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ATTAINMENT IN SECONDARY SCHOOL

L. FEINSTEIN and J. SYMONS

ABSTRACT

This paper studies attainment in secondary schools. We estimate an education production function in which attainment depends upon parental inputs, peer group inputs and schooling inputs. We find that the most powerful parental input is parental interest in children, as assessed by teachers. We find a strong peer group effect. The school pupil-teacher ratio does not enter significantly. The only strongly endogenous variable is initial attainment. We argue that this is due to measurement error. There is some evidence that parental interest is endogenous but we do not find peer group variables to be so.

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1. INTRODUCTION

This paper estimates an education production function to test the importance of peer group and other inputs for educational improvement in secondary schools. We find evidence of strong peer group effects, as do Robertson and Symons (1996) for a parallel study of primary education. We also consider the channels for the impact of general socio-economic variables such as paternal occupational class. We find that variables indicating parental interest in the education of their children generally drive out the family background indicators of social class, family size and parental education.

There has been much concern recently about the achievement (or otherwise) by British children of set standards in education. This has run in tandem with continuing debates about the role of selection by schools and of expanding choice for parents. Economists have applied theoretical models developed in human capital theory to education in order to shed light on the complex set of factors that influence the attainment of children. The centre-piece of this theoretical apparatus is the education production function which enables structural models of inputs and outputs to be developed and tested.

Many psychologists and educationalists, however, stress the inter-connectedness of variables. Inputs to a production function might themselves be outputs or choice variables from other structural relationships. For example, a peer group might be considered to be an input to education through the effects of role models, learning interactions between children or as a description of the task facing teachers. On the other hand, membership of peer groups is controlled both by schools and by parents: schools often select children by ability and other criteria and parents select schools either directly or by location decisions. More subtly, some psychologists have pointed out that the ability to gain entry to a good peer group (or to develop beneficial relationships within one)

is to some extent an attainment produced in the family environment (see, for example, Parke *et al* (1992) for a selection of papers on such issues). Thus, membership of a good peer group can be considered an output of earlier production (as, for example, by psychologists in the tradition of Bowlby, 1969). Clearly, then, the association between peer groups, family variables and performance is complex, characterised by considerable endogeneity. For this reason, writers in other disciplines have stressed the value of ecological models (Bronfenbrenner, 1979) or multiple pathways (Schneider, 1993) that consider the inter-relatedness of inputs and outputs. Thus, one of our aims in this study is to test the applicability of a structural econometric model to children's attainment in school.

We test for the endogeneity of peer group inputs including school type and ability stream, as well as the social class of the school's peer groups. We control for standard social class variables and consider how peer groups and parental interest in education provide channels for family variables to influence attainment. The data considered are provided by the NCDS and are based on an initial survey of all children born in the UK between March 3—9, 1958. Further sweeps were carried out when the children were 7, 11, 16, 21 and 31, giving information on the academic attainment of those children who remain in the survey. Sample children entered secondary education in 1969 when the education system in the UK was undergoing considerable change. Selection by examination, formerly widespread, was gradually being replaced by non-selective comprehensive schools. Clearly choices of schools by parents render peer groups endogenous, but this is compounded when schools choose children by examination. To some extent, this is evaded by controlling for early attainment. The NCDS provides a number of useful peer group variables as well as family background variables and measures of attainment.

In the next section we describe the theoretical framework and introduce the variables used to describe inputs and outputs. We present the results in Section 3.

2. THEORETICAL FRAMEWORK

The theoretical concept underlying our analysis is the educational production function. Attainment is generated by family inputs, conventional schooling inputs and peer group inputs. We follow Hanushek (1992) in writing

$$A_t = f\,(A_{t-1}\,,\, F_t\,,\, S_t\,,\, P_t)$$

where A_t denotes attainment at date t, F_t refers to family inputs during period t, S_t denotes schooling inputs and P_t denotes peer group effects. One can think of this as a value-added formulation: the inputs at t act on initial attainment A_{t-1} to produce attainment at t. Robertson and Symons (1996) adopt this framework to study attainment in primary schools in NCDS data.

Measures of attainment

The dependent variables in the analysis are Reading and Mathematics ability at 16, as well as an index of overall exam performance in all subjects. The NCDS administered tests in both Reading and Maths. We use the NCDS mathematics score at 16 as our measure of attainment. We found, however, low discriminatory power in the reading test: about one third of the population scored in the top seventh of the reading scale. Robertson and Symons (1996) encountered a similar problem in analysis of the tests at age 7. As our measure of attainment in Reading, we use an index of highest grade attained in national examinations in English at any time.

We construct a value-added model using NCDS scores of Reading and Maths at age 11 as lagged dependent variables in the Reading and Maths regressions. Ideally, the lagged dependent variable is true attainment at age 11. Since a test score inevitably contains measurement error (with respect to true attainment) some instrumentation is required.

Measures of parental inputs

Parental inputs are commonly found to be immensely significant in determining attainment. This finding goes back at least as far as the Coleman Report (1966). (See Haveman & Wolfe (1995) for a comprehensive discussion.) There are a number of channels for parents to influence their children's educational performance. These have often been classified as measures of the amount of time devoted to children and measures of the educational quality of that time. Hanushek (1992) finds that attainment decreases with family size and explains this using Becker's theory of time allocation within the family (Becker, 1991). As Haveman and Wolfe highlight, it is also generally found that children of parents with high levels of schooling perform better than children with less educated parents. This might be due to the transmission of genetic endowments or to environmental factors such as the higher educational quality of the time of educated or able parents. It is also normally found that children from higher social classes perform better but the channels for this effect remain somewhat uncertain. One hypothesis is that this reflects superior ability, controlling for education, of those in higher occupational groups, this superior ability then being reflected in better child raising. Parents can also influence attainment by provision of study material (an example of a financial effect of social class) and indirectly by providing incentives and discipline. Presumably these latter effects become more important in secondary education.

The NCDS has recorded teachers' impressions of the interest parents take in the progress of their children at ages 7, 11 and 16, available separately for mothers and fathers. One pleasant feature of the parental interest variable is that it seems likely to be correlated with parental time spent with the child, a more conventional economic input to a production function. Hanushek (1992) makes an important distinction between 'public' and 'private' time of parents. Public time refers to the establishment within the household of a common environment comprised of attitudes towards learning, ambition, morality, language *etc*. Private time refers to active parental involvement with the education of specific

children, correcting homework, for example. A plausible interpretation of the parental interest variable is as a proxy for Hanushek's 'private time'. Public time, however, seems likely to be associated with parental education and social class. Thus regressions containing both proxies possibly enable comparison of the relative importance of public and private time as well as evaluating the direct factor input of parental interest.

The parental interest variables suffer from potential problems of endogeneity. Parents may show high levels of interest in children who do exceptionally well at school: for example, they might regularly attend parent teacher evenings to bask in reflected glory. On the other hand, parents of children who do unexpectedly badly might attend PTA meetings to see what can be done to improve their child's performance. Thus endogeneity bias can go either way.

In principle, working women have less time to spend on their children. Robertson and Symons (1996) find in NCDS data that, while the children of working women have lower attainment at 7, the increase in attainment between 7 and 11 is unaffected by the mother's labour force status. *A fortiori*, one expects to find no effect between 11 and 16. Hill and Stafford's (1980) time diary study finds that the reduction in time devoted to adolescent children by working women is quite modest. In the empirical work (discussed below) we performed some experiments with mother's labour force status, finding no consistent effects.

Measures of schooling inputs

Variables such as class size and teacher experience are usually found to have little effect on attainment. Hanushek (1986) provides an extensive discussion of this evidence. Some recent studies have found more positive evidence. Card and Kreuger (1992) showed that the returns to education across states in the US are correlated with state-wide educational expenditure. The STAR experiment in Tennessee shows significant benefits of smaller classes but these seem to occur only for fairly dramatic reductions in class size and mainly in the first year. The difficulty of

finding an effect of class size on attainment is curious at first glance. It is popularly believed that children perform better in small classes and if pushy parents choose schools with low class sizes as well as fostering development in unobserved ways, apparently significant correlations should be easy to find. The problem appears to be that schools tend to put children who are performing badly in smaller classes. For example, top streams in the NCDS are significantly larger than bottom streams. To some extent this endogeneity problem can be reduced by using the pupil-teacher ratio (PTR) as a general measure of the school's endowment of teachers. However, it is usually found (Darlington and Cullen, 1982) that PTR itself is wrongly signed in attainment regressions. The reason is perhaps analogous to the placement of less able children in small classes within given schools: it may be that schools in deprived areas seek or are given low PTRs, reflecting their particular teaching and disciplinary needs. Thus the Ofsted Report (1995) finds that Local Education Authorities in inner-urban schools in the UK tend to have lower pupil-teacher ratios than other schools. This problem should be offset by controlling for social class and peer groups but other problems remain. Darlington discusses the problem of separating teaching from administrative time. The quality of teaching is also a key variable that is unmeasured in the NCDS.

Measures of peer group inputs

The Coleman Report emphasises the importance of a child's peer group for attainment, but these findings have been controversial. See Smith (1972), Averch (1972) and Hanushek (1971, 1972). More recently Summers and Wolfe (1977) and Henderson *et al* (1978) have found positive peer group effects, as have Robertson and Symons (1996). In other contexts peer group effects have been found to be important in teenage pregnancy and school drop-out behaviour (Evans *et al*, 1992). Educational theory provides support for peer group effects. For example Foot *et al* stress the importance of strengthening teaching interactions between children.

The NCDS has a number of measures of peer group at age 16. Four were used in this study: the proportion of children in the class with fathers in non-manual occupations, the proportion of children in the class only taking GCE examinations, the proportion of children in the class only taking CSE examinations and the proportion of children from the previous year's class who stayed on in education after the then minimum leaving age of 15. We constructed a single peer group index as the sum of these variables (the CSE proportion entering negatively). The index was scaled to range between 0 and 1.

We include school type (grammar, comprehensive, secondary modern, private) as a peer group input. In general, the intake of grammar schools and secondary moderns at the time of the tests was determined by examination. These schools were gradually being replaced, as noted above, by (non-selective) comprehensive schools. Endogeneity problems arise from choices by parents and choices by schools. In the first place, ambitious parents will tend to choose good peer groups for their children as well as helping them in other unobserved ways, perhaps not captured by the parental interest variables. Secondly, if some schools are better than others in ways observed by parents but not by the NCDS, these schools will have positive control over their selection intake. The peer group effect will then be conflated with the unobserved school quality.

Table 1 shows the proportion of cohort members in different school types. In 1974, at age 16, 59% of the NCDS cohort members attended comprehensive schools. Because the number attending special schools was low we exclude the dummy variable on special schools in the analysis below.

Table 1: School Type and Streaming

			% streamed	
	No	%	English	Maths
Comprehensive	7454	58.5	75.5	83.3
Grammar	1347	10.6	50.4	82.0
Secondary Modern	2738	21.5	68.7	77.0
Private	764	6.0	49.2	77.9

Special	446	3.5	28.3	30.0
Total	12749	100		

Of course, school type does not only represent peer group inputs but also reflects the reverse causal link between pupil intake and curriculum. Secondary moderns, for example, were intended to meet the educational and future occupational requirements of less academically able children. We expect these children to do less well in exams, partly reflecting the lower expectations and perhaps motivation of teachers in these schools. However, since entrance to grammar schools and secondary moderns was based on selection by examination at 11, these schools do also provide very homogenous intellectual peer groups.

As well as school type itself, ability groups within schools also create peer group effects. Table 1 shows that streaming was much more common in comprehensive schools than elsewhere. A pupil in a high stream receives good peer group effects as well as advanced instruction. These advantages are to some extent controlled for in our analysis by the peer group variable itself but we do include dummy variables for the pupil's stream. These variables will be endogenous if pupils who show unexpected development between 11 and 16 tend to be allocated to a high stream.

Instrumentation

It is possible to argue for the endogeneity of nearly all right hand side variables in socio-economic analysis of the kind conducted here. However, the scarcity of instruments limits the amount of endogeneity that can be handled. We will focus on measurement error in the lagged dependent variable and reverse causality in the parental interest and peer group variables. Finally, we instrument PTR because it is a choice variable for parents and schools.

To deal with the measurement error in early attainment we instrument attainment at 11 using teachers' assessments of children's abilities. Additionally, in the Maths equation the lagged Reading score

enters the instrument set and *vice versa*. The use of teachers' assessments of the child at age 11 as instruments is open to the objection that teachers might have better knowledge of a child's future attainment than is revealed by the test at 11. This would invalidate use of the assessments as instruments. We use a Sargan test (Sargan, 1988) of the orthogonality of instruments and equation error to assess the use of these and other instruments.

To instrument average parental interest between 11 and 16 we use mothers' and fathers' interest at 7. Local Authority dummies are used to instrument for peer groups and PTR. This requires some discussion. The appropriateness of instruments is related to the source of potential endogeneity. We consider here the peer group variables, though very similar remarks could be made about PTR. If, as argued above, ambitious parents choose good peer groups for their children as well as helping them in other ways, then the peer group parameter will be biased upwards if peer group is treated as exogenous. The question then is whether especially ambitious parents are likely to be clustered in certain areas: if so, geographical variables are inappropriate as instruments. However, since we control for social class and parental education, the question becomes whether a family of given social class and education is likely to be more ambitious for its children in Wandsworth, say, than in Clapham. Brooks-Gunn *et al* (1993) discuss various ways in which parental ambition, aptitude in household production and location might be related. For example, parents who consider themselves able to counteract the negative effects on attainment of living in an economically deprived area are more likely to choose to locate there. Alternatively, parents unable to re-locate are more likely to be found in such areas. The direction of whatever bias there may be is therefore uncertain. Robertson and Symons (1996) conclude that location effects are not an important source of bias, though their analysis is conducted for larger geographical areas. In their analysis of peer group effects described above, Evans *et al* (1992) use variables measuring local area deprivation as instruments for peer group. Again, the Sargan methodology offers a test of our instruments.

As stated above, endogeneity can also arise because of the choices

of schools: if certain schools are good in ways observed by parents but unobserved in our data (for example, because of a good headmistress) these schools may 'cream' the best students. This means that the peer group effect is conflated with the unobserved school quality. The question is then whether such unobserved quality, unrelated to observable school type and peer group, is correlated with Local Authority area. We do not find this compelling.

3. RESULTS

In Table 2 we present IV estimates of production functions for attainment in English, Maths and for the overall index of examination success. We treat parental interest, peer groups and PTR as exogenous. (In Table 4 we shall report a test similar to Hausman (1978) supporting the exogeneity of our peer group variables.) Inputs are loosely classified as family, peer group or schooling variables. A dummy variable for gender is also included.

In these regressions we have instrumented the lagged dependent variables for the errors in variables reason set out above. The parameters obtained for Maths, English and All Exams are 0.47, 0.62, and 0.57 respectively, as against 0.31, 0.46, and 0.46 without instrumentation. These changes are very significant by the Hausman criterion, providing support for the hypothesis of measurement error. The proportional bias is given by the ratio of the measurement error variance to the variance of observed lagged attainment. (In the multivariate case the denominator is the variance of the residuals from the regression of lagged attainment on the other exogenous variables.) This enables calculation of the magnitude of the standard deviation of the measurement error. We find these to be 7.7, 9.1, and 6.0 for English, Maths, and All Exams, respectively. These numbers seem to give fairly plausible 95% confidence intervals for test scores.

Of the family inputs, only parental interest has a consistently strong impact. In contrast to what is usually found, social class, family size and

parental education are not generally significant. We performed chi-squared tests for the exclusion of these seven variables in each of the three equations, obtaining values of 2.8, 16.1 and 21.7 for English, Maths and All Exams respectively. Thus, only in the All Exams regression do we find joint significance of the seven background variables at the 1% level. It is not clear what is the appropriate test size with such numerous data. In any event, the seven SES variables have relatively small effects on All Exams results: the combined effect of coming from a high social class with parents who stayed on in school after 16 is still only 5.33 percentage points compared to an effect of 21.59 from moving from no parental interest to the highest level of interest. The correction for measurement error plays a role here. If this correction is not made, initial attainment is biased down and the regression acquires more of the nature of a cross-section in which these variables are stronger. The fact that parental interest far outweighs social class in these regressions suggests that, in Hanushek's terminology, private time is more potent than public time in fostering attainment in children. In any case, it is clear that the interest parents take has a strong effect on the education of their children

Recall that parental interest is measured as the average of mother's and father's interest. When entered separately, mother's and father's interest attracted roughly equal parameters: the average of the two is therefore a convenient simplification. It will also minimise the number of endogenous variables requiring instrumentation. When a parent was absent from the family, that parent's interest was set to zero and a dummy variable was introduced in the regressions in Table 2. The parameter on the parental absence dummies thus estimates any effect of an absent parent beyond that channeled through missing parental interest. These dummies were never significant at the 5% level, so it follows that the effect of absence of a parent who takes (or would have taken) maximum interest is represented by *half* the parameter on parental interest in Table 2, while the absence of a parent taking minimum interest has no effect at all. Note that the former effect is significant and important in magnitude.

The peer group variable is very strong, as is being in the top stream of a streamed school. The parameter on the dummy variable 'streamed

school' measures the effect of being in the bottom stream. Thus, a pupil in the bottom stream for English scores 4.60% less than a student in a non-streamed school (and 8.66% less than a student in the top-stream), *ceteris paribus*. The mixed school parameter measures the average advantage to boys of being in a mixed-sex school. This tends not to be significant. However, girls in mixed schools do worse than in single sex schools although the effect is only significant for English. Grammar schools appear to have a strong positive effect on performance relative to the default group, comprehensive schools. We also observe a negative effect of secondary modern attendance, especially for English. Attendance at private schools is nowhere significant.

The pupil-teacher ratio has a negative effect on attainment but is not significant in any of the three regressions. As commonly found, girls perform better than boys in English and worse in Maths. Girls perform a little better than boys in overall academic attainment but not significantly.

We tested a number of variables in this model to represent effects from the neighbourhood (non-school peer group effects). Both at the level of the Local Authority (average population about 300,000) and at the level of the OPCS Enumeration District (average population about 460), we tried the unemployment rate, the proportion of unskilled manual workers, the proportion living in council housing, and the proportion of immigrants. Only once was the parameter correctly signed and significant (the All Exams regression for the unemployment rate measured at the L.A. level). We conclude that the school provides by far the most influential peer group.

Table 2: Attainment at 16

	English		Maths		All Exams	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
Score at 11	0.47	13.6	0.62	30.4	0.57	13.9
Parent quality and time inputs						
Father in top SES	0.95	0.9	1.26	1.5	2.30	1.8
Father in middle SES	0.19	0.3	0.19	0.3	-0.32	0.4
Father stayed on at school	0.73	0.9	0.43	0.7	1.35	1.4
Mother stayed on at school	-0.32	0.4	1.25	2.1	1.68	1.9
Number of older children	-0.14	0.6	-0.50	2.4	-0.61	2.0
Number of younger children	-0.15	0.5	0.03	0.1	-0.15	0.4
Father plays a role in upbringing	0.28	0.3	-0.12	0.1	-0.75	0.6
Parental interest	13.22	5.2	10.11	4.7	21.59	6.8
Peer group inputs						
Peer group	7.57	3.4	6.67	3.6	9.32	3.4
Top stream	4.06	5.4	5.59	9.0	5.98	5.6
Streamed School	-4.60	3.8	-2.81	2.7	-3.20	1.7
Grammar School	5.92	4.5	2.90	2.8	6.73	4.2
Secondary modern school	-3.64	4.5	0.73	1.0	-1.91	1.9
Private school	2.34	1.2	-0.37	0.3	-0.03	0.0
Schooling inputs						
Pupil-teacher ratio	-0.16	1.0	-0.02	0.2	-0.07	0.4
Gender (=1 if girl)	6.75	5.1	-2.83	2.8	2.35	1.5
Mixed School	1.00	0.9	0.64	0.7	-1.09	0.8
Girl in mixed school	-4.03	2.8	-2.01	1.8	-2.00	1.1
Constant	-7.94	2.0	8.75	1.38	1.39	1.8
R-squared	0.51		0.65		0.63	
Number of observations	2514		3234		2429	

Notes: i) All dependent variables are scaled to take values between 0 and 100. "All Exams" is a composite index of school examination results. Peer group and parental interest are scaled to take values between 0 and 1.

ii) In the "All Exams" regressions, score at 11 was represented by the average of Maths and English scores. Dummy variables of ability streams of both English and Maths were required.

iii) When parental interest at 7, 11, or 16 was missing, either because it was unreported or a parent was missing, it was set to zero. Dummy variables were introduced for missing mothers and fathers as well as for genuinely unreported observations at 7, 11, and 16 (12 dummies in all). These are not reported.

iv) Maths and English scores at 11 are treated as endogenous and instrumented by the score in the other subject (Maths by English and vice versa) as well as teachers' assessments at 11.

Channels for the transmission of parental inputs

The finding that social class and family inputs other than parental interest do not have important effects on attainment is partly to be expected in an improvement regression. Early effects of parental inputs are channeled through attainment at 11. Mainly, however, this is due to the effects of parental interest and peer group. If these variables are excluded the other family variables become much stronger and generally significant. It is interesting to consider the determination of the peer group and parental interest variables. Table 3 shows the results of these regressions.

Table 3: Channels for Parental Inputs

	Parental interest at 16				Peer Group	
	Father		Mother			
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
Father in top SES	0.12	12.1	0.14	12.4	0.13	15.4
Father in middle SES	0.04	5.6	0.05	6.2	0.02	3.8
Father stayed on at school	0.08	10.2	0.09	10.0	0.09	13.3
Mother stayed on at school	0.09	13.9	0.08	10.0	0.08	14.0
Number of older children	-0.04	17.7	-0.05	16.5	-0.01	7.7
Number of younger children	-0.03	11.3	-0.04	10.7	0.01	5.3
Mother works			0.01	1.7		
Father not present			-0.12	6.1		
Gender (=1 if girl)	0.01	1.6	0.00	0.5		
Constant	0.41	51.4	0.30	35.6	0.44	65.5
R-squared	0.18		0.20		0.19	
Number of observations	7430		5387		7299	

Note: The dependent variables take values between 0 and 1.

These regressions indicate that the socio-economic variables commonly found to be associated with educational performance affect attainment *via* parental interest and choice of peer group. Our finding that higher SES groups show more interest in their children parallels direct estimates of time allocation by Hill and Stafford (1974,80). The fact that lone mothers and the parents of large families show reduced interest in each child is

consistent with a parental time constraint. This may not be the full story. Hill and Stafford's 1980 study shows that the direct time absorbed by adolescents tends to be rather small (about 26 minutes for all mothers, though 60 for women who have been to university). It may be that, in some circumstances, large numbers of children or the absence of a spouse make it difficult, for reasons unrelated to time, to establish discipline about such things as homework. Note that working women show no less interest in their adolescent children. Feinstein *et al* (1996) find in these data that, if a women is working when her child is 7, or if she has ever worked over the preceding 7 years, she is reported as showing lower interest. This presumably reflects a time constraint. If we interpret parental interest as a genuine measure of parental input, we conclude that this input is lower for women who work when their children are young but not when their children are older. This accords well with Hill and Stafford's (1980) finding that working women spend substantially less time with younger children.

Endogeneity issues

In the estimates presented only the initial score at 11 has been instrumented. We have argued above that parental interest and all the variables classified as peer group inputs in Table 2 could be considered as endogenous. Table 4 (columns 3 and 4) gives the results of treating them as such using Local Authority area dummies as extra instruments. A Sargan specification test provided some legitimacy for this larger instrument set: we do not reject orthogonality of instruments and residuals from the instrumented equations for any of the three attainment measures at the 10% level.

To assess the effect of instrumentation, Table 4 also contains the estimates from Table 2 where these variables were treated as exogenous. We can thus perform tests similar to those of Hausman (1978) for the change in the parameter when a variable is treated as endogenous. Our base-line regression instruments only the score at 11 (for measurement error). Because we are comparing two instrumental variables estimators,

we cannot assume that our base-line regression is efficient (Mroz, 1987). The Hausman analysis requires this assumption for the computation of the variance of the difference in estimators. However, if we assume that measurement error is uncorrelated with our extra instruments in the second regression (Local Authority dummy variables and lagged parental interest) then the simple Hausman technique does apply. The t-statistics reported in column 5 are calculated according to this assumption.

Instrumenting the peer group variable leads to much increased standard errors but the point estimates are nearly unchanged. Thus, counter to Evans *et al* (1992), we do not reject the null hypothesis that peer group is exogenous. This holds not only for the main peer group variable, but also for school type and presence in the high stream. Parental interest appears to control for some of the potential endogeneity bias.

We do reject the null hypothesis of exogeneity of parental interest two times out of three. Instrumentation increases the parameter on parental interest suggesting the source of endogeneity: parents show more interest if their children do unexpectedly badly. This supports the 'something must be done' hypothesis discussed in Section 2. An alternative explanation for the increase in the parameter on instrumentation is that parental interest measures with error the underlying parental factor input to attainment.

Overall, there does not seem to be a lot of endogeneity bias for peer group and school type variables. Indeed, the only strong effect of instrumentation is on the initial score variable, as discussed above. Given early attainment, parents do not seem to choose peer groups and schools in such a way as to generate important endogeneity. It must be remembered that this evidence dates from the early seventies. Active parental choice may have been relatively restricted or unimportant for most of the population. It is also true that, at the time, there was considerable restructuring of the education system, in such a way that many of the school-type variables could have been determined effectively as random experiments.

Table 4: Treating Key Variables as Endogenous in the Attainment Equation

	Variables treated as				t-stat on difference
	Exogenous		Endogenous		
	Estimate	s.e.	Estimate	s.e.	
Parental interest					
C Reading	13.22	2.56	26.42	6.82	2.1
C Maths	10.11	2.16	12.63	5.90	0.5
C All Exams	21.59	3.18	41.21	8.53	2.5
Peer Group					
C Reading	7.57	2.23	6.84	5.28	0.2
C Maths	6.67	1.88	7.43	4.93	0.1
C All Exams	9.32	2.76	11.12	6.58	0.3
High stream					
C Reading	4.06	0.75	4.09	2.31	0.0
C Maths	5.59	0.62	7.71	2.03	1.1
C All Exams	5.98	1.07	4.14	3.05	0.6
Private school					
C Reading	2.34	1.92	-0.25	6.05	0.5
C Maths	-0.37	1.43	-0.63	5.06	0.1
C All Exams	-0.03	2.36	3.08	7.21	0.5
Grammar school					
C Reading	5.92	1.32	7.82	3.56	0.6
C Maths	2.90	1.05	7.63	2.93	1.8
C All Exams	6.73	1.62	11.18	4.34	1.1
Secondary Modern					
C Reading	-3.64	0.81	-2.33	1.79	0.8
C Maths	0.73	0.68	-1.34	1.55	1.5
C All Exams	-1.91	1.00	-1.72	2.24	0.1
PTR					
C Reading	-0.16	0.15	-0.17	0.28	0.0
C Maths	-0.02	0.11	-0.30	0.23	1.4
C All Exams	-0.07	0.19	0.11	0.34	0.6

Note: The table describes the effects of making each of the seven tabulated variables endogenous in the regressions in Table 2. The instruments were Local Authority dummies, parental interest at 7 and early attainment.

4. CONCLUSIONS

In this paper we consider the influence of family, schooling and peer groups on the development of children in the NCDS between the ages of 11 and 16. We estimate a structural model that provided a plausible representation of linkages of family background variables, schooling and peer group effects. It seems that satisfactory instruments are available to handle endogeneity problems. In fact, we encounter less endogeneity than is suggested by the literature surveyed in the introduction. PTRs seem to have minimal effects on attainment at 16, consistent with recent research. In common with other researchers, we find that peer groups have a significant effect on attainment but we do not reject the exogeneity of the peer group variable. Families select or determine peer groups in ways associated with social class, family structure and parental education but the peer group, rather than these background variables, then provides the major input during the period between 11 and 16. Thus we confirm the 'parents and peers' theory of educational attainment for children in British secondary schools, as emphasised by Robertson and Symons (1996) for children in primary schools.

The major channel through which family background variables influence attainment is parental interest. This dwarfs the direct effects of parental education and class, but is itself strongly correlated with these. The involvement of parents in the secondary education of their children has an important effect on continued development, presumably through motivation, discipline and support.

Sallis (1987) shows how the 1986 Education Act strengthened earlier measures to reinforce parental interest over schools. Sallis discusses the shift in education policy from paternalism to consumerism, arguing that schools and parents are constrained in the development of partnerships by professional resistance to dialogue with parents. Our findings suggest that the more parents can be brought into involvement with their children's education, the more effective that education will be.

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