

# **Are Secondary Schools in Northern Ireland Too Small?**

## **A Microeconomic Analysis of School Size and Career Choice at Sixteen.**

**Duncan McVicar**

**Northern Ireland Economic Research Centre**

January 2000

JEL: I21, J24.

Keywords: School size, participation, selection.

This paper was written as part of the Centre's research programme on Human Resources and Economic Development. Financial support from the Department of Economic Development and the Department of Finance and Personnel in Northern Ireland is gratefully acknowledged, as is excellent research assistance from Brian McKee and Rosemary McNicholl at NIERC. The usual disclaimer applies.

## **Abstract**

Recent research suggests the existence of an inverted U-shaped relationship between school size and examination performance at 16 for English secondary comprehensive schools. Increasing from a small size, positive teacher-specialisation and related effects dominate negative personal-relationship effects and vice versa at large sizes. It is suggested that schools with around 1000 to 1500 pupils are optimal in this respect. Given the existence of such an examination-performance effect, it is possible that school size also affects career choice at sixteen in a similar way. However, the literature has not so far addressed this question explicitly.

In this paper, I examine the possible importance of school size as an explanatory factor in career choice at sixteen for a sample of young people completing their compulsory education in Northern Ireland. The issue is of particular interest in the region because of the religious segregation of schools, which, other things being equal, is likely to reduce their average size relative to those in Britain. However, rather than suggesting that NI schools are indeed too small, the results suggest they are close to their optimal size, at least in terms of discouraging early labour market entry. One possible explanation for this is that schools can operate successfully at a smaller scale because of the selective nature of secondary education in the region.

# 1: Introduction

If the UK is to compete successfully in international markets it is widely believed that we need a highly trained and highly qualified workforce. One way of achieving this is to improve the skill levels of young people entering the labour market, which has been a primary aim of recent government policy.<sup>1</sup> Increasing participation in post-compulsory education is therefore an essential part of our overall economic strategy. A number of factors that affect participation are, in theory, available to policy makers as instruments for change. In this paper, I examine whether government could influence participation through changes in school size.

Bradley and Taylor (1998) argue that a school's size might affect the examination performance of its pupils in a number of conflicting ways.

1. Subject choice in small schools may be more limited than that in large schools because small schools are less able to employ a diversity of subject specialists. Consequently pupils in small schools may have less opportunity to select subjects in which they could perform well.
2. Teachers in small schools might have to teach a wider range of subjects, reducing the benefits from specialisation.
3. Small schools are less able to stream than large schools, which may reduce beneficial peer group effects (see Feinstein and Symons, 1999).
4. Teachers in small schools may have to undertake more administrative tasks than teachers in large schools and this might reduce contact time.
5. Larger schools have a greater resource base and may therefore be better able to afford central facilities such as computers or libraries. They may also be able to benefit from any economies of scale through bulk buying of equipment, for example.
6. Pupils and teachers may interact less outside the classroom in larger schools which might be detrimental to performance.
7. Large schools may suffer from management difficulties or problems with discipline that could harm teacher morale (see Haller, 1992).

---

<sup>1</sup> One example is the setting of qualifications targets for 16, 19 and 21 year olds (see NACETT, 1998).

8. Increasing average school size might reduce the intensity of competition between different schools for pupils, which might reduce performance incentives.

In short, many of the economies and diseconomies of scale that economists take for granted in firms might also be reflected in schools. References to examples of these economies and diseconomies of scale can be found in Inspection Reports for Secondary schools in Northern Ireland.<sup>2</sup> One small school is noted for how:

The principal and staff have worked consistently and successfully to capitalise on the advantages and to counter the disadvantages of the small school...The majority of teachers teach two or more subjects...(but there is)...a strong sense of community within the school.

Another report notes:

As a consequence of the low enrolment, significant demands are placed on the teachers, most of whom teach more than one subject or carry other responsibilities.

One large school is noted for how:

The links between the departments which contribute to work in the...area of study are insufficiently developed; in particular, there is little planning to help disseminate good practice throughout the area of study.

Bradley and Taylor (1998) examine the relationship between school size and examination performance for a sample of English comprehensive schools between 1992 and 1996.<sup>3</sup> Both school size and squared school size are included as explanatory variables in an attempt to capture the possible non-linearity of any relationship, as suggested by the contrasting positive and negative effects listed above. They find a significant positive coefficient on the school size variable and a negative coefficient on the squared school size variable. Overall, this suggests the existence of an inverted U-shaped relationship between school size and exam performance. Given this non-

---

<sup>2</sup> These are freely available directly from DENI. Individual schools are not identified here, however.

<sup>3</sup> 11-16s.

linearity, they argue there is an optimal school size in terms of exam performance, which they estimate to be around 1200 for schools without 6<sup>th</sup> Forms and 1400 for schools with 6<sup>th</sup> Forms. As the average size of such schools in England is around 800 and 1000 respectively, Bradley and Taylor argue that increasing the average size of schools will improve average exam performance.

Given the existence of a non-linear relationship between examination performance and school size, it is possible that something similar exists between school size and career choice at sixteen. Optimally sized schools that perform well in terms of examinations are likely to encourage post-compulsory education relative to sub-optimally sized schools over and above the exam performance effect for the same reasons. Regardless of exam performance, pupils are more likely to want to stay on where there is a sufficient range of subjects offered and where their experience of pupil/teacher relationships has included informal outside-classroom interaction, for example. This paper examines the evidence for such a relationship in a sample of young people completing compulsory education in Northern Ireland in 1993.

The possibility of a relationship between school size and career choice at sixteen is of particular interest in Northern Ireland because of the largely segregated nature of the education system in the region. This segregation reduces the average size of schools substantially below that of the rest of the UK. The selective nature of secondary education in the region is also likely to reduce the average size of schools catering for this age group. For example, average secondary school size in NI was just 543 in 1996/97 compared to around 800 for English comprehensives.<sup>4</sup> The implication is that Northern Ireland's schools may be too small by a considerable margin. If this is indeed the case, then by encouraging integration of existing schools, the government could have a significant effect on post-compulsory education participation through the implied increase in average school size.

---

<sup>4</sup> Source: DENI (1998).

## 2: The Data

The individual level data used in this study are taken from a survey of young people in Northern Ireland who became eligible to leave school for the first time in 1993.<sup>5</sup> The survey was carried out in June 1995, with information collected on post school destinations, qualifications gained at 16, individual and family background characteristics and school attended. The sample was stratified by post-5<sup>th</sup> Form destination, giving extra weight to those young people who left school and entered employment, unemployment or vocational training.<sup>6</sup> 980 responses from this sample are usable.

The data from the 1995 Status 0 Survey were supplemented by information at school level from a number of sources. Firstly, the type (eg: ELB Controlled/Voluntary) and selection regime (grammar/secondary) of schools is available from DENI's 1992/93 School Performance Indicators. The same source contains information on the proportion of 5<sup>th</sup> Form leavers obtaining 5 or more GCSE grades A-C and on attendance rates. The presence of a 6<sup>th</sup> Form at the school, the co-ed or otherwise status of a school and information on number of teachers and pupils are available from DENI directly. Information on school expenditures is available from the 5 Education and Library Boards of Northern Ireland. All this information is not available for all schools in the sample. Consequently, our sample is reduced to 566 individuals by deletion of observations with key information missing.

The sample is then restricted to secondary schools without 6<sup>th</sup> Forms (all grammar schools and secondary schools with 6<sup>th</sup> Forms are omitted).<sup>7</sup> Given the non-random nature of this sample, proportions are weighted in the estimation procedure as outlined in the following section. Table 1 shows the population and sample proportions for the career choices at sixteen of secondary school pupils.

---

<sup>5</sup> The Status 0 Survey (see Armstrong et al, 1997).

<sup>6</sup> These young people were the focus of the original research for which the survey was carried out (see Armstrong et al, 1997).

<sup>7</sup> Following Bradley and Taylor (1998). The sample size is too small for separate analysis of secondary schools with 6<sup>th</sup> Forms.

*Table 1: Career Choice at 16 Population and Sample Proportions*

	Population %	Sample %
School	27.5	10.5
FE College	26.2	39.2
Vocational Training	33.6	17.3
Employment	5.2	28.4
Unemployment/Other	7.4	4.7

Notes: Population figures for 16 year olds, educated at secondary schools, for 1993, taken from Armstrong et al (1997). The sample size is 342 individuals. Population proportions are not available separately for secondary schools with and without 6<sup>th</sup> Forms, so figures given are for secondary school pupils in total.

The variables used to explain career choice at 16 are listed in Table 2, with their sample means. They can be divided into separate groups of individual and family, school and environmental factors. With the exception of the school size variables and the grammar school and sixth form dummies, the set of explanatory variables is identical to that used in McVicar (1999b), to which readers should refer for further discussion. They consist of standard background factors and frequently used school-level factors.

*Table 2: Sample Means of Explanatory Variables*

	Variable	Sample Mean
<b>Individual/Family</b>	Catholic	.43
	Male	.58
	Quals	5.33
	Professional Father	.22
	Professional Mother	.08
	Siblings	2.73
	<b>School</b>	PTR
Expenditure per Pupil		2188.12
School % GCSE5		22.06
Attendance Rate		91.11
School Size		560.47
School Size <sup>2</sup> /1000		363.38

	Controlled	.57
	Single Sex	.29
<b>Environmental</b>	LGD Unemployment Rate	14.67
	Urban	.20
	TSN Area	.57

What do the raw data tell us about the relationships between career choice at 16 and school size in NI? At individual level, career choice is modelled as either a number of binary choices (eg: school or not school) or as a multiple choices variable. There is little to be learned from graphical presentation of such variables. However, we may get a sense of an underlying pattern by looking at simple pairwise correlations between binary career choices and school size for different size intervals. This exercise is summarised below in Table 3.

*Table 3: Simple Correlations Between Binary Career Choices and School Size.*

	No. Pupils		
	<500	500-700	700-900
School	.10	-.07	-.14
FE	.12	.13	.05
School/FE	.19	.09	-.03

Choosing to stay on at school appears to be related to school size in a non-linear way broadly consistent with the inverted U-shaped prediction. The optimum school size in terms of encouraging such staying on appears to fall somewhere around 500. This is not the case for those choosing to enter FE: Although there is evidence of decreasing returns to scale, optimum size would appear to be above 900 pupils, and therefore not identified in the sample. Overall, participation in post-compulsory education either at school or in FE College displays an inverted U-shaped relationship, with a suggested optimum size between 500 and 900.<sup>8</sup> The raw data therefore suggest that secondary schools without 6<sup>th</sup> Forms in NI may be above or below optimum size on average, in

---

<sup>8</sup> An alternative school-level data set based on Inspection Reports for Northern Ireland was also analysed. With only 101 observations and many missing values for other school characteristics, econometric analysis of this second data set was not deemed possible. Nonetheless the simple

terms of encouraging participation in post-compulsory education, but are more likely to be below optimum given the range of potential optimum values. Increasing the average size of these schools could raise the participation rate. Of course this kind of analysis is only suggestive, at best. In order to isolate the true relationship between school size and career choice at 16, we need to turn to econometric estimation.

### **3: Estimation of the Empirical Model**

The empirical model is set up following the approach of McVicar (1999b), to which readers are referred for more detailed discussion. The empirical models of McVicar (1999b) and the current paper differ only in the inclusion of school size and school size squared to capture the possible non-linear relationship between size and career choice and the restriction of the sample to secondary schools without 6<sup>th</sup> Forms only.

McVicar (1999b) argues that career choice at sixteen is more complex than a simple binary stay-on-in-education-or-not decision. In this case, Cramer-Ridder tests for separating states suggest that FE and school should be treated together as one state (post-compulsory participation), but that employment should be separated from training and unemployment (see Cramer & Ridder, 1991).<sup>9</sup> The dependent variable is therefore defined as follows:

$Y_i = 0$ , if young person is at school or FE,

$Y_i = 1$ , if young person is in full-time employment,

$Y_i = 2$ , if young person is unemployed or on a training scheme.

A multinomial logit model is specified as follows. Let  $Y_{ij}$  be a binary variable that takes the value one if an individual is in category  $j$  and zero otherwise, ie:

---

correlations in the raw data also display a weak inverted U-shaped relationship between size and staying-on (.043 for size<600 and -.151 for size>600).

<sup>9</sup> The Cramer-Ridder test is a likelihood-ratio test comparing the log-likelihoods of the model when the dependent variable is aggregated (into 2 states) and when it is disaggregated (into 3 states). Two separate tests are performed for separation of school and FE and for the division of employment and YT/unemployment. The test statistics are -49.6 and 96, respectively, and are distributed chi-square with 18 degrees of freedom (the number of parameter restrictions in the model). The 5% critical value is 9.39, therefore the separation of school and FE is not supported but the separation of employment

$$\sum_j Y_{ij} = \sum_j P_{ij} = 1,$$

where  $P_{ij}$  is the probability that individual  $i$  is in category  $j$ . The individual probabilities are given by:

$$P_{ij} = P(Y_i = j) = \exp(X_i' b_j) / \sum_j \exp(X_i' b_j).$$

The parameters  $b_j$  measure the effect of  $X_i$  (the set of explanatory variables) on the *relative* probability of individual  $i$  being in one of two categories. It is more straightforward to interpret the *marginal effects* at the sample means, which can be recovered from the estimated parameters in the following way:

$$\delta P_{ij} / \delta X_i = P_{ij} (b_j - \sum_k P_k b_k),$$

giving the effect of the explanatory variables on the *absolute* probability of being in category  $j$ , where  $P_k$  is the relative probability of being in category  $k$ , as given above.<sup>10</sup>

The log-likelihood is given by:

$$\ln L = \sum_i \sum_j d_{ij} \ln P(Y_i = j),$$

where  $d_{ij} = 1$  if individual  $i$  chooses option  $j$  and zero otherwise.

The original sample was stratified in such a way that a predetermined number of young people were in each category. Thus the probability of being in the sample in the first place is related to the model itself, or the sample is *choice-based* (see

---

from training and unemployment is supported. Training and unemployment are treated together because of small sample proportions and sample similarities between the two states.

<sup>10</sup> Given that some of the explanatory variables are binary dummies, care needs to be taken in interpreting these marginal effects. They cannot be interpreted as individual-level marginal probabilities (there is no margin at which to change with a binary dummy; it is either 0 or 1) but only in terms of sample proportion effects.

Armstrong, 1999). Therefore the Manski-Lerman estimator is used (see Manski and Lerman, 1977) based on the following log-likelihood:

$$\ln L = \sum_i \sum_j d_{ij} w(Y_i = j) \ln P(Y_i = j),$$

where  $w(Y_i=j)$  is the ratio of the population proportion to the sample proportion in category  $j$ . The variance-covariance matrix for this estimator is given by:

$$H^{-1} B H^{-1},$$

$$\text{Where } H = -\delta^2 \ln L^*(\hat{b}) / \delta \hat{b} \delta \hat{b}',$$

$$B = \sum_i g_i g_i',$$

$$\text{and } g_i = \delta \ln L^*(\hat{b}) / \delta \hat{b}.$$

## 4: Results and Discussion

Table 4 below presents the results from estimating the multinomial logit model with all variables.<sup>11</sup> Where estimated relationships are close to those in McVicar (1999b) I do not provide any discussion in the current paper. Rather, the discussion concentrates on school size effects and any contrasts with the preceding paper as a result of the specification and sample changes.

*Table 4: Marginal Effects at Sample Means*

	Stay On	Employment	Other
Constant	-3.80**	.03	3.77**
Size	.0006	-.00008**	-.0005
Size <sup>2</sup> /1000	-.0006	.00009**	.0004
Exp/Pupil	.0003*	.00003**	-.0003**

<sup>11</sup> The Catholic and Professional Mother dummies drop out of the model, but re-estimation omitting these two variables yields very little extra insight, so is not reported. Estimation uses LIMDEP 7's 'marginal effects' command.

PTR	.03	.004*	-.04
Controlled	-.13	.02**	.11
Single-Sex	-.001	-.01**	.01
%GCSE5	.003	.0003*	-.003
Attend Rate	.02	-.002**	-.02
Catholic	-.02	.007	.009
Male	-.28**	-.008**	.29**
Prof Father	.12*	-.02**	-.11
Prof Mother	.01	.006	-.02
Qualifications	.02**	.0003	-.02*
Siblings	-.03	.003**	.02
U. Rate	.03**	-.0009	-.03**
TSN	-.10	.02**	.08
Urban	-.19**	-.03**	.22**
Pseudo R <sup>2</sup>	0.13		

Notes: Marginal effects significant at 5% are marked \*\* and at 10% marked \*.

The school size marginal effects are consistent with an inverted U-shaped relationship with the participation rate, but are not significant at standard levels. Nevertheless, this provides further suggestive evidence of a possible non-linear school size effect, albeit a weak one. However, it is the marginal effects on the probability of entering employment that are the most striking in this model. Here there is firm evidence of a U-shaped relationship between leaving education to enter employment and school size, with both the level and squared school size marginal effects significant at 5%. This is echoed by a similar, though insignificant, pattern for entry to training or unemployment. In other words, although we do not see a significant inverted U-shaped relationship between staying-on and school size, we do see the other side of the picture with a U-shaped relationship between leaving education and entering the labour market. This result is over and above all the other school and individual effects captured by the remaining explanatory variables.

Let's take stock of what this result really means. Firstly, it suggests that the non-linear relationship found by Bradley and Taylor (1998) between school size and school

exam performance is also reflected in career choice at sixteen. In other words, there is an optimum school size in terms of discouraging early entry into the labour market, if not directly for encouraging post-compulsory education participation. Based on the employment entry regression coefficients, this optimum size is around 500.<sup>12</sup> Given that the average size of secondary schools in NI is 543 pupils, other things being equal, NI secondary schools appear to be close to the optimum size in terms of discouraging early labour market entry.<sup>13</sup>

Bradley and Taylor (1998) found the optimum size of broadly comparable schools to be around 1200 in England, in terms of examination performance. This begs the question why the figures are so different. We are of course looking at a different issue in career choice rather than exam performance. The currently available data is not rich enough to enable a comparable exercise to Bradley and Taylor's for NI.<sup>14</sup> It may be the case that the optimum size of a school in terms of encouraging post-compulsory education is smaller than the exam performance optimum. Including exam performance at sixteen as an explanatory variable in the model is problematical (there are potential endogeneity problems) and this may also be a contributory factor. In the absence of any suitable instruments for ability, however, there is no alternative but to include this measure and accept the possibility of some bias in the results. Equally, there may be real life reasons why schools in NI perform better on a smaller scale than schools in England. One potential explanation is that the selective system of education in NI reduces optimum size because of easier streaming (a given school needs only cater for a fraction of the academic ability spectrum, therefore streaming can be tighter for a given number of pupils). This may also be reflected in better targeting of subject choice to ability ranges.

The other explanatory variables behave largely as expected and as discussed in detail in McVicar (1999b). Interestingly, the Catholic dummy variable drops out of the model (see McVicar, 1999a, for a discussion of why this might be the case). Also,

---

<sup>12</sup> Only marginal effects are reported in Table 4. The relative probabilities of choosing to stay on or enter employment (see Section 3) are estimated before these marginal effects are calculated. This relative probability of entering employment, based on the estimated parameters, is minimised at size=500, other things being equal. The table of estimated parameters is available from the author on request.

<sup>13</sup> This includes secondary schools with 6<sup>th</sup> Forms. The majority of secondary schools do not cater for Years 13 and 14, however, so average 11-16 school size will not be much smaller than this figure.

maternal employment status does not play any significant role in the current sample, despite its significance in both McVicar (1999a) and McVicar (1999b). There is evidence of school resource effects and other school-climate effects along with more usual background and individual level effects. The point to stress is that the size effects discussed above are after controlling for the effects of these other RHS variables.

## 5: Concluding Remarks

I began this paper with the purpose of exploring whether there might be evidence of an inverted U-shaped relationship between school size and post-compulsory participation in education in Northern Ireland. In other words, is there evidence of an optimum school size in terms of encouraging staying-on? This exploration was prompted by the evidence of just such a relationship in English schools between size and exam performance found by Bradley and Taylor (1998). Using a micro-level data set for 342 young people completing their compulsory education in 1993 in NI secondary schools, I do indeed find some evidence of such a relationship. There is an optimum school size in terms of encouraging participation in post-compulsory education in NI.

Given Northern Ireland's largely segregated education system, my prior expectation was that schools would be too small and that merging existing secondary schools might be an effective policy for discouraging early labour market entry. However, the evidence in this paper suggests schools in Northern Ireland are close to their optimal size in terms of encouraging participation, despite being considerably smaller on average than comprehensive schools in England. Although I cannot rule out the possibility that this result is at least partly an artefact of the data, it is nonetheless very interesting. I put forward the suggestion that the selective nature of secondary education in the region acts to significantly lower the optimum size of schools compared to English comprehensives. In any case, there is no *extra* school-size optimization argument for integrating schools to be found here.

---

<sup>14</sup> This is an avenue currently being explored at NIERC.

Further research should explore these issues in greater depth. In particular, richer data would enable study of the relationship between school size and *examination performance* in NI. Two new data sets under construction at NIERC can potentially offer this opportunity. The first is a recent follow-up of the 1995 Status 0 Survey that includes information on 11+ results for sample members. The second is a school-level data set based on school inspection reports from both NI and Scotland.

## 6: References

Andrews, M.J. and Bradley, S. (1997). 'Modelling the Transition from School and the Demand for Training in the United Kingdom.' *Economica*, 64, 387-413.

Armstrong, D. (1997) (ed). *Status 0: A Socioeconomic Study of Young People on the Margin*, T&EA, Belfast.

Armstrong, D. (1999). 'School Performance and Staying-On: A Micro Analysis for Northern Ireland.' *The Manchester School*, 67, (2), 203-230.

Bradley, S. and Taylor, J. (1998). 'The Effects of School Size on Exam Performance in Secondary Schools.' *Oxford Bulletin of Economics and Statistics*, 60, 291-324.

Cormack, R.J., Miller, R.L. and Osborne, R.D (eds) (1987). 'Education and Policy in Northern Ireland.' Policy Research Institute, Queens University of Belfast.

Cramer, J. S. and Ridder, G. (1991). 'Pooling States in the Multinomial Logit model.' *Journal of Econometrics*, 47, 267-272.

DENI, (1998). *Compendium of Northern Ireland Education Statistics*, Bangor, NI.

Feinstein, L. and Symons, J. (1999). 'Attainment in Secondary School.' *Oxford Economic Papers*, 51, 2, 300-321.

Haller, E. J. (1992). 'High School Size and Student Indiscipline: Another Aspect of the School Consolidation Issue?' *Education Evaluation and Policy Analysis*, **14**, 145-56.

Manski, C. and Lerman, S.R. (1977). 'The Estimation of Choice Probabilities from Choice-Based Samples.' *Econometrica*, 45, 1977-88.

McVicar, D. (1999a). 'Selective Secondary Education and Staying On.' Northern Ireland Economic Research Centre, Working Paper, No. 41, Belfast.

McVicar, D. (1999b). 'School Quality and Staying-On: Resources, Peer Groups or Ethos?' Northern Ireland Economic Research Centre, Working Paper No. 45, Belfast.

Spencer, A.E.C.W. (1987). 'Arguments for an Integrated School System,' in Cormack et al (eds) *Education and Policy in Northern Ireland*, Policy Research Institute, Belfast.