Department for Education

Research Report DFE-RR227a

Evaluation of the Free School Meals Pilot

Impact Report Appendices

Sarah Kitchen, Emily Tanner, Vicky Brown, Colin Payne – NatCen
Claire Crawford, Lorraine Dearden, Ellen Greaves – IFS
Susan Purdon – Bryson Purdon Social Research

This research report was commissioned before the new UK Government took office on 11 May 2010. As a result the content may not reflect current Government policy and may make reference to the Department for Children, Schools and Families (DCSF) which has now been replaced by the Department for Education (DfE).

The views expressed in this report are the authors' and do not necessarily reflect those of the Department for Education.

Appendix A Sampling and fieldwork

This appendix details the sampling and fieldwork methods used in the evaluation of the Free School Meal pilot. The design of the study is summarised in the introduction to this report.

A.1 Sampling

The starting point for sampling for the longitudinal survey was the identification of the three pilot areas, which occurred in April 2009. The sample for the study was prepared by IFS with input from NatCen and Susan Purdon, using Pupil Level Annual Schools Census (PLASC) data.

Selection of pilot area schools

An initial sample was compiled of all maintained schools in the pilot areas excluding special schools and pupil referral units.

Based on assumptions about co-operation with schools and parents it was estimated that 16 primary schools in each of Newham and Durham and 17 secondary schools in Wolverhampton would need to be issued in order to deliver the target number of 10 co-operating schools per pilot area. However, as there were only 18 available schools in Wolverhampton, it was decided to use all of these rather than to randomly exclude one.

It was agreed that the research would be restricted to schools where pupils could be expected to be in the same setting at both the baseline survey and the follow-up survey. This led to the exclusion of a small number of infant and junior schools, as follows:

- 6 schools in Newham (from a total of 64, i.e. around 9%);
- 29 schools in Durham (from a total of 208, i.e. around 14%).

For primary schools in Newham and Durham, it was decided to stratify the sample along three dimensions:

- Proportion of students eligible for Free School Meals;
- School size;
- Average point score for students sitting Key Stage 2 exams in the previous year.

Schools which did not have this information were dropped, as follows:

- 1 school in Newham (from a total of 64, i.e. around two per cent);
- 29 schools in Durham (from a total of 208, i.e. around 14%);

For each category, schools were classified as either above or below the median (calculated separately for each pilot area). Combining these categories generated eight unique groups, from which two schools were randomly selected (to give a total of 16 schools in each pilot area).

The random selection procedure was adjusted to ensure that selected schools were roughly representative according to the type of school, as follows:

1. If two non-community schools were chosen in a particular group, one was replaced with a community school (chosen randomly);
2. If two community schools were chosen and the proportion of non-community schools in the group exceeded 35%, one non-community school was randomly selected to replace one of the community schools in that group.

Following this process, the proportions of community schools in each of our primary school pilot area samples closely matched the proportions in the areas overall:

- 81% of the Newham sample were community schools compared to 84% overall;
- 69% of the Durham sample were community schools compared to 69% overall;

Selection of comparison areas and schools

At the outset, all LAs in England were considered as potential comparison areas for the study. Based on assumptions about co-operation with schools and parents it was estimated that the number of issued schools that would be required to deliver the target number of 10 co-operating schools per comparison group would be 40 primary schools (20 each to match pilots A and B) and 22 secondary schools.

The following restrictions were imposed on the LAs and schools that could be used as potential comparison areas:

1. LAs that had applied to operate one of the FSM pilots were excluded, on the grounds that these areas might go ahead and run their own schemes (as the bid required them to set aside funding for this purpose). This eliminated: Barnsley, Barking & Dagenham, Bristol, Cornwall, Croydon, Dudley, Gateshead, Halton, Sandwell and Waltham Forest.
2. Other LAs and schools were excluded on the advice of the School Food Trust due to the existence of special activities that would render them unsuitable for use as comparators, for example, Islington, Bishop Challoner School in Tower Hamlets[1].
3. Other LAs were excluded because they contained too few schools (City of London and Isles of Scilly).

For the remaining areas and schools, kernel-based propensity score matching was used (imposing common support and a bandwidth of 0.01) to choose schools in comparison areas that best matched our issued sample of schools in pilot areas. The matching process was carried out separately for each pilot area,[2] and used the following characteristics: school type (community vs. non-community); whether school is gender mixed; school size; number of full-time equivalent teachers; proportion of students eligible for FSM; proportion of students eligible for FSM who take-up school meals; proportion of

[1] Because we were selecting our samples alongside information being provided to us by the SFT, we eliminated some LAs and schools here, and some once we had chosen our top five authorities (see below for more details).

[2] Results are available on request.

students with special educational needs; proportion of White British students; average point score (at Key Stage 2 for primary schools and Key Stage 4 for secondary schools) in previous four years; school contextualised value-added score.

Figure A.1 Selection of comparison areas

Pilot areas	10 areas with best matches	The 5 comparison areas finally selected	Notes on initially selected areas that were rejected
Newham (Pilot A)	Birmingham Bradford Enfield Haringey Leicester City Manchester Redbridge Southwark Tower Hamlets Wandsworth	Enfield Haringey Manchester Redbridge Wandsworth	Leicester was originally selected but SFT advised that it was not suitable. Southwark and Bradford were then considered but rejected because of the difficulties of finding sufficient numbers of interview staff (given the number of central London areas already selected) and on the advice of the SFT respectively. Leicester was then replaced with Enfield.
Durham (Pilot B)	Coventry Devon Hackney Kent Lincolnshire Norfolk Plymouth Sefton South Tyneside Wirral	Kent Norfolk Sefton South Tyneside Wirral	Hackney was originally selected but rejected because of the difficulties of finding sufficient numbers of interview staff (given the number of central London areas already selected). Plymouth, the next best match, was rejected on the advice of the SFT. Hackney was then replaced with South Tyneside.
Wolverhampton (Pilot C)	Birmingham Bradford Hillingdon Kent Kirklees Lincolnshire Northamptonshire Nottinghamshire Tower Hamlets Warwickshire	Kirklees Lincolnshire Northamptonshire Nottinghamshire Tower Hamlets	Warwickshire was originally selected but it was not possible to check with SFT whether it was a suitable comparison area within the time available. We therefore replaced it with the next best match, Lincolnshire.

For each potential comparison LA, the average weight was calculated across the six[3] schools that provided the best matches for the issued sample of pilot schools. This led to the selection of 10 LAs which had the highest average weights as potential comparisons for each pilot area (see Figure B.a).

[3] We chose six schools rather than four to give us a couple of spare schools in each LA should the response rate be lower than expected.

The kernel-based matching procedure was then re-run, restricting the potential comparison sample to the top six schools in each of these LAs. (For this common support was not imposed and a bandwidth of 0.15 was used instead of 0.01.)

Imposing these restrictions lead to three pilot schools in Newham not being appropriately matched to schools in our potential comparison areas. (All schools in Durham and Wolverhampton were appropriately matched.) Each of these primary schools was replaced with another school of the same type (community or non-community) in their stratification group (i.e. with similar characteristics in terms of size, the proportion of students eligible for FSM and previous Key Stage results).

The matching procedure (as specified above) was then re-run with the new pilot school selection and the average weight across the top four schools in each LA calculated. The final sample selection used the top four schools within the five LAs with the highest average weights. The LAs finally selected are shown in Figure A.1. In three cases, areas that were selected on these criteria were rejected as unsuitable. The reasons for this are detailed in the final column of Figure A.1.

Selection of pupils in pilot areas

The target starting sample sizes (before parental opt-out) were:

- 30 pupils per year per school in Newham and Durham;
- 37 pupils per year per school in Wolverhampton.

Individuals with missing IMD, IDACI, LEASIS or ACORN data and those in the wrong academic year (on the basis of their month of birth) were excluded (about 2% of the sample). Also excluded were those pupils who were born from March onwards in the Reception year in Newham and its associated comparison areas (just over 1,000 individuals in total).[4]

The evaluation was particularly concerned with the effect of the FSM pilots on the poorest students, especially those who become entitled to FSM through the switch from the old to the new eligibility criteria. To be able to target our sample as accurately as possible, a good measure of household income was required. The only available measure that gave any indication of household income was whether the child was eligible for Free School Meals in the Autumn 2009 census. This information was supplemented by postcode-level indicators of household type (based on ACORN data) and an SOA-level measure of children living in poverty (IDACI score). Principal components analysis was used to generate a continuous measure of socio-economic status (SES).[5]

[4] This was necessary because Newham adopts an admissions policy under which children born between 1st March and 31st August do not start school until January of the year in which they turn five. As we were only able to access the Autumn 2009 census (which is taken in September), children born between March and August were not included in our pilot sample. Due to well-documented differences by month of birth in terms of test scores and other outcomes, we decided to focus the comparison sample on children born between September and March (the oldest in their academic year) as well.

[5] We used the Longitudinal Study of Young People in England to devise our measure of socio-economic status. We did this by checking how different combinations of variables (including FSM eligibility, IMD score,

For each pilot area, the sample was split into quartiles on the basis of this SES measure. The same cut-offs were then used to classify the respective comparison samples.

After consultation within the consortium and with DCSF, the following sample weights for pilot areas were chosen:

- Bottom SES quartile: 7/15
- 3rd SES quartile: 5/15
- 2nd SES quartile: 2/15
- Top SES quartile: 1/15

In this way, the bottom two SES quartiles were over-sampled relative to the top two quartiles such that they provided 12/15 instead of half of the survey sample.

Another modification to the sampling method was to make the probability of choosing a particular pupil related to the size of their school year, so that more pupils could be selected from the larger school years.

Within these constraints, pupils were selected randomly within categories. The numbers selected are shown in Figure A.2.

Figure A.2 Sample of pupils for pilot areas

Pilot areas	Number of available pupils	Number of pupils selected	Number selected as proportion of those available
Newham	4,084	2,354	59%
Durham	1,992	1,961	100%
Wolverhampton	7,722	2,132	28%

Selection of pupils in comparison areas

Pupils in comparison areas were selected using nearest neighbour propensity score matching (without replacement).

Pupils were matched on a range of individual and school controls:

- **Individual**: SES, gender, ethnicity[6], whether the pupil has statemented or non-statemented special educational needs and month of birth.
- **School**: as per school selection above, plus the size of each school year relative to others in the pilot and other comparison areas.[7]

IDACI score and various measures of household type from ACORN data) performed against an actual measure of household income. We found that combining FSM, IDACI and ACORN type provided the most accurate targeting of individuals with income below £16,040. Results are available on request.

[6] For reception pupils, plus those in Durham and Wolverhampton and their associated comparison areas, we are only able to use a White British indicator. For non-reception pupils in Newham and its associated comparison areas, we use a more detailed measure of ethnic group (with 12 categories).

For secondary schools in Wolverhampton and its associated comparison areas, pupils were matched within SES strata. (This was not possible for primary schools in Newham and Durham, due to the much smaller sample sizes.)

It should be noted that no restrictions were placed on the number of pupils who could be interviewed per school (or school year), so samples were not necessarily equally distributed across schools or school years.

Recruitment of schools

Once the selection process was complete, NatCen contacted the selected schools to ask them to co-operate with the research. Letters were sent to the chief executive of the local authority, the headteacher and the chair of the school governors on 5 May 2009. The study name was given as 'Study of Children's meals in school and at home' and the letters explained that the purpose of the study was to examine take-up of school meals and the relationship between school meals and children's outcomes including diet, health, behaviours, concentration and attainment. The letter stated that the school's help was sought with classifying whether pupils took school meals and assisting with a telephone survey with a catering manager to obtain more information about the provision of meals and dining facilities at the school. It was explained that some parents of pupils would be contacted directly for a survey interview in their homes.

In order to seek parent agreement for providing this information, schools were asked to send an opt-out letter to the parents and guardians and allow two weeks for parents or guardians to opt out on their child's behalf if they wished to do so. NatCen drafted the opt-out letter and provided each school with copies for mailing. At the end of the two week opt-out period it identified from the school which parents had not opted out and collected the school's classification of their take-up of school meals.

Each school was asked to classify a list of their pupils that had been selected from the NPD according to whether or not they took any school meals. Schools were asked to use the last week as a reference point so that if a pupil has taken at least one school lunch during the last week that counted as 'takes school meals' and if they haven't taken school lunch at all during past week that counted as 'doesn't take school meals'. It was explained that the classification should refer to meals eaten at lunch time only, not snacks at break time. The calls to the schools were made by a clerical team based at NatCen's Brentwood offices.

The timetable for contacts with schools was constrained by the need to administer an opt-out mailing and identify pupils in time for fieldwork to be completed in the Summer term. The contacting process began on 6 May 2009 and schools were recruited in the following two weeks. Of 120 schools issued, 79 were recruited to help with the research (66%). Of

[7] For reception pupils, we are only able to use school size, school type (community vs. non-community), proportion of pupils eligible for FSM, proportion of pupils eligible for FSM who take-up school meals, average point score, contextualised value-added and size of school year.

these schools, 74 went on to administer the opt-out mailing and return information to classify take up of school meals by the final cut off date of 17 June (this exceeded the target of 65 schools). Full details of school co-operation rates are shown in Figure A.3.

Figure A.3 Co-operation rates with schools by sample category

Sample group	Initial recruitment				Sample compilation		
	Issued	Not recruited	Recruited	Recruitment rate	Recruited but not projected to return take up data	Recruited and projected to return take up data	Sample compilation rate
Pilot A	16	2	14	88%	1	13	93%
Pilot B	16	1	15	94%	0	15	100%
Pilot C	18	6	12	67%	2	10	83%
Control A	25	12	13	52%	1	12	92%
Control B	27	11	16	59%	1	15	94%
Control C	18	9	9	50%	0	9	100%
Total	120	41	79	66%	5	74	94%

Classification of the school sample of pupils

It was possible to classify take-up of school meals for 93% of pupils who had been sampled for co-operating schools (Figure A.4). Just 2% of records were lost due to opt-outs while 4% were recorded as having left the school.

Figure A.4 Return of take-up data for pupils in co-operating schools

	Sampled		Missing / unclear	Left school	Opt out	Returned	
	N	%				N	%
Pilot A	1973	100%	1%	5%	4%	1783	90%
Pilot B	1905	100%	0%	4%	1%	1808	95%
Pilot C	1176	100%	1%	2%	3%	1113	95%
Control A	789	100%	0%	6%	2%	728	92%
Control B	1115	100%	0%	2%	1%	1078	97%
Control C	1096	100%	0%	4%	4%	1008	92%
Total	8054	100%	0%	4%	2%	7518	93%

Among pupils for whom details were returned, 38% of those in primary schools and 29% of those in secondary schools were classified as non-takers of school meals (Figure A.5).

It is to be remembered that our samples were skewed towards pupils in deprived areas, many of whom would already qualify for free school meals, and this is likely to explain why take-up rates are higher than reported take-up rates for pupils as a whole (for example in the SFT's research).

Figure A.5 Classification of pupils in co-operating schools as takers and non-takers of school meals

	School meal take-up	
	Takers	Non-takers
Pilot A	70%	30%
Pilot B	57%	43%
Pilot C	70%	30%
Control A	60%	40%
Control B	57%	43%
Control C	72%	28%
- primary schools	62%	38%
-secondary schools	71%	29%
Total	64%	36%

Pupils who were classified as non-takers of school meals constituted the school sample that was prepared for the survey. Checks were made for duplicates, whereby there were two or more pupils in the same household. In these cases, one child was selected randomly and this resulted in 8% of the sample being removed. A final school sample of 2,420 pupils was issued.

Additional sample of pupils

The school-based identification of pupils who were not taking school meals yielded too few cases for the study's sample targets to be achieved. It was therefore necessary to consider alternative ways of increasing the sample of pupils covered by the research, so that the study's research objectives could be achieved. It was decided to issue parents and pupils from schools that were not able to co-operate with the sample compilation process. As we would not know whether these pupils took school meals, this would involve contacting the parents and checking whether their child took school meals. This implied that a higher number of parents than originally planned would need to be contacted to achieve sample targets of parents of pupils who were not taking school meals.

Two other options for boosting the sample (selecting additional schools and selecting additional pupils from recruited schools) were rejected because there would be insufficient time to do this, administer an opt-out mailing and complete the survey fieldwork within the timetable.

As with the school sample, checks were made for duplicates and one child was randomly selected for each household with multiple selected children. An additional sample of 4,141 cases was issued, making a total issued sample of 6,561.

B.2 Ethical review

The design of the longitudinal survey and administrative data collection was reviewed by NatCen's internal Research Ethics Committee in April 2009. The design was approved, subject to three minor points:

- Given potential literacy problems, researchers should be briefed on what to tell children and parents about the survey (this was covered in the fieldwork briefings).
- Helpline leaflets should be given to children and researchers should be briefed on how to deal with children exhibiting body image issues or with eating disorders (this was done).
- The opt-out letter sent out by the school asking permission to pass on details about school meal status should refer to selection for a survey (some text was added to explain that if the child was selected for the survey a separate letter would be sent).

B.3 Development of the parent and pupil interview

The questionnaire was developed in April and May 2009 by NatCen with input from DCSF, DoH, IFS and the SFT.

The questionnaire was designed to be mostly completed by a parent or guardian who had the main responsibility for shopping and cooking for the selected child (interviewers were instructed to use this phrase to help them to identify the appropriate person).

Screening questions were included in the sample sheet (the address record form) so that interviewers could make the following checks:

- That child did not take school meals in the current term (parents were screened out if school meals were taken at least three times in the most recent week)
- In Pilot C and its control areas: that income did not exceed levels for eligibility (parents were screened out if their income was clearly above the extended eligibility level).

Questions about eating habits and diet were asked of a combination of parents and pupils, depending on the pupil's age, as follows:

- Aged under 11 (at primary school): questions asked to the parent / guardian
- Aged 11 or over (at secondary school): questions asked to child.

In developing questions about eating habits and diets, it was decided to focus on the consumption of food types and food behaviours for which the pilots might be expected to have an impact, for example consumption of fruit and vegetables and buying snacks on the way home from school. It was agreed that it would not be feasible to capture children's total dietary intakes or detailed nutrient intakes. Questions about food types were

developed with reference to other surveys, including the Scottish Sugar Study and the National Diet and Nutrition Survey (NDNS).

Questions about household composition and demographics were taken from the NDNS. The Income question was taken from the NDNS but the scale was adjusted so that the eligibility limit for FSM could be identified.

The protocols for height and weight measurements were consistent with NDNS and the Health Survey for England, both of which are also conducted by NatCen, and the same equipment was also used.

An expert panel was held on 19 May 2009 to review the full questionnaire. This was attended by: Michele Weatherburn (DCSF), Michael Nelson (SFT), Jo Nicholas (SFT), Mark Bush (Food Standards Agency), Bev Bates and Caireen Roberts (NatCen's NDNS team) and Sarah Kitchen and Ola Turczuk of the research team. The following changes were the main ones agreed at the panel:

- Plans to use a standard strengths and difficulties questionnaire (SDQ) were dropped since this was judged not to be suitable for measuring perceptions of behaviour that would be relevant to the FSM pilots.
- Use of food frequency questions was prioritised to a small number of key categories, such as fruit, vegetables, crisps and cakes. It was decided to collect the number of times each of these food types was consumed each day.
- Draft questions on 'usual' eating habits were modified to be asked specifically about school days within the last seven days.
- Draft questions about consumption of food at morning and afternoon breaks were modified to encompass any consumption during the morning or afternoon, not just at break times.
- Questions about who provided food consumed during the day were added (whether provided from home, provided by the school or bought from school, or bought outside school
- Draft questions about lunchtime consumption were modified to include information about where the food was eaten (in school, at home, at a friend or relative's home or somewhere else).
- Additional questions about consumption of drinks were added.

The questionnaire was largely unchanged for the follow-up survey in summer term 2011. Repeating the same questions at both surveys was essential in order to measure changes over time. The only changes made were:
-the question asking about awareness of the pilot was reworded to reflect that the pilots were underway
-the question which asked parents how often they expected their child to take school meals during the pilot was reworded to ask how the pilot had affected the frequency of their child taking school meals.

A.4 Fieldwork and response

Baseline survey

The parent and child survey fieldwork was carried out between 17 June and 26 July 2009. All fieldwork was carried out by trained NatCen interviewers who received a face to face briefing from members of the research team.

Details of response to the baseline parent and pupil survey are shown in Figures A.6 to A.9. On each table, response figures are presented separately for the school sample and the additional sample, as well as for the total sample.

Figure A.6 shows the *screening response rate*, that is the proportion of issued cases for which a screening interview was completed. This proportion was 83% overall (85% for the schools sample and 82% for the additional sample).

In total, 8% of the issued sample were found to have moved, indicating that the NPD did not have up to date contact details for these pupils. In 7% of cases the screening was not carried out because there was no contact with the household. Explicit refusals to give screening information were very low (1%).

Figure A.6 Screening response

Outcome	Schools sample		Additional sample		Total sample	
	n	%	n	%	n	%
Issued	*2420*	*100%*	*4141*	*100%*	*6561*	*100%*
Not screened - moved	179	7%	347	8%	526	8%
Not screened - no contact	123	5%	294	7%	417	6%
Not screened - refusal to office	49	2%	37	1%	86	1%
Not screened - contact made but info refused	14	1%	41	1%	55	1%
Not screened - contact made but info not obtained	7	0%	11	0%	18	0%
Total not screened	372	15%	730	18%	1102	17%
	2048	**85%**	**3411**	**82%**	**5459**	**83%**

Screening response rate (*a*)	

Figure A.7 shows the eligibility rate, that is the proportion of screened cases where the pupil was found to be eligible due to taking school meals (for any of the pilots) or on income grounds (for secondary school pupils only). As expected, the rate of eligibility was much higher for the schools sample, where schools had advised us that the pupil was eligible, than for the additional sample where eligibility had to be checked for the first time on the doorstep (83% compared with 39%).

Figure A.7 Eligibility rate

Outcome	Schools sample		Additional sample		Total sample	
	n	%	n	%	n	%
Total screened	*2048*	*100%*	*3411*	*100%*	*5459*	*100%*
Ineligible – not attended school in 2 weeks	14	1%	52	2%	66	1%
Ineligible – 3 + school meals in week	204	10%	1738	51%	1942	36%
Ineligible at income screening	132	6%	282	8%	414	8%
Other ineligible	5	0%	10	0%	15	0%
Total ineligible	355	17%	2082	61%	2437	45%
Total eligible	**1693**	**83%**	**1329**	**39%**	**3022**	**55%**

Ten per cent of pupils in the school sample (where schools had indicated that the pupil did not take school meals) were found to have taken school meals on three or more days in the past seven days. This discrepancy is likely to have been due to variations in behaviour across the term (i.e. pupils may not have had school meals in the reference week used by the school but had done so in the week prior to the interviewer calling). In the additional sample, where school meal status had not been provided by schools, just over half of pupils (51%) were found to have taken school meals on three or more days. The much larger ineligibility rate in the additional sample shows how the original method of identifying school meal status via schools made the fieldwork process much more efficient than under the alternative method.

Figure A.8 shows the interview response rate, that is the proportion of screened and eligible cases where an interview was taken. This was 84% for the schools sample and 71% for the additional sample, a rate of 79% overall.

We think that the main reason for the lower response rate for the additional sample was that these parents had not been contacted by the schools through an opt-out mailing to cover provision of take-up data to the evaluation. These parents had therefore not had the study explained to them earlier and had not been given an earlier opportunity to withdraw. Moreover, they had not had the reassurance of hearing about the study via their child's school. These factors help explain the higher refusal rate for the additional sample. A second factor will have been the shorter fieldwork period for the additional sample, which helps explain the higher rate of other unproductive cases in the additional sample.

Figure A.8 also shows the overall response rate for the study, which is obtained by multiplying the screening response rate with the interview response rate. The overall response rate was 71% for the schools sample and 59% for the additional sample (65% overall).

Figure A.8 Response from eligible sample

Outcome	Schools sample		Additional sample		Total sample	
	n	%	n	%	n	%
Total eligible	*1693*	*100%*	*1329*	*100%*	*3022*	*100%*
Refusal (eligible respondent)	206	12%	250	19%	456	15%
No contact with eligible respondent	16	1%	19	1%	35	1%
Other unproductive	46	3%	110	8%	156	5%
Interview response rate (*b*)	**1425**	**84%**	**950**	**71%**	**2375**	**79%**
Overall response rate (= a x b; i.e. screening response rate x interview response rate)		***71%***		***59%***		***65%***

Height and weight measurements were both carried out with 96% of sampled children whose families were interviewed, a very good rate of participation.

Response by area

Overall response rates were higher in Durham (81%) than in Newham (63%) or Wolverhampton (57%). A similar patter was observed for the comparison areas where the response rates for Pilot B areas (70%) were higher than those for Pilot A (62%) or Pilot C areas (55%). We think that there are two factors evident here. Firstly, the lower response rates in Newham, Wolverhampton and their comparison area reflected higher incidence of movers and addresses where no contact was made than for the other, relatively rural areas. Secondly, response rates among families of secondary school pupils, in Wolverhampton and its comparisons areas, were lower than among families of primary school pupils.

The rate of eligibility for interview was much lower in Wolverhampton and Pilot C comparison areas (36% in both) than in other areas, due to the additional requirement to screen for income as well as the taking of school meals.

Figure A.9 Fieldwork outcomes by pilot and control areas

	Total	Newham (Pilot A)	Durham (Pilot B)	Wolver-hampton (Pilot C)	Compari-son areas for A #	Compari-son areas for B #	Compari-son areas for C #
Issued	6561	879	695	1233	1442	1008	1304
Screened	5459	698	625	1015	1155	856	1110
% of issued	*83%*	*79%*	*90%*	*82%*	*80%*	*85%*	*85%*
Eligible	3022	469	555	366	654	582	396
% of screened	*55%*	*67%*	*89%*	*36%*	*57%*	*68%*	*36%*
Productive interview	2375	370	501	255	510	482	257
% of eligible	*79%*	*79%*	*90%*	*70%*	*78%*	*83%*	*65%*
Overall response rate	***65%***	***63%***	***81%***	***57%***	***62%***	***70%***	***55%***

Comparison areas were:

A Redbridge, Manchester, Haringey, Wandsworth, Enfield

B Norfolk, Wirral, Sefton, Kent, South Tyneside

C Nottinghamshire, Kirklees, Tower Hamlets, Northamptonshire, Lincolnshire

Follow-up survey fieldwork and response

Fieldwork for the follow-up survey took place between May and July 2011. This was during the final term of the two-year pilot. Of the 2,375 parents interviewed in the baseline survey, 44 said that they did not wish to be contacted for a further interview. Therefore, the total issued sample for the follow-up survey was 2,331.

Figure A.10 shows the summary of outcomes for the follow-up fieldwork. An overall response rate of 79% was achieved which translates to 77% of the total sample interviewed at baseline.

Figure A.10 Response rate for follow-up survey

Final Outcome	N	%
Fully productive	1831	79
Partially productive	2	0
No contact/new address not known or outside area	209	9
Refusal	220	9
Unavailable / unwell / in hospital	25	1
Ineligible / child attends school outside LA	44	2
Issued sample	2331	100

Figure A.11 shows the response rate across the six sample types. Response was somewhat higher in the Pilot A and B areas (primary) than in the Comparison A and B areas. However, response was higher in Comparison C than in Pilot C (secondary).

Figure A.11 Response rates for follow-up survey by sample type

Sample type	Response rates
	%
Pilot A (Newham)	85
Pilot B (Durham)	87
Pilot C (Wolverhampton)	66
Comparison A	75
Comparison B	79
Comparison C	73
All areas	79

Tracking take-up of school meals

The take-up of school meals among the pupils originally sampled for the longitudinal survey was tracked in the summer term of each year of the evaluation (before the pilot began, at the end of the first year and at the end of the second year). A description of the collection of take-up data at the baseline survey is given in section 1.2.5.

At the two follow-up points, schools were given the same list of sampled pupils for whom information had been supplied at the baseline and were asked to indicate whether these pupils had taken school meals at least once in the most recent school week. Figure A.12 shows the numbers of schools responding to the data request at each point.

Figure A.12 Response rates for follow-up survey by sample type

Sample type	Baseline	Year 1	Year 2
			n
Pilot A (Newham)	13	11	12
Pilot B (Durham)	15	15	15
Pilot C (Wolverhampton)	10	8	8
Comparison A	12	10	5
Comparison B	15	11	10
Comparison C	9	8	5
All areas	74	63	55

The analysis of pupil take-up was based on pupils for whom information was available at all three points of collection.

Appendix B The matching process

B.1 The evaluation problem

When evaluating a particular programme or intervention, one would ideally like to compare the outcomes of individuals[8] who experienced the programme (or received the "treatment") with the outcomes of the same individuals had they not received the treatment (the counterfactual outcome). This is of course impossible; an individual either receives the treatment or does not, so one cannot observe outcomes for the same group of individuals under both scenarios. The absence of an answer to the question "What outcomes would treated individuals have experienced in the absence of the Pilot?" is known as the evaluation problem.

The way to address this problem is to construct an appropriate comparison group. Ideally this group should be identical to the treatment group in all respects – in terms of characteristics that are both observed and unobserved to the researcher – except that one group received the treatment and the other did not. Perhaps the best way of doing this is for the treatment to be randomly assigned. In the absence of such an experiment, however, a wide range of techniques have been developed to enable researchers to construct an appropriate comparison group and hence a suitable counterfactual outcome in order to be able to identify the impact of the treatment on the outcomes of interest.

Propensity score matching is a technique that is often used to solve the evaluation problem and is the approach adopted in this evaluation. The assumptions underlying this process are described in more detail in the next section.

B.2 Propensity score matching

Propensity score matching relies on constructing a suitable comparison group on the basis of a wide range of characteristics that are observable to the researcher (i.e. available in the data at their disposal). The key assumptions underlying this approach are as follows: first, it must be assumed that, conditional on all observable characteristics included in the model, the outcomes for the treatment and comparison group would be identical in the absence of the pilot; this is known as the conditional independence assumption (CIA). Second, there must be some degree of common support between the characteristics of pupils in the treatment and comparison areas, i.e. there must be some individuals in the comparison group who "look" like the individuals in the treatment group; otherwise it will be impossible to find a suitable match for these individuals.

For the CIA to hold, the researcher must be able to observe all of the characteristics that are relevant both for determining whether the individual is in the treatment or comparison

[8] The treatment unit could equally be schools, areas, etc.

group and for determining the outcomes of interest. This means that the availability and selection of characteristics on which to match is crucial to the likelihood of the CIA holding. This is particularly relevant to some of the analysis in this evaluation, for which only administrative data is available. This necessarily limits the number of characteristics that can be included in the model and may mean that the CIA is less likely to hold than in the analysis which is able to take advantage of bespoke survey data as well. This issue is discussed in more detail below.

The larger the number of characteristics that must be included in the model, the harder it becomes to find a perfect match for each individual. One way to get around this problem is to estimate a propensity score, which is a simple way of summarising an individual's characteristics. This means that, rather than finding an exact match for each individual in the treatment group in terms of all of their observable characteristics, similar individuals can be found in terms of this summary propensity score.

The propensity score is simply the predicted probability from a discrete choice model (either probit or logit) where the dependent variable is a binary variable equal to one if the individual is in the treatment group and zero if the pupil is in the comparison group. All characteristics that are thought to predict either the likelihood of treatment or the outcomes of interest should included in the model.

Once the propensity score has been estimated, individuals in the comparison group are weighted according to how closely matched they are to each individual in the treatment group. There are a number of different approaches to undertaking this weighting process, for example, giving weight only to those individuals in the comparison group that are closest in absolute terms to a particular individual in the treatment group (nearest neighbour matching), allocating a fixed weight to all individuals within a certain absolute distance (radius matching), or allocating weight depending on how close they are to each individual in the treatment group (weighted smoothed matching).

It is worth noting that matching comes at the cost of a reduction in statistical power, which may be particularly problematic when dealing with the relatively small numbers of observations available in the longitudinal survey. Propensity score matching can lead to a reduction in effective sample size and the loss can be quite large when the groups to be matched are very different. There is always a trade-off between statistical power and the potential reduction in bias arising from matching, both of which contribute to the ability to detect a significant impact.

Propensity score matching for the FSM evaluation

In this evaluation, the treatment group comprises pupils in the relevant pilot area and the comparison group comprises individuals in the associated comparison areas (the selection of which was described in detail in Appendix A).

The characteristics that are used to match pupils in the pilot and comparison groups are all observed before the pilot was introduced. The impact of the pilot is obtained by comparing the outcomes of pupils in the pilot and weighted comparison groups at some

point after the pilot has been introduced (in this case, usually two years afterwards). Underlying this approach is the notion of "common trends"; that is, the idea that the change in outcomes over time would have been the same in the pilot and comparison areas had the pilot not been introduced.[9]

For the analysis of outcomes from the National Pupil Database (attainment and absence from school) and the take-up data collected from schools, matching models are run separately for each pilot area and its respective comparison areas (for example, pupils in pilot area A are matched with pupils in the set of five local authorities that make up comparison area A).

For the analysis of outcomes from the longitudinal survey of parents and pupils – such as children' diet, health and behaviour – matching models are run for primary school pupils in the two universal entitlement areas (A and B) together (to maximise sample size), with separate analysis carried out for secondary school pupils in the extended entitlement area (C).

For all outcomes, further analysis was also carried out on a sample of pupils who were known or predicted to be entitled to free school meals under the extended entitlement criteria introduced in area C. The definition of this group differed slightly depending on whether longitudinal survey information was available or not, and will be discussed in more detail in the relevant sections below.

In terms of the matching process, "kernel" matching – a weighted smoothed matching estimator – has been used throughout the evaluation, applying a bandwidth of 0.06 (the default bandwidth applied in empirical work).[10] A common support restriction has also been applied, indicating that only pupils in pilot areas with at least one suitable match in the relevant set of comparison areas have been included in the estimation of the impact of the pilot. This ensures that only appropriate comparisons are made.

The fact that several pupils are observed within the same school may mean that their outcomes are correlated due to unobserved factors at the school level (such as the quality of teaching). To try to account for this, standard errors are clustered at the school level when comparing outcomes between the pilot and weighted comparison groups.

B.3 Matching with data from the longitudinal survey

As outlined above, there are three main groups of interest for which separate matching models will be estimated:

[9] This assumption is the key assumption behind the "difference-in-differences" approach that was originally proposed for this evaluation (which involves subtracting the change in outcomes over time amongst pupils in comparison areas from the change in outcomes over time amongst pupils in the pilot areas.) Where the outcomes at baseline are sufficiently similar, the two approaches are essentially equivalent, assuming that the trend between baseline and follow-up is the same in both pilot and comparison areas.

[10] The bandwidth determines how closely matched individuals in the treatment and comparison groups must be. The larger the bandwidth, the more dissimilar individuals can be. The trade-off here is in terms of common support; with a small bandwidth, the matches are likely to be very good, but may only be possible for a small number of individuals; vice versa for a large bandwidth.

- Primary school pupils in the universal entitlement pilot areas (A and B);
- Secondary school pupils in the extended entitlement pilot area (C);
- Primary school pupils in the universal entitlement area who would have been entitled to free school meals under the extended entitlement criteria introduced in area C.

For each of these three matches, a logistic regression model was used to identify which variables (out of a set that included demographic variables and baseline survey outcome measures) best identified differences between the pilot and comparison samples. The predicted probabilities (or propensity scores) from this model were then used to match the two samples together using a kernel matching approach (as set out above). The output was a set of matching weights which, when applied, reduced differences between the profiles of the pilot and comparison samples. Due to the skewed nature of the sample of pupils included in the longitudinal survey (described in detail in Appendix A), a further adjustment to these matching weights was required to correct for the unequal selection probabilities. These steps are described in more detail below.

Missing data

In every match all follow-up respondents were included; no cases were dropped using listwise deletion.[11] Cases were coded to the modal category when variables had ten or fewer cases of item non-response. Dummy missing value variables were created where greater than ten cases were missing.

Variables included in the modelling

The first step in the matching process was to decide which characteristics to match on. A number of different types of data were available: demographic information relating to the child (such as their gender and ethnicity), a selection of key baseline outcomes (such as whether the child ate a range of different food types at least once a day), and household, school and area characteristics. The list of variables used is shown in Table A3: these variables were purposively selected because they were likely to be linked to the study outcomes. The key baseline outcomes were included in the matching model to ensure that the groups were well balanced in terms of pre-pilot outcomes.

The first step was to test[12] each of the variables listed in Table B.A1 (shown at the end of this Appendix) to determine whether or not they significantly predicted the likelihood that the child was in the pilot or comparison group. Those that were significant at the 10 per cent level were included in the final model.

A further set of baseline survey outcomes were then considered. Although it is desirable to achieve a match across as many outcomes as possible, the sample sizes for some of the groups (particularly when considering the extended entitlement pilot) were relatively small so a balance needed to be struck between achieving an optimum match and avoiding an over-specified model, which could result in very variable propensity scores.

[11] Listwise deletion involves omitting the entire observation from analysis when any of the variables included in the matching model have missing data.

[12] A T-Test was used to evaluate all continuous predictors and a Chi Square Test to evaluate all categorical or ordinal variables.

Thus, rather than include all of the bivariate significant outcomes in the final model, the significant variables from Table B.A1 were included in the logistic regression model and others from the list below were included using a forward stepwise approach. This methodology means that only outcomes that are contributing to the model above and beyond the originally defined final model were retained.

What eats before school: crisps
What eats before school: fruit
Child never eats before school in the morning
Morning break: crisps
Morning break: fruit
Morning break: soft drinks
Morning break: water
Cake/biscuit/choc for morning break
Child never eats in the morning break
Any lunch at home
Any lunch at shop or café
Any lunch elsewhere
Any lunch not eaten
Any packed lunch
Any sandwich for lunch
Soft drink for lunch
Vegetables for lunch
Water for lunch
Child had hot food for lunch
Cake/biscuit/choc for lunch
Chips, fried & roast potato, potato products for lunch
Crisps for lunch
Fruit for lunch
Afternoon break: Chips
Afternoon break: crisps
Afternoon break: fruit
Afternoon break: soft drinks
Afternoon break: water
Cake/biscuit/choc for afternoon break
Child never eats in the afternoon break
On way home: chips
On way home: crisps
On way home: fruit
On way home: Soft drinks
On way home: Water
Cake/biscuit/choc on way home
Child never eats on the way home from school
Child never eats snack when gets home from school
At home after school: chips
At home after school: crisps
At home after school: fruit
At home after school: soft drinks
At home after school: water
Cake/biscuit/choc at home
Cake/biscuit/choc for dinner
Child had sweet food for an evening meal
Vegetables for dinner
Fruit for dinner
Chips, fried & roast potato, potato products for dinner
Crisps for dinner
Child had take away food at least once
Child eats a fruit more than once a day
Child eats cake and biscuits more than once a day
Child eats chips more than once a day
Child eats crisps at least once a day
Child eats crisps more than once a day
Child eats veg more than once a day
Child had a meal from a cafe or restaurant at least once
Child had a meal prepared from fresh ingredients at least once
Child had at least one meal provided by school
Child had convenience food cooked at home at least once
Child had hot food both for lunch and dinner
Does child enjoy school?
Views on packed lunch - two items
Views on school meals - eight items
SDQ Behaviour - five items
Attitudes to diet - four indicators

n a

- A pilot group indicator (for models that include multiple groups, e.g. pilots A and B);
- Quartiles of socio-economic status (derived from eligibility for free school meals, IDACI score and ACORN data) which were used to identify sample selection probabilities;

- The current and new definitions of eligibility for free school meals (where applicable).

The proportion of pupils who were eligible for free school meals at the local authority level was dropped from all models[13].

The final models

Pilot AB – Final Model	Pilot C – Final Model	Pilot AB in C – Final Model
Pilot indicator	School type	Pilot indicator
School type	FSM eligibility (current)	FSM eligibility (current)
FSM eligibility (current)	FSM eligibility (revised)	English as an additional language
FSM eligibility (revised)	Ethnic group	SEN
English as an additional language	SEN	Birth order
Ethnic group	Benefit claimants	Socio-economic status
SEN	Single parent family	% FSM in school
Respondent socio-economic class	Number of siblings	Number of pupils in school
Number of siblings	Respondent socio-economic class	Prior attainment
Owner occupied house	Socio-economic status	% White British pupils
Partner work status	Number of pupils in school	Average point score
Absence	Prior attainment	SDQ behaviour (1 item)
% FSM in school	CVA score	Cake, pudding, biscuit or chocolate at lunch
Number of pupils in school	% pupils SEN statement	Frequency eat cake & biscuits
% White British pupils	Socio-economic status	Frequency eat vegetables
% pupils SEN statement	Drinks water in the afternoon	Fruit for lunch
Average point score	Attitudes to school	Rate the dining room facilities
CVA score	SDQ behaviour (2 items)	Fresh fruit in the morning before lunch
Socio-economic status	Choice of meals	
Frequency eat fruit	Drinks water in the morning before lunch	
Frequency eat cake & biscuits	Attitudes to diet	
Attitudes to school	Drinks doft drinks when comes home from school	
Rate how long it takes pupils to get served	Cake, biscuits or chocolate at morning break	
How often talk about food	Any lunch at home	
Quality of school meals		
Packed lunch		
Range of meals provided		
Soft drink for lunch		
Value for money		
Crisps in the morning before lunch		

These models were used to generate the propensity scores used in the matching. The matching was carried out in Stata Version 10 using the psmatch2 commands. Tables B.A2 to B.A4 illustrate the success of the matching process by comparing the weighted pilot and comparison groups pre- and post-matching. (All tables are shown at the end of this Appendix.)[14]

[13] Inclusion of the proportion of pupils who are eligible for free school meals at the local authority level resulted in a number of school level variables being significantly different between pilot and comparison post matching. This variable was therefore dropped from all models.

[14] Tables illustrating the determinants of the matching model for each of the three groups are available on request.

With just 165 pilot area interviews and 185 comparison area interviews, Pilot C (the extended entitlement area) had a smaller sample size than the pilot AB combined match. Given the large number of variables included in the matching this resulted in more extreme matching weights in area C. To address this, the largest (top 2%) weights were trimmed. The trimming made very little difference to the size of impacts estimated.

A number of groups of pupils with particular characteristics were also identified for further analysis. They were:

- Pupils who were entitled to free school meals under the old criteria in areas A and B (universal entitlement);
- Pupils who were not entitled free school meals under the old criteria in areas A and B (universal entitlement);
- Pupils who were identified as having a less healthy diet at baseline (defined as eating crisps at least once a day, eating cake, biscuits or chocolate bars at least once a day, and eating fruit less than twice a day) in areas A and B (universal entitlement);
- Pupils in area C who were entitled to free school meals under the extended entitlement criteria introduced under pilot C.

New matches for the pilot and comparison respondents within each of these groups were created to enable appropriate analysis to be carried out.

In all cases, a further post-matching adjustment was made to account for the fact that the longitudinal survey did not survey pupils from the pilot population at random. This adjustment is described in more detail below.

Selection Weights

The longitudinal survey of parents and pupils was designed to over-sample pupils who were more likely to be at risk of having a less healthy diet. In practice, this meant over-sampling pupils from lower income or more deprived backgrounds. A continuous measure of socio-economic status (SES) was generated using information on free school meals take up, ACORN classification and IDACI score, and used to divide the population in England into quartiles, from which a higher number of pupils were selected from the more deprived quartiles. (This process is described in more detail in Appendix A.)

Table B1 shows the distribution of pupils in the pilot areas according to the National Pupil Database; primary school pupils in areas A and B (the universal entitlement pilot areas) and secondary school pupils in area C (the extended entitlement pilot). This makes clear that the pilot areas are relatively more deprived than the population in England as a whole, with substantially more pupils in the bottom two quartiles and substantially fewer pupils in the top two quartiles. Table B1 also shows the corresponding proportions of pupils that were sampled for the longitudinal survey. (These figures are substantially higher than the proportion of pupils who actually responded to the survey – see Appendix A above for further discussion of this issue.)

Table B1 Distribution of pilot population and selected sample by SES quartile						
SES quartile	NPD data for pilot areas		Selected pilot pupils		Selected comparison pupils	
	AB	C	AB	C	AB	C
Top SES quartile	12,449 (11%)	3,877 (11%)	285 (5%)	853 (11%)	810 (7%)	2,335 (19%)
2nd SES quartile	17,084 (15%)	7,993 (22%)	641 (11%)	1,778 (23%)	1,837 (15%)	2,654 (21%)
3rd SES quartile	40,931 (36%)	9,690 (27%)	2,088 (35%)	2,089 (27%)	3,907 (33%)	3,507 (28%)
Bottom SES quartile	42,799 (38%)	14,000 (39%)	2,930 (49%)	2,987 (39%)	5,434 (45%)	3,917 (32%)
Total	113,263	35,560	5,944	7,707	11,988	12,413

The selection weights correct for the variation in selection across SES quartiles. They are generated as the inverse of the selection probabilities for pupils in the pilot areas; the number of pupils selected in each SES quartile divided by the population in that quartile. Table B2 shows the selection probabilities and the associated weights.

This process enables estimates of the impact of the pilot to be weighted back to the relevant population covered by the longitudinal survey: in Pilot AB, this is all pupils not taking school meals in reception to Year 4; in Pilot C, this is all pupils not taking school meals in Years 7 to 9 who are likely to be entitled to free school meals under the new entitlement criteria. This works because the proportion of entitled pupils in the sample (within SES quartile) is likely to be a reasonable match to the pilot population, since pupils are randomly selected within SES quartile.

Table B2 Selection probabilities and selection weights of pilot pupils				
SES quartile	Selection probabilities		Selection weights	
	AB	C	AB	C
Top SES quartile	0.02	0.22	43.68	4.55
2nd SES quartile	0.04	0.22	26.65	4.50
3rd SES quartile	0.05	0.22	19.60	4.64
Bottom SES quartile	0.07	0.21	14.61	4.69

Similar weights were then applied to the matched comparison sample so that both pilot and comparison samples match the pilot area populations in terms of the SES distribution across quartiles. The adjustment weights for the matched comparison group are set out in Table B3. The final weights were then scaled (within both pilot and comparison groups) to the total number of follow-up respondents. Applying the 'selection weights' to both the pilot and matched comparison samples generates survey weighted impact estimates that are arithmetically equivalent to a weighted average of the SES quartile specific impacts.

Table B3 Adjustment weights of comparison pupils			
SES quartile	Adjustment weights		
	AB	C	Pupils in areas AB eligible under area C
Top SES quartile	1.57	0.22	2.33

2nd SES quartile	1.29	1.95	1.02
3rd SES quartile	1.13	0.83	1.25
Bottom SES quartile	0.45	1.01	0.72

B.4 Matching using administrative data

The previous section discussed the matching process undertaken in order to estimate the impact of the pilot on outcomes observed in the longitudinal survey of parents and pupils. The information available for each pupil in the survey is relatively detailed, with the main concern there being the balance between including lots of characteristics to improve the match between pupils in the pilot and comparison areas against the risk that the matching weights becoming too variable because of the relatively small sample sizes involved.

This section now moves on to discuss the issues involved when matching on the basis of characteristics that are available from administrative data. This is the only information available for all pupils in the National Pupil Database – which is used to estimate the impact of the pilot on attainment and absence from school – and the pupils sampled for the longitudinal survey, for whom take-up information is available and used to estimate the impact of the pilot on school meal take-up. The issue here is that there are relatively few characteristics available on which to match pupils in pilot and comparison areas, thus the combination and specification of variables to include becomes much more important.

The characteristics available for all pupils are shown in Table B4. All characteristics are measured at baseline, before the pilot was introduced. For pupils who were sampled as part of the longitudinal survey, information on whether they took school meals at least once a week was also available; this was only included in the analysis of take-up data.

To ensure that the results are robust to model specification, four different ways of constructing the propensity score are investigated. These are:

1. A model based on theoretical reasoning.
2. A model based on theoretical reasoning, excluding IDACI. There was some concern that the area-level measures of deprivation (IDACI and ACORN type) would be very highly correlated, which could introduce multi-colinearity to the model and thus produce imprecise and perhaps misleading propensity scores. IDACI was excluded rather than ACORN type because it was felt that IDACI may provide a less good indication of deprivation in densely populated urban areas, such as Newham.

Table B4 Characteristics available in administrative data

	Pupil characteristics
Male	A binary variable coded to equal one if the pupil is male and zero otherwise
White	A binary variable coded to equal one if the pupil is white and zero otherwise
EAL	A binary variable coded to equal one if the pupil is classified as having English as an additional language and zero otherwise
Month of birth	A series of binary indicators coded to equal one if the pupil was born in a particular month and zero otherwise

NCYR	A series of binary indicators coded to equal one if the pupil is in a particular national curriculum year group and zero otherwise
SEN	A binary variable coded to equal one if the pupil is classified as having special educational needs (statemented or non-statemented) and zero otherwise
FSM	A binary variable coded to equal one if the pupil is classified as eligible for Free School Meals under the old criteria and zero otherwise
Prior attainment	Based on a standardised average point score from the last measure of attainment available (FSP, KS1 or KS2 depending on the age of the child) grouped into deciles and entered as a set of binary variables. If there were fewer than 15 observations per cell, then deciles were grouped accordingly.
Absence	A continuous variable indicating the percentage of school the pupil missed over the three terms prior to the introduction of the pilot
	Area characteristics
IDACI score[15]	A continuous measure of relative deprivation grouped into deciles and entered as a set of binary variables. If there were fewer than 15 observations per cell, then deciles were grouped accordingly.
ACORN type[16]	A discrete classification based on neighbourhood characteristics, entered as a set of binary variables. If there were fewer than 15 observations per cell, then ACORN types were grouped accordingly.
	School characteristics
% FSM	A continuous variable indicating the percentage of pupils in the school who are eligible for free school meals under the old criteria
% White	A continuous variable indicating the percentage of pupils in the school who are white British.
% SEN	A continuous variable indicating the percentage of pupils in the school who have special education needs (either statemented or non-statemented)
APS	A continuous variable indicating the average points score of pupils in the school (at KS2 for primary schools and KS4 for secondary schools)
CVA[17]	A continuous variable indicating the contextual value added of the school; that is, the average progress made by pupils, conditional on their background characteristics, between KS1 and KS2 for primary schools, and KS2 and KS4 for secondary schools.

3. A model based on variables that are significantly different between pilot and comparison areas and have a significant impact on the outcome variable in question.
4. A model based on variables that are significantly different between pilot and comparison areas and have a significant impact on the outcome variable in question, excluding IDACI (for the reasons outlined above).

Each of these models – and the method used to decide between them – is discussed in more detail below. In all models, missing dummies are included so that no observations

[15] IDACI is an acronym for the Income Deprivation Affecting Children Index, which is created by the Department for Communities and Local Government using administrative data at local levels across several domains. More information can be found here: www.communities.gov.uk/documents/statistics/pdf/1871208.pdf

[16] ACORN is a commercially produced classification of small geographical areas in to "types" of household based on a combination of government and consumer research data. More information can be found here: http://www.caci.co.uk/acorn2009/CACI.htm. The ACORN types can be found here: http://www.caci.co.uk/acorn2009/acornmap_ext.asp.

[17] For more information, see: http://www.education.gov.uk/performancetables/pilotks4_05/aboutcva.shtml.

are dropped if they have missing values. Common support is also imposed, so that only pupils in pilot areas with a sufficiently close match in the comparison areas are included in the final regression. This condition means that the number of observations used to calculate the impact estimate differs between models.

Theory models

The variables included in the theoretical model have been chosen because, in the authors' judgement, they are likely to differ between pilot and comparison areas and have some impact on the outcome in question. For the attainment models, these variables are white, EAL, SEN, FSM, prior attainment, IDACI, ACORN type, % FSM, % white, APS and CVA. For the take-up models, take-up at the pupil and school level at baseline is also included and EAL, SEN, attainment decile, % white, APS and CVA are excluded. (This means that gender, month of birth, NCYR, SEN, absence and % SEN have not been included in either the attainment or take-up models, primarily because there is no particular reason to think that they may differ across areas.)

Data models

The models described above include variables that are theoretically justified. It may be that a number of the variables thought to be relevant are not in practice, however. This second set of models thus contain only variables that are significantly different between pilot and comparison areas and have a significant impact on the outcome in question (either the take-up of school meals, educational attainment or absence from school). The reasoning is that variables that do not affect the outcome in question at baseline are unlikely to do so after the pilot has been introduced either, while those that do not differ between pilot and comparison areas are unlikely to be relevant in defining the counterfactual outcome and thus the choice of comparison group.

The steps to derive the data models are as follows:

1. Start with the broad list of factors that may differ between pilot and comparison areas and affect the outcome variable in question (see Table B4 above).
2. For each factor, run a simple linear regression model (OLS) with the dependent variable equal to one if the pupil is in the pilot area and zero if they are in the comparison area (henceforth referred to as the pilot indicator), and the variable or variables of interest being the only independent factors included in the model.[18] Significance is tested in the following ways:
    a. For continuous or binary variables, using a t-test.
    b. For discrete variables, using an F-test on all coefficients entered as a series of binary variables.

    Significance is defined at the 10 per cent level, meaning that in 90 per cent of random samples, the relationship would be greater than zero.
3. For variables that significantly differ between pilot and comparison areas, also check whether they have a significant impact on the outcome in question (measured at

[18] Models are robust to using a probit model rather than a linear regression.

baseline), using a similar process to that described above. (This time, the dependent variable is the outcome in question, rather than an indicator for being in the pilot or comparison group.)

4. Only include in the matching model variables that are significantly different between pilot and comparison areas and also significantly related to the outcome in question.

Choosing between theory and data models

Each of the four models described above was run for each outcome considered. Reassuringly, the impact estimate produced by the four models was very similar in most cases. In the report, however, the impact estimate presented comes from the model that performed "best". The criteria used to select the best performing model are as follows:

1. The outcomes of pupils in the pilot and matched comparison group are balanced (not significantly different from one another) at baseline: this is analysed by regressing the outcome of interest on the pilot indicator, using a probit or OLS regression model (depending on whether the outcome is binary or continuous). A coefficient (or estimate of impact) close to zero (and not significant at the 10 per cent level) is preferred.
2. It is difficult to predict whether the pupil lives in the pilot or comparison area on the basis of their characteristics once the matching weights have been applied: in practice, this means a low R-squared in a (weighted) regression of the pilot indicator on the full set of variables that are included in the matching model.
3. The number of observations excluded because of lack of common support is low: this is used as a deciding factor where other criteria are very similar.

These criteria are applied as follows:

a. First find the model for which the outcomes of pupils in pilot and comparison areas are most similar;

b. Check that this model has a low R-squared;

c. If this model has a low R-squared, check that the number of observations excluded is not excessive;

d. If conditions b and c hold then accept the model as the most preferred.

e. If conditions b and c do not hold, find the model that is the next most balanced at baseline.

f. Repeat checks b and c.

g. Repeat as necessary (in practice, no more than two rounds of this process are necessary to pick an appropriate model).

Table B.A1 Matching model predictors

Variable	Description	Range	
		Min	Max
LA take up of FSM	% of primary or secondary school pupils eligible for FSM within the LA Jan 08-09	7	56
Pilot type indicator	Pilot A, B or C indicator	0	2
Year Group	National Curriculum Year Group (NPD)	0	9

Absence from school	% school missed due to absence at the baseline	0	49
EAL	English as an additional Language (binary)	0	1
Child's ethnicity	Ethnic Group (White, Asian, Black, Mixed or Other)	0	2
Prior Attainment	Standardised score based on last relevant measure of attainment at baseline (FSP, KS1 or KS2)	-5.61	1.8
SEN	Special Educational Need indicator - includes with/without a statement (binary)	0	1
Gender	Male / Female indicator (binary)	0	1
Eligibility Pilot C	Eligible for Free School Meals under revised (Pilot C) rules (binary)	0	1
FSM eligibility	Eligible for Free School Meals under current rules (binary)	0	1
BMI	Body Mass Index - standardised within year group	-2.75	12.69
Birth Order	Reference child's birth order	1	9
Month of birth of child	Month the child was born in	1	12
Chips	Eats chips at least once a day (binary)	0	1
Veg	Eats vegetables at least once a day (binary)	0	1
Cake	Eats cake/biscuits at least once a day (binary)	0	1
Fruit	Eats fruit at least once a day (binary)	0	1
Eat Breakfast	Eats before school - only applicable if the child attends school two or more days	0	1
Hot evening Meal	Reference child had a hot evening meal	0	1
Social class / Nssec	Respondents National Statistics Socio-Economic Classification (eight groups)	1	8
Parents education	Respondents highest qualification (five groups)	1	5
Means tested benefits	Family receiving a means tested benefit (binary)	0	1
Housing tenure	Family living in an owner occupied house (binary)	0	1
Number of siblings	Number of siblings reference child has - grouped for 3+	0	3
Work status	Respondent's economic status (full time education, working, not working)	1	3
Single parent HH	Single parent household (binary)	0	1
Mother's age when born	Age of mother at birth of reference child - additional dummy for children with no mother in household	15	48
SES	Socio-economic status of the household - derived based on FSM eligibility, ACORN type and IDACI	-2.03	3.78
School type	Type of school reference child attending (community, foundation, voluntary controlled or aided)	1	4
% FSM eligible	% pupils in the school eligible for free school meals	1	60
School size	Total number of pupils in the school (2008)	64	1458
% SEN	% pupils in the school with a statement of special educational needs	0	0.1
% WB	% pupils in the school who are White British	0	100
CVA	Contextual value added score for the school	98	103.3
APS	Average points score of pupils within the school (KS2 for primary and KS4 for secondary)	24.6	759.6

Table B.A2 Pilot AB (universal entitlement) model checks

Unweighted Base (smallest): 734

Variable	**Matching Statistics**		
	Pilot AB		
	Pilot	Comparison	Weighted comparison
Reference child's birth order (Survey)			
1	47.2%	43.2%	48.6%
2	34.5%	34.6%	32.1%
3+	18.3%	22.2%	19.3%

English as an additional language (NPD)			
No	74.2%	61.4%	65.7%
Yes	25.8%	38.6%	34.3%
Ethnic Group (NPD)			
White	70.9%	57.8%	61.5%
Asian	22.1%	30.6%	30.5%
Black, mixed or other	7.0%	11.6%	7.9%
Gender (Survey)			
Female	47.4%	46.4%	45.2%
Male	52.6%	53.6%	54.8%
SEN (statement and non-statement) (NPD)			
No	77.7%	82.2%	77.1%
Yes	22.3%	17.8%	22.9%
Month of birth of pupil from (NPD)			
1	7.6%	8.0%	8.4%
2	7.3%	8.1%	9.4%
3	9.8%	8.0%	9.9%
4	7.5%	8.4%	7.9%
5	8.7%	9.3%	9.4%
6	9.1%	7.0%	7.8%
7	11.0%	8.1%	9.1%
8	8.6%	7.4%	8.4%
9	7.4%	9.2%	7.2%
10	7.1%	9.0%	7.5%
11	6.9%	6.5%	6.3%
12	9.0%	10.9%	8.7%
Number of siblings reference child has (Survey)			
0	19.3%	17.0%	17.7%
1	46.8%	40.3%	47.5%
2	21.4%	26.1%	19.5%
3+	12.6%	16.6%	15.4%
Eligible for FSM (current) (Survey)			
No	89.2%	85.5%	89.1%
Yes	10.8%	14.5%	10.9%
Eligible for FSM (revised) (Survey)			
No	76.1%	66.2%	75.7%
Yes	23.9%	33.8%	24.3%
Respondents highest qualification (Survey)			
Level 4/5, group 3/4	36.2%	31.5%	33.9%
Level 3/group 2	20.7%	17.3%	19.6%
Level 2/group 1	23.5%	25.0%	24.3%
Level 1 and other qualifications	2.9%	4.1%	4.0%
No qualifications	16.7%	22.1%	18.1%
Respondents NS-SEC (Survey)			
Employers in large organisations, higher managerial occupations and higher professions	14.0%	17.7%	16.2%
Lower professional and higher technical occupations	13.6%	11.7%	11.8%
Lower managerial occupations and higher supervisory occupations	11.0%	10.4%	9.9%
Intermediate occupations	11.7%	7.3%	10.5%
Employers in small organisations/own account workers	12.7%	15.2%	14.7%
Lower supervisory occupations and lower technical occupations	10.9%	8.8%	9.9%
Semi-routine occupations	14.6%	17.7%	16.0%
Routine occupations	11.5%	11.3%	11.1%
Owner occupied housing (Survey)			
Rented or other	23.9%	35.6%	25.7%
Owner occupied	76.1%	64.4%	74.3%

Respondent work status (Survey)			
Going to school/college full-time (including on vacation)	2.7%	2.8%	2.1%
In full or part-time employment	66.4%	58.0%	60.8%
Not working at present	30.9%	39.2%	37.1%
Partner work status (Survey)			
No Partner	12.3%	15.6%	10.9%
Going to school/college full-time (including on vacation)	1.8%	0.4%	0.1%
In full or part-time employment	74.7%	71.4%	77.3%
Not working at present	11.1%	12.6%	11.7%
Single parent family (Survey)			
No	87.6%	85.0%	89.7%
Single parent	12.4%	15.0%	10.3%
School type from (Edubase 2008)			
Community School	76.3%	84.3%	85.4%
Foundation School	0.0%	3.1%	2.2%
Voluntary Aided School	21.9%	4.5%	4.8%
Voluntary Controlled School	1.8%	8.1%	7.6%
National Curriculum Year Groups (NPD)			
0	15.0%	18.4%	16.3%
1	20.0%	19.7%	17.7%
2	22.3%	23.1%	19.9%
3	20.9%	19.1%	20.1%
4	21.8%	19.7%	26.0%
% school missed due to absence (NPD)	4.53	4.82	4.62
Age at birth of reference child (Survey)	28.72	27.61	28.42
Average points score in 2008 (NPD)	27.98	27.65	27.93
Standardised prior attainment measure (NPD)	0.11	0.09	0.05
Contextual value added between KS2 and KS3 (NPD)	100.29	100.44	100.35
% pupils eligible for FSM in school (Edubase 2008)	21.12	24.48	21.87
Total number of pupils in the school (Edubase 2008)	287.02	324.06	306.53
% pupils in school with SEN with statement (NPD)	0.10	0.11	0.11
SES index	-0.08	0.21	-0.07
% pupils in the school that are White British (NPD)	58.12	40.10	50.37
BMI - Standardised within year group (Survey)	0.02	-0.01	-0.10
Eats before school (Survey)			
No	5.4%	7.0%	6.9%
Yes	85.2%	82.8%	81.1%
At school for 2 or less days a week	9.4%	10.1%	12.0%
Child eats cake/biscuits at least once a day (Survey)			
No	20.3%	25.9%	20.4%
Yes	79.7%	74.1%	79.6%
Child eats chips at least once a day (Survey)			
No	77.9%	72.2%	77.1%
Yes	22.1%	27.8%	22.9%
Child eats a fruit at least once a day (Survey)			
No	9.0%	5.5%	8.1%
Yes	91.0%	94.5%	91.9%
Child eats vegetables at least once a day (Survey)			
No	18.9%	16.5%	17.2%
Yes	81.1%	83.5%	82.8%

Table B.A3 Pilot C (extended entitlement) model checks

Unweighted Base (smallest): 165

Variable	**Matching Statistics**
	Pilot C

	Pilot	Comparison	Weighted comparison
Reference child's birth order (Survey)			
1	50.3%	46.2%	50.5%
2	35.2%	33.5%	26.4%
3+	14.5%	20.3%	23.1%
English as an additional language (NPD)			
No	84.2%	77.5%	85.7%
Yes	15.8%	22.5%	14.3%
Ethnic Group (NPD)			
White	62.4%	73.1%	78.0%
Asian	21.8%	18.7%	11.5%
Black, mixed or other	15.8%	8.2%	10.4%
Gender (Survey)			
Female	47.9%	54.9%	59.9%
Male	52.1%	45.1%	40.1%
SEN (statement and non-statement) (NPD)			
No	83.6%	64.3%	75.3%
Yes	16.4%	35.7%	24.7%
Month of birth of pupil from (NPD)			
1	10.3%	8.2%	11.5%
2	7.9%	7.7%	2.7%
3	4.8%	9.3%	11.5%
4	9.1%	9.3%	4.4%
5	7.3%	7.7%	5.5%
6	9.1%	8.2%	10.4%
7	9.7%	8.8%	12.6%
8	6.1%	9.3%	7.1%
9	8.5%	7.1%	9.3%
10	10.3%	9.9%	7.1%
11	7.3%	5.5%	3.8%
12	9.7%	8.8%	13.7%
Number of siblings reference child has (Survey)			
0	15.8%	14.3%	12.6%
1	41.8%	36.8%	38.5%
2	28.5%	22.5%	31.3%
3+	13.9%	26.4%	17.6%
Eligible for FSM (current) (Survey)			
No	72.1%	68.7%	79.1%
Yes	27.9%	31.3%	20.9%
Eligible for FSM (revised) (Survey)			
No	41.2%	34.1%	46.2%
Yes	58.8%	65.9%	53.8%
Respondents highest qualification (Survey)			
Level 4/5, group 3/4	16.4%	11.5%	14.8%
Level 3/group 2	18.2%	15.4%	17.0%
Level 2/group 1	24.8%	32.4%	33.0%
Level 1 and other qualifications	6.7%	2.7%	6.6%
No qualifications	33.9%	37.9%	28.6%
Respondents NS-SEC (Survey)			
Employers in large organisations, higher managerial occupations and higher professions	4.8%	6.0%	4.4%
Lower professional and higher technical occupations	7.9%	6.6%	8.8%
Lower managerial occupations and higher supervisory occupations	3.0%	3.3%	4.4%
Intermediate occupations	9.1%	8.2%	12.6%
Employers in small organisations/own account workers	7.3%	8.8%	6.6%
Lower supervisory occupations and lower technical	10.3%	13.2%	13.2%

occupations			
Semi-routine occupations	38.8%	26.9%	27.5%
Routine occupations	18.8%	26.9%	22.5%
Owner occupied housing (Survey)			
Rented or other	52.1%	56.0%	50.5%
Owner occupied	47.9%	44.0%	49.5%
Respondent work status (Survey)			
Going to school/college full-time (including on vacation)	2.4%	1.6%	1.6%
In full or part-time employment	57.0%	51.6%	61.5%
Not working at present	40.6%	46.7%	36.8%
Partner work status (Survey)			
No Partner	45.5%	35.2%	43.4%
Going to school/college full-time (including on vacation)	0.6%	0.0%	0.0%
In full or part-time employment	37.6%	43.4%	41.8%
Not working at present	16.4%	21.4%	14.8%
Single parent family (Survey)			
No	54.5%	64.3%	56.6%
Single parent	45.5%	35.7%	43.4%
School type from (Edubase 2008)			
Community School	84.2%	45.1%	37.4%
Foundation School	4.8%	33.0%	52.2%
Voluntary Aided School	10.9%	22.0%	10.4%
Voluntary Controlled School	0.0%	0.0%	0.0%
National Curriculum Year Groups (NPD)			
7	39.4%	31.3%	41.8%
8	30.3%	62.1%	22.5%
9	30.3%	6.6%	35.7%
% school missed due to absence (NPD)	6.35	6.67	6.38
Age at birth of reference child (Survey)	26.87	25.52	25.72
Average points score in 2008 (NPD)	420.49	392.52	411.06
Standardised prior attainment measure (NPD)	-0.04	-0.12	-0.13
Contextual value added between KS2 and KS3 (NPD)	99.85	99.81	100.12
% pupils eligible for FSM in school (Edubase 2008)	16.68	21.36	16.93
Total number of pupils in the school (Edubase 2008)	942.08	1057.26	943.33
% pupils in school with SEN with statement (NPD)	0.07	0.06	0.06
SES index	0.71	0.96	0.72
% pupils in the school that are White British (NPD)	73.68	65.18	62.95
BMI - Standardised within year group (Survey)	0.03	-0.04	0.05
Eats before school (Survey)			
No	35.2%	31.3%	31.9%
Yes	57.0%	62.1%	61.0%
At school for 2 or less days a week	7.9%	6.6%	7.1%
Child eats cake/biscuits at least once a day (Survey)			
No	17.6%	20.9%	19.2%
Yes	82.4%	79.1%	80.8%
Child eats chips at least once a day (Survey)			
No	66.7%	70.3%	67.6%
Yes	33.3%	29.7%	32.4%
Child eats a fruit at least once a day (Survey)			
No	24.2%	22.0%	19.8%
Yes	75.8%	78.0%	80.2%
Child eats vegetables at least once a day (Survey)			
No	26.7%	24.7%	35.2%
Yes	73.3%	75.3%	64.8%

Table B.A4 Pilot C in AB (pupils in the universal entitlement areas who would

have been entitled to free school meals under the extended entitlement pilot) model checks			
Unweighted Base (smallest): 206			
Variable	**Matching Statistics**		
	Pilot C in AB		
	Pilot	Comparison	Weighted comparison
Reference child's birth order (Survey)			
1	45.1%	40.6%	48.6%
2	26.7%	36.6%	25.9%
3+	28.2%	22.8%	25.5%
English as an additional language (NPD)			
No	59.7%	47.6%	53.9%
Yes	40.3%	52.4%	46.1%
Ethnic Group (NPD)			
White	53.7%	49.6%	55.5%
Asian	36.1%	38.2%	34.3%
Black, mixed or other	10.2%	12.2%	10.2%
Gender (Survey)			
Female	49.0%	48.0%	48.4%
Male	51.0%	52.0%	51.6%
SEN (statement and non-statement) (NPD)			
No	72.8%	81.9%	72.0%
Yes	27.2%	18.1%	28.0%
Month of birth of pupil from (NPD)			
1	7.8%	6.7%	9.4%
2	7.8%	7.5%	6.7%
3	9.7%	8.3%	7.1%
4	8.7%	9.4%	11.0%
5	8.3%	9.1%	10.6%
6	7.8%	6.3%	7.5%
7	10.7%	7.9%	8.6%
8	8.7%	5.9%	9.0%
9	9.2%	9.8%	7.8%
10	4.9%	9.8%	8.6%
11	6.8%	5.1%	3.5%
12	9.7%	14.2%	10.2%
Number of siblings reference child has (Survey)			
0	20.4%	19.3%	20.4%
1	39.3%	32.7%	34.5%
2	22.3%	28.3%	26.3%
3+	18.0%	19.7%	18.8%
Eligible for FSM (current) (Survey)			
No	54.9%	57.1%	53.5%
Yes	45.1%	42.9%	46.5%
Eligible for FSM (revised) (Survey)			
No	N/A	N/A	N/A
Yes	N/A	N/A	N/A
Respondents highest qualification (Survey)			
Level 4/5, group 3/4	20.9%	16.1%	16.2%
Level 3/group 2	19.4%	18.1%	19.0%
Level 2/group 1	27.7%	24.4%	26.9%
Level 1 and other qualifications	5.8%	7.1%	8.7%
No qualifications	26.2%	34.3%	29.2%
Respondents NS-SEC (Survey)			
Employers in large organisations, higher managerial occupations and higher professions	9.7%	12.6%	11.0%

Lower professional and higher technical occupations	6.8%	3.1%	1.6%
Lower managerial occupations and higher supervisory occupations	3.9%	5.1%	5.5%
Intermediate occupations	12.1%	5.9%	5.5%
Employers in small organisations/own account workers	17.0%	20.9%	22.0%
Lower supervisory occupations and lower technical occupations	7.3%	7.5%	7.1%
Semi-routine occupations	25.2%	27.6%	29.8%
Routine occupations	18.0%	17.3%	17.6%
Owner occupied housing (Survey)			
Rented or other	49.5%	59.4%	58.3%
Owner occupied	50.5%	40.6%	41.7%
Respondent work status (Survey)			
Going to school/college full-time (including on vacation)	3.9%	3.9%	4.3%
In full or part-time employment	47.1%	41.3%	40.9%
Not working at present	49.0%	54.7%	54.7%
Partner work status (Survey)			
No Partner	29.1%	30.7%	30.4%
Going to school/college full-time (including on vacation)	3.9%	0.4%	0.0%
In full or part-time employment	41.7%	48.0%	52.2%
Not working at present	25.2%	20.9%	17.4%
Single parent family (Survey)			
No	70.4%	70.1%	69.7%
Single parent	29.6%	29.9%	30.3%
School type from (Edubase 2008)			
Community School	84.5%	90.9%	91.3%
Foundation School	0.0%	1.6%	1.2%
Voluntary Aided School	15.5%	2.0%	2.4%
Voluntary Controlled School	0.0%	5.5%	5.1%
National Curriculum Year Groups (NPD)			
0	12.6%	18.1%	14.2%
1	23.8%	18.5%	22.8%
2	20.4%	24.4%	20.5%
3	19.9%	21.3%	23.6%
4	23.3%	17.7%	18.9%
% school missed due to absence (NPD)	5.64	5.74	6.02
Age at birth of reference child (Survey)	27.27	26.15	26.88
Average points score in 2008 (NPD)	27.71	27.29	27.81
Standardised prior attainment measure (NPD)	-0.12	0.00	-0.20
Contextual value added between KS2 and KS3 (NPD)	100.33	100.43	100.55
% pupils eligible for FSM in school (Edubase 2008)	24.41	29.48	23.26
Total number of pupils in the school (Edubase 2008)	327.98	360.46	345.89
% pupils in school with SEN with statement (NPD)	0.10	0.11	0.12
SES index	0.54	0.75	0.52
% pupils in the school that are White British (NPD)	46.97	33.26	43.98
BMI - Standardised within year group (Survey)	0.14	0.03	-0.01
Eats before school (Survey)			
No	6.8%	10.2%	9.8%
Yes	84.0%	76.8%	77.2%
At school for 2 or less days a week	9.2%	13.0%	13.0%
Child eats cake/biscuits at least once a day (Survey)			
No	19.9%	29.9%	22.4%
Yes	80.1%	70.1%	77.6%
Child eats chips at least once a day (Survey)			
No	75.2%	71.7%	69.7%
Yes	24.8%	28.3%	30.3%
Child eats a fruit at least once a day (Survey)			
No	11.2%	7.5%	3.9%

Yes	88.8%	92.5%	96.1%
Child eats vegetables at least once a day (Survey)			
No	18.0%	22.0%	17.7%
Yes	82.0%	78.0%	82.3%

Appendix C Predicting entitlement

Predicting entitlement to free school meals under the extended entitlement criteria introduced in area C

Under the pilot introduced in area C, entitlement to free school meals was extended to cover pupils whose families were claiming Working Tax Credit but whose annual income did not exceed the existing income criteria (£16,190 in 2009-10).

Using the information collected in the longitudinal survey of parents and pupils, it is possible to identify pupils who would be newly entitled to free school meals under these criteria, not only in the extended entitlement area (C), but also in the universal entitlement areas (A and B). It is not possible to precisely identify entitlement for pupils who do not appear in the longitudinal survey, however, because the necessary information is not available in the take-up data or the National Pupil Database (NPD). To identify the impact of the pilot on take-up (and attainment and absences) amongst all pupils who would be newly entitled to free school meals under the extended entitlement criteria introduced in area C, it is therefore necessary to make some assumptions about the pupils who would be entitled who do not appear in the longitudinal survey.

To do so, information that is available for all pupils and that is likely to be correlated with entitlement (such as ethnicity, attainment at baseline and detailed local area information such as IDACI score and ACORN type) is used to model entitlement to free school meals under pilot C for pupils in the longitudinal survey (for whom actual entitlement can be observed). (Note that characteristics that are only observed in the survey cannot be used – even though many are likely to predict entitlement better than those available in the NPD – because it means that the results could not be extrapolated to pupils for whom these characteristics were not available (i.e. to anyone outside the longitudinal survey).) The results of this model are then used to predict entitlement for all pupils in the pilot and comparison areas.

In areas A and B (the universal entitlement pilot), this process is implemented as follows:

1. Identify the characteristics of pupils (observed in the NPD) that predict entitlement for free school meals under the extended criteria introduced in area C:
    a. Focus on pupils in the longitudinal survey and restrict attention to pupils who are not eligible for free school meals under the old criteria at baseline.
    b. Amongst the remaining group, use a probit model to identify the relationship between the dependent variable (being entitled to free school meals under the new criteria) and a range of characteristics that are expected to influence this probability, including: month of birth, white, EAL, SEN, NCYR, attainment (grouped

into deciles), IDACI (grouped into 20 equally sized groups known as vigintiles[19]) and ACORN type.[20]

c. Experiment with the variables that are included in the model to find the best fit (where "best" is defined as the model that maximises the number of correct predictions of entitlement amongst those in the survey).

2. Use the chosen model to create a predicted probability for each pupil in the data (extrapolating to those not in the survey) based on their observed characteristics:

   a. The predicted probability ranges between 0 and 1, where a number close to 0 indicates that (based on their characteristics) the pupil is very unlikely to be entitled to free school meals under the extended entitlement pilot and a number close to 1 indicates that they are very likely to be entitled.

   b. This predicted probability is created on the basis of the coefficients of independent variables in the probit model. All else equal, characteristics that have large coefficients in the model will have a larger impact on the predicted probability of being entitled to free school meals under the extended entitlement pilot in area C.

3. Use these predicted probabilities to select a group of pupils who are most likely to be entitled to free school meals under the extended entitlement criteria. In practice, the steps taken are as follows:

   a. For pupils in the survey, summarise the binary variable indicating whether they are actually entitled to free school meals under the extended entitlement criteria to find the mean. (This figure is equivalent to 25 per cent in area B, for example.)

   b. Find the predicted probability above which this percentage of pupils in the survey lie – this will be the 75th percentile in area B – and use this as the "cut-off" above which pupils will be regarded as entitled to free school meals. (Note that this is not the same as using the lowest predicted probability amongst those who are actually entitled, because it is not possible to perfectly predict entitlement, so this method would tend to over-estimate the proportion of entitled pupils.)

      Figure C1 shows the predicted probabilities for those in the survey and not in the survey in area B. The red line denotes the cut-off at which the appropriate proportion of pupils in the survey is found to be entitled to free school meals. All those with a predicted probability above this line will be classified as entitled.

   c. Create a binary variable indicating likely entitlement based on this cut-off value.

   d. Compare actual and predicted entitlement amongst those in the survey. If the model has performed reasonably well, then there will be a substantial cross-over between actual and predicted entitlement.

Figure C1 Characteristics available in administrative data

[19] Note that vigintiles rather than deciles were used to refine the match.

[20] Note that if there were insufficient numbers of observations in the pilot and comparison areas then attainment deciles, IDACI deciles and ACORN types were grouped accordingly.

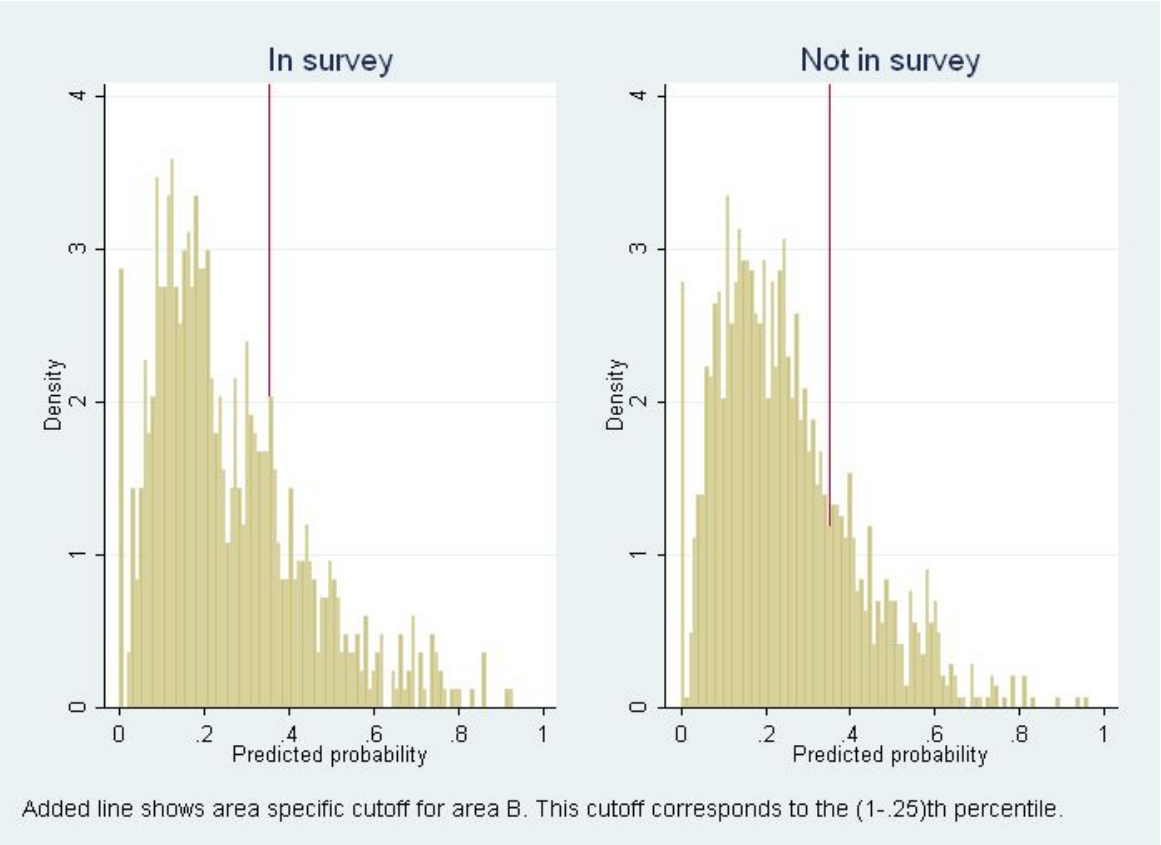

Table C1 presents some summary statistics and diagnostic checks for this process in the universal pilot areas A and B. (The process is implemented slightly differently in the extended entitlement pilot area C; these differences are discussed in more detail in the next section.) The first three rows of this table compare the average predicted probabilities for those in the survey who are and are not entitled to free school meals under the extended entitlement criteria. On average, the model correctly assigns a higher predicted probability to those who are entitled to free school meals, as one would hope, with the difference in predicted probabilities between the two groups around 0.15 in each area.

Table C1 Diagnostic checks for prediction of entitlement under Pilot C

	Pilot area	
	A	B
Predicted probability for those not entitled	0.352	0.216
Predicted probability for those entitled	0.499	0.370
Difference	0.146	0.154
% of those in pilot areas predicted to be entitled	43.7%	26.1%
% of those in comparison areas predicted to be entitled	30.2%	18.5%
% correctly predicted	66.8%	74.5%

This table also presents the percentage of pupils in each area who would be predicted to be entitled to free school meals in pilot area C. It shows that a higher proportion of pupils are predicted to be entitled in area A than in area B (43.7 per cent vs. 26.1 per cent). (This

is consistent with expectations based on the socio-economic characteristics of these areas.)

Finally, the bottom row of Table C1 shows that the model correctly predicted entitlement for 66.8 per cent of those in the survey in area A and 74.5% of those in the survey in area B. These high proportions indicate that the information available in the NPD is sufficient to predict entitlement to free school meals under the extended entitlement criteria introduced in area C with a reasonable degree of accuracy.

Predicting entitlement to free school meals in area C

As described in Appendix A, pupils who were sampled for the longitudinal survey in area C were additionally screened on the basis of income and receipt of benefits/tax credits; to be included, families had to have household income below £20,000 per year and/or to be receiving relevant benefits or tax credits. Because of this additional screening process, those included in the survey in area C are more deprived, on average, than those in areas A and B. As an illustration of this, 41 per cent and 25 per cent of those in the survey and not eligible for free school meals at baseline in areas A and B respectively are entitled to free school meals under the extended entitlement criteria introduced in area C, while in area C the equivalent percentage is 63 per cent.

Predicting entitlement on the basis of survey data in area C would thus over-estimate the proportion of pupils predicted to be entitled to free school meals under the new criteria. Instead, it was decided to use the predicted probabilities from a model run in area B to predict entitlement in area C. (Area B was used rather than area A, because the distribution of pupils by socio-economic quartile is more similar in areas B and C than in areas A and C – as shown in Table C2.)

Table C2 Distribution of SES quartiles in pilot and comparison areas

SES quartile	A	B	C
Highest SES quartile (%)	8.03	27.98	31.61
2nd highest (%)	16.46	30.11	24.33
3rd highest (%)	30.67	24.01	22.77
Lowest SES quartile (%)	44.84	17.90	21.30

Source: National Pupil Database.

Notes to Table C2: The highest SES quartile relates to the least deprived, and the lowest SES quartile relates to the most deprived.

Two assumptions are required in order for this process to be valid: firstly, that the characteristics that predict entitlement in areas B and C are similar; secondly, that the proportion entitled is similar in areas B and C. The first assumption is likely to hold, as it seems reasonable to suppose that similar characteristics predict entitlement in each area.[21] The second assumption seems reasonable as the population of pupils in areas B and C are evenly matched in terms of the nationally defined SES quartiles (see Table C2).

[21] Similar characteristics seem to predict entitlement in areas A and B. This conclusion is reached from the following experiment: predict entitlement using a model run on survey participants separately in areas A and

Table C3 compares the results from the model predicting entitlement in area C using predicted probabilities in areas B and C respectively. While the model using predicted probabilities from survey participants in area C appears to better predict entitlement – the percentage of pupils correctly predicted is higher (70.1 per cent compared with 57 per cent), as is the difference in the predicted probability, on average, between those entitled and not (0.176 compared with 0.155) – there are a number of factors that suggest that this model is not correct. For example, 57.2 per cent and 42.9 per cent of pupils in pilot and comparison areas respectively are predicted to be entitled to free school meals under the extended entitlement criteria when using the model based on area C, which seems implausibly large given the characteristics of pupils in area C. The predicted probability of being entitled to free school meals for those in the survey is also very high, reflecting the highly skewed sample of pupils selected for the survey.

Table C3 Diagnostic checks for prediction of entitlement under Pilot C

	Pilot area	
	C using model in B	C using model in C
Predicted probability for those not entitled	0.216	0.520
Predicted probability for those entitled	0.371	0.696
Difference	0.155	0.176
% of those in pilot areas predicted to be entitled	35.7%	57.2%
% of those in comparison areas predicted to be entitled	20.8%	42.9%
% correctly predicted	21.9%	43.9%

B, then compare these predictions. In area A, the different models gave the same prediction of entitlement in 63 per cent of cases, which seems reasonably high.

Appendix D Additional results

Table D1 Differences in observable characteristics between the whole population and those predicted to be entitled to free school meals under the extended entitlement criteria introduced in area C

Base: pupils in Pilot and Comparison areas

	Whole population	Pupils predicted to be entitled to free school meals under the pilot in area C	Difference
	%	%	ppt
	Area A		
Male	51.3	42.6	-8.7**
FSM at baseline	30.8	0	-30.8**
White	37.5	36.4	-1.1**
EAL	47	67.1	20.1**
Highest quartile of SES	8	0.6	-7.4**
2nd quartile of SES	15.6	7.9	-7.7**
3rd quartile of SES	30.6	43.7	13.1**
Lowest quartile of SES	45.8	47.9	2.1**
Standardised prior attainment	-9.4	-33.1	-23.7**
IDACI	43.3	51.1	7.8**
Maximum bases (unweighted)	*147,238*	*30,915*	
	Area B		
Male	51.3	49.4	-1.9**
FSM at baseline	17.2	0	-17.2**
White	91.8	90.7	-1.1**
EAL	4.3	9.2	4.9**
Highest quartile of SES	26.7	6	-20.7**
2nd quartile of SES	29.7	22.9	-6.8**
3rd quartile of SES	23.9	46.5	22.6**
Lowest quartile of SES	19.7	24.6	4.9**
Standardised prior attainment	2.3	-22	-24.3**
IDACI	21	29.1	8.1**
Maximum bases (unweighted)	*254,736*	*37,785*	
	Area C		
Male	51.2	48.9	-2.3**
FSM at baseline	16.4	0	-16.4**
White	79	75.6	-3.4**
EAL	13.6	19.7	6.1**
Highest quartile of SES	30.8	7	-23.8**
2nd quartile of SES	24.3	20.3	-4**
3rd quartile of SES	23	47.2	24.2**
Lowest quartile of SES	21.9	25.6	3.7**
Standardised prior attainment	2.7	-26.3	-29**
IDACI	23.4	30.7	7.3**
Maximum bases (unweighted)	*414,198*	*68,009*	

Notes to Table D1: ** indicates significance at the 1 per cent level; * at the 5 per level. Note that the number of observations varies across outcomes.

Table D2 Impact on attainment at Key Stage 1 in area C (extended entitlement) by Free School Meal status at baseline

Base: pupils in Pilot and Comparison area C who sat Key Stage 1 tests in 2010-11

	Pilot C	Comparison C	Difference
	Eligible for Free School Meals at baseline		
	score	score	score
Standardised average point score	-0.547	-0.577	0.03
	%	%	ppt
Expected level in maths	80.4	81.2	-0.8
Expected level in reading	76.4	73.1	3.3
Expected level in writing	66.9	67.2	-0.3
Expected level in speaking and listening	70.1	76.8	-6.7*
Expected level in science	77.7	76.4	1.4
Maximum bases (unweighted)	692	4,398	
	Not eligible for Free School Meals at baseline		
	score	score	score
Standardised average point score	-0.068	-0.064	-0.004
	%	%	ppt
Expected level in maths	89.9	90.1	-0.2
Expected level in reading	88	87.1	0.9
Expected level in writing	82.4	82.7	-0.3
Expected level in speaking and listening	85	88	-3
Expected level in science	88	88.8	-0.8
Maximum bases (unweighted)	1,942	21,665	

Source: National Pupil Database.

Notes to TableD2: ** indicates significance at the 1per cent level; * at the 5 per cent level. Note that the number of observations varies across outcomes. For the analysis of pupils who are eligible for free school meals at baseline, the minimum number of observations is 4,982; 674 in the pilot area and 4,308 in the comparison areas. For the analysis of pupils who are not eligible for free school meals at baseline, the minimum number of observations is 23,588; 1,941 in the pilot area and 21,647 in the comparison areas.

Table D3 Impact on attainment at Key Stage 2 in area A (extended entitlement) using teacher assessments of performance

Base: all pupils in Pilot and Comparison area A who sat Key Stage 2 tests in 2010-11

	Pilot A	Comparison A	Difference
	%	%	ppt
Expected level in English	70.3	62.2	8.1
Expected level in maths	71.5	64.2	7.3
Expected level in science	73.3	63.8	9.5
Maximum bases (unweighted)	3,253	14,281	

Source: National Pupil Database.

Notes to Table D3: ** indicates significance at the 1per cent level; * at the 5 per cent level. Note that the number of observations varies across outcomes. The minimum number of observations is 17,531; 3,250 in the pilot area and 14,281 in the comparison areas.

Table D4 Impact on attainment at Key Stage 2 in area B (extended entitlement) using teacher assessments of performance

Base: all pupils in Pilot and Comparison area B who sat Key Stage 2 tests in 2010-11

	Pilot B	Comparison B	Difference
	%	%	ppt
Expected level in English	80.3	59.5	20.8**
Expected level in maths	82.4	59.4	23**
Expected level in science	84.5	63.7	20.8**
Maximum bases (unweighted)	4,926	29,281	

Source: National Pupil Database.

Notes to Table D4: ** indicates significance at the 1per cent level; * at the 5 per cent level. Note that the number of observations varies across outcomes. The minimum number of observations is 34,202; 4,921 in the pilot area and 29,281 in the comparison areas.

Table D5 Impact on attainment at Key Stage 2 in area C (extended entitlement) by Free School Meal status at baseline

Base: pupils in Pilot and Comparison area C who sat Key Stage 2 tests in 2010-11

	Pilot C	Comparison C	Difference
	Eligible for Free School Meals at baseline		
	score	score	score
Standardised average point score	-0.599	-0.586	-0.013
	%	%	ppt
Expected level in English	65	62.7	2.3
Expected level in maths	64.6	60.8	3.8
Maximum bases (unweighted)	625	4,425	
	Not eligible for Free School Meals at baseline		
	score	score	score
Standardised average point score	-0.085	0.041	-0.126
	%	%	ppt
Expected level in English	81.7	83.5	-1.7
Expected level in maths	81	81.2	-0.1
Maximum bases (unweighted)	1,846	20,729	

Source: National Pupil Database.

Notes to Table D5: ** indicates significance at the 1per cent level; * at the 5 per cent level. Note that the number of observations varies across outcomes. For the analysis of pupils who were eligible for free school meals at baseline, the minimum number of observations is 4,890; 625 in the pilot area and 4,265 in the comparison areas. For the analysis of pupils who were not eligible for free school meals at baseline, the minimum number of observations is 20,786; 1,846 in the pilot area and 18,940 in the comparison areas.

Table D6 Impact on attainment at Key Stage 4 in area C amongst pupils predicted to be newly entitled to Free School Meals under Pilot C (extended entitlement)

Base: pupils in Pilot and Comparison area C who sat Key Stage 1 tests in 2010-11 and were predicted to be newly entitled to Free School Meals under Pilot C

	Pilot C	Comparison C	Difference
	score	score	score
Standardised total point score	-0.169	-0.189	0.02
	%	%	ppt
5 A*-C grades at GCSE or equivalent	33.4	41.4	-8.0
Maximum bases (unweighted)	647	5,028	

Source: National Pupil Database.

Notes to Table D5: ** indicates significance at the 1per cent level; * at the 5 per cent level. Note that the total number of observations used in the analysis of the standardised average point score is slightly lower, with 651 pupils in the pilot areas and 4,984 pupils in the comparison areas.

Table D7 Impact on attainment at Key Stage 4 in area C (extended entitlement) by Free School Meal status at baseline

Base: pupils in Pilot and Comparison area C who sat Key Stage 4 tests in 2010-11

	Pilot C	Comparison C	Difference
Eligible for Free School Meals at baseline			
	score	score	score
Standardised total point score	-0.386	-0.515	0.129
	%	%	ppt
5 A*-C grades at GCSE or equivalent	21.3	29.1	-7.8
Maximum bases (unweighted)	493	4,542	
Not eligible for Free School Meals at baseline			
	score	score	score
Standardised total point score	0.104	0.076	0.028
	%	%	ppt
5 A*-C grades at GCSE or equivalent	50.1	55.9	-5.8
Maximum bases (unweighted)	2,025	26,123	

Source: National Pupil Database.

Notes to TableD6: ** indicates significance at the 1per cent level; * at the 5 per cent level. Note that the number of observations varies across outcomes. For the analysis of pupils who were eligible for Free School Meals at baseline, the minimum number of observations is 4,992; 490 in the pilot area and 4,502 in the comparison areas. For the analysis of pupils who were not eligible for Free School Meals at baseline, the minimum number of observations is 27,897; 2,016 in the pilot area and 25,881 in the comparison areas.

Ref: DFE-RR227a

ISBN: 978-1-78105-125-2

July 2012