis is one variable classifies households as either wealthy, index or pensioner households, which allows us to strip out those households with spending patterns that would be substantially different from those of working households with income constraints.

households, we compared expenditures of households with the same number and gender make-up of adults, with the additional marker of whether the women in the households are economically active or not. The cost of bringing up a child can be assessed by looking only at households with one child or no children. However, there are some practical difficulties associated with estimating the expenditure patterns of households with more than one child, since it is difficult to measure the effect of shared expenditures or separate expenditures (such as sharing travel costs if the children attend the same school, or separate if they do not). However, given this limitation of the data, we present information on the additional costs associated with caring for more than one child broken down by the type of family unit.

The headline comparison between households is in terms of total expenditure, however, the EFS also contains more refined information on the purpose of the expenditure. There are 12 broad categories of consumption expenditure, which comprise activities listed in Table 24. We do not consider non-consumption expenditure in assessing the cost of caring for a child.

<b>Table 24: Contents of expenditure categories in the EFS</b>	
<b>Expenditure category</b>	<b>Sub-categories</b>
<b>Food and non-alcoholic drinks</b>	Food [in detail]; non-alcoholic beverages (brought home)
<b>Alcoholic drinks and tobacco</b>	Alcoholic beverages (brought home); tobacco and narcotics
<b>Clothing and footwear</b>	Clothing; footwear [including separate entries for children's items]
<b>Housing, water, fuel and power</b>	Rental (but not mortgage) payments; maintenance and repair of dwelling; water supply and miscellaneous services relating to the dwelling; electricity, gas and other fuels
<b>Household goods and services</b>	Furniture and furnishings, carpets etc ; household textiles; household appliances; glassware, tableware and household utensils; tools and equipment for house and garden; goods and services for routine household maintenance
<b>Health</b>	Medical products, appliances and equipment; hospital services
<b>Transport</b>	Purchase of vehicle; operation of personal transport equipment; transport services
<b>Communication</b>	Postal services; telephone equipment; telephone services
<b>Recreation and culture</b>	Audio-visual, photographic and information processing equipment; other major durables for recreation and culture; other recreational items and equipment, gardens and pets; recreational and cultural services; newspapers, books and stationery; package holidays
<b>Education</b>	Education fees; payments for school trips, other ad-hoc expenditure
<b>Hotels, cafés and restaurants</b>	Catering services; accommodation services
<b>Miscellaneous goods and services</b>	Personal care; personal effects not elsewhere classified; social protection; insurance; other services not elsewhere classified

Source: EFS documentation (5986\_spec2006\_userguide.xls and 5986\_volume\_f\_derived\_variables.xls)

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11-15 Betterton Street  
London WC2H 9BP  
Tel: +44 20 7866 8185  
Fax: +44 20 7866 8186  
Email: [info@londecon.co.uk](mailto:info@londecon.co.uk)

London | Brussels | Dublin | Paris | Budapest | Valletta