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Do Australian Catholic and Independent Primary Schools Produce Better Academic Outcomes than Government Schools?

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Abstract

In Australia, non-government schools consistently outperform government schools in standardized tests of literacy and numeracy. However, student heterogeneity across school sectors suggests that this performance differential may not be entirely attributable to the nature of the schools. This study investigates the extent of non-government school advantage, after controlling for characteristics of students and their families. We focus on primary schools, where the foundation for later learning is laid. Test scores, from the National Assessment Program Literacy and Numeracy, of a nationally representative sample from the Longitudinal Study of Australian Children are analysed using econometric methods that take account of the complex nature of the sample design. We find little evidence that attendance at non-government primary schools has a positive effect on academic outcomes. Our findings challenge common perceptions of non-government school efficiency and raise some important questions about current policies for funding Australian primary schools.

Do Australian Catholic and Independent Primary Schools Produce Better Academic Outcomes than Government Schools?

I. Introduction

Australia has one of the highest rates of non-government primary school enrolment among OECD countries, with 19 per cent of students in Catholic schools and 12 per cent in independent schools (OECD, 2013; ABS, 2013).[1] Indeed, the proportion of students in non-government primary and secondary schools has been increasing since the late 1970s, growing from 21.8 per cent in 1979 to 34.9 per cent in 2013 (ABS, 2013; ABS, 2001). This trend has coincided with increasing government funding for non-government schools and the removal of barriers to their establishment (Buckingham, 2010).

Despite relatively wide-spread enrolment in non-government schools, differences in the characteristics of students across school sectors reveal substantial segregation. While 36 per cent of government school students are located in the bottom quarter of socio-economic advantage, disadvantaged students make up only 21 and 13 per cent of Catholic and independent school students, respectively. At the other end of the spectrum, 22 per cent of government school students are located in the top quarter of socio-economic advantage, compared with 29 and 47 per cent for Catholic and independent schools, respectively (Gonski *et al.*, 2011). Given the widely observed positive relationship between socio-economic advantage and academic outcomes (e.g. Sirin, 2005), it is not surprising that non-government school students consistently outperform their government school counterparts in standardised tests of literacy and numeracy (Gonski *et al.*, 2011, Figure 11).

[1] In this paper, non-government schools are the aggregation of Catholic and independent schools.

However, the extent to which this non-government school advantage is due to school characteristics or student background is unclear. Economic theory suggests that non-government schools should be relatively more efficient. For example, Friedman (1955) argues persuasively that a minimum standard of education for all students could be achieved by an entirely privatised education system, where market forces would combine with parental choice to produce more adaptive and productive schools. More recently, Chubb and Moe (1990) emphasised the importance of accountability and autonomy, arguing that whereas government schools are excessively bureaucratic and inflexible, non-government schools are accountable to the market and must therefore meet consumer demand to survive. Despite these theoretical predictions, the empirical literature remains inconclusive. This study seeks to add to this literature by investigating whether there is a non-government school advantage among Year 5 primary school students in Australia once student background and other characteristics are taken into account. To the best of our knowledge, this is the only Australian study of sector effects in primary schools (as opposed to secondary schools) that is based on recent and comprehensive child level (rather than school level) data.

In the following section we review the empirical literature on the non-government school advantage, with emphasis on the methodology employed and on Australian contributions. In section III we state our model and discuss our data. Section IV presents some descriptive statistics. We present our results in section V and some discussion and concluding comments in section VI.

II. Empirical Literature

International studies of non-government school advantage

A large international literature, mostly from the US, has estimated non-government school effects, but in the main for secondary schooling only. Whilst initial investigations relied on raw comparisons of test scores and found that non-government schools

outperformed their government counterparts (e.g. Prince 1960), later analyses focused on the contribution of student and school characteristics to the sectoral advantages. In a seminal paper, Coleman *et al.* (1982) used ordinary least squares (OLS) regression analysis to control for students' background characteristics in a sample of government and Catholic secondary schools and found a significant Catholic school advantage. However, these findings were subsequently criticised because the study did not control for unobserved, student heterogeneity, and assumed linear and additive functional forms when specifying the learning process.

To the best of our knowledge, Sander (1996) performed the first OLS examination of school sector effects in US primary schools. Using data from a nationally representative survey, Sander compared students who had spent elementary and middle school in government schools, in Catholic schools, or in a combination of school sectors. After controlling for family and geographic variables, students from Catholic primary and middle schools were found to outperform their government school counterparts in a set of standardised mathematics and reading tests. These findings provided initial support for a Catholic school advantage in primary school, but since the measurement of academic ability was taken in Year 10 (whilst treatment occurred from kindergarten to Year 7), the potential confounding influence of the secondary schooling was raised (Jepsen, 2003). More recent OLS studies, which have had access to measures of student achievement during primary school have produced either non-significant or negative estimates. For mathematics, Catholic school effects have been either negative (Elder & Jepsen, 2014; Reardon *et al.*, 2009; Lubiesnki & Lubienski, 2004) or non-significant (Jepsen, 2003), while no significant effects have been found for reading (Reardon *et al.*, 2009; Braun *et al.*, 2007).

Unobserved heterogeneity is a central issue in the estimation of school sector effects. If students in non-government schools have unobserved, academic enhancing attributes then

OLS estimates provide an upper bound on school sector effects. Instrumental variables (IV) have been used to address this issue in the context of secondary schools but their ability to produce unbiased estimates rests on the availability of suitable instruments. Initially, IV estimations of school sector effects used family religiosity as an instrument (Noell, 1982), reasoning that religiosity would influence school choice but not academic outcomes. However Gibbons and Silva (2013) have argued that religiosity may influence school outcomes via its relationships with unobservable characteristics. Religiosity has been found to be correlated with income, disability, marriage, divorce and attitudes conducive to positive economic outcomes - all variables which may influence academic achievement (Gruber, 2005) - so religiosity is likely to be correlated with unobservable attributes as well. More recent estimations have exploited differences in accessibility of Catholic schools across regions using the proportion of Catholic citizens within a student's locality (Neal, 1997), the density of Catholic schools (Cohen-Zada & Elder, 2009), and the availability of public transportation to Catholic schools (Figlio & Ludwig, 2012). However, the exogeneity of the various measures of accessibility to Catholic schools has been challenged, with the suggestion that housing decisions are affected by school enrolment intentions (Gibbons & Silva, 2013).

Sander (1996) employed a two-stage least squares (2SLS) procedure with both religiosity and location as IVs. He found a Catholic school advantage in mathematics and science for those who spent eight years in a Catholic School, compared with students similarly enrolled in a government school. Although these results are similar to those

produced in the same study using OLS regression, the magnitude of the estimates increased across all learning domains.[2]

To address the limitations of OLS estimation relating to functional form, a number of recent studies have applied propensity score matching (PSM).[3] Using a range of matching techniques, PSM estimates have also produced mixed results, with negative Catholic school effects for mathematics (Peterson & Llaudet, 2006; Elder & Jepsen, 2014; Reardon *et al.*, 2009) and either positive (Peterson & Llaudet, 2006) or non-significant (Elder & Jepsen, 2014) effects for reading. While PSM addresses issues relating to functional form, it is still vulnerable to bias from unobserved heterogeneity. Indeed Petersen and Laudet (2006) attribute consistent findings of negative non-government school effects for mathematics, but not for reading, to a differing influence of student background on the two learning domains. They argue that mathematics scores are less influenced by home environment and thus less subject to upward bias from unobserved heterogeneity.

Australian studies of non-government school effects

In Australia, non-government school effects have also been estimated but mostly for secondary schools. An early study by Williams and Carpenter (1991) compared performance in a composite vocabulary, reading and mathematics test for students attending government, Catholic and independent schools. For Year 5 students, Catholic school enrolment was not associated with higher achievement, although an advantage for independent school students

[2] Fixed effects (FE) estimation has also been used to control for time-invariant, unobserved heterogeneity. However, FE estimates of school sector effects are identified solely by students who switch school sectors. If these students are not representative of the student population the results will be misleading. In the case of Elder and Jepson (2014) for example, 'switchers' comprised less than five per cent of the sample and 80 per cent of the 'switchers' moved out of Catholic schools, mostly in Year 8.

[3] PSM is a quasi-experimental approach that addresses school selection by matching students from separate school sectors according to their propensity score. For school sector effects estimation, the propensity score refers to the probability of non-government school enrolment conditional upon set of observed covariates. Once students are matched according to their propensity score, the average difference in scores between matched students provides the estimated school sector effect, thus imitating experimental design.

was found. However, the data were from 1975, at the very early stages of the shift of enrolment from government to non-government schools in Australia, and so the characteristics of students in the different school sectors were likely very different to what they are today. Furthermore, the covariates used to control for student heterogeneity across school sectors were limited.

Vella (1999) investigated the impact of attendance at Catholic high schools on high school completion, the probability of obtaining higher education, and labour market performance using data from the 1985 Longitudinal Survey of Australian Youth (LSAY). Vella found that Catholic high school enrolment increased the probability of high school completion by around 18 percentage points compared with government school enrolment. The likelihood of higher educational attainment, and labour market outcomes, were also improved by Catholic school enrolment. However, the data used are again somewhat dated whilst the focus was on high school, rather than primary school, enrolment.

Le and Miller (2003) also examined high school sector effects on the likelihood of completing high school. They used data from the 1961 and 1970 birth year waves of the Youth in Transition surveys and found that the cohort enrolled in Catholic (independent) high schools enjoyed a high school completion rate around 20 (35) percentage points higher than their government school counterparts. Interestingly, after controlling for selection effects by applying Blinder-Oaxaca decompositions, the authors found a marked deterioration in the Catholic school sector effect on high school completion, from 13 to -19 percentage points, across the two birth cohorts. On the other hand, the authors found a marked increase in the sectoral effect for independent schools across the two cohorts, which increased from 17 to 46 percentage points.

More closely related to our study, Miller and Voon (2011) estimated school sector effects on school level achievement using NAPLAN test scores in Years 3 and 5. In Year 3

they found positive and significant independent school effects across all learning domains and positive Catholic school effects in grammar, reading, spelling and writing, but not in numeracy. For Year 5 they found positive school sector effects for both sectors across all learning domains. However, since their data were restricted to school level averages from the My School website, their study did not control for background characteristics at the student level.[4]

Cardak and Vecci (2013) estimated Catholic school sector effects on high school completion rates, university commencement, and university completion rates for a 1998 cohort of students from the LSAY. Their initial finding of a significant Catholic school advantage over government schools of between 12 per cent and 18 per cent diminished to between five per cent and seven per cent as individual, family and demographic covariates were sequentially introduced into the model. The Catholic school advantage diminished further after applying a technique that assumes the effect of unobservables was as large as that of observables (Altonji *et al.*, 2005) and provides upper and lower bound estimates. The Catholic school effect, for all three outcome variables, ranged between minus five per cent and seven per cent and the lower bound estimate of the Catholic school sector effect on all three outcome variables was negative and significant. Hence a zero Catholic school effect could not be ruled out.

In conclusion, whilst it is likely that significant, sizeable and positive Catholic school effects on school completion and post-secondary education outcomes existed in the past, these effects appear to have diminished substantially over the last two decades. Authors have

[4] In a closely related paper, Miller and Voon (2012) analysed NAPLAN scores for years 3, 5, 7 and 9. On this occasion they partitioned their data by school sector after *F-tests* suggested that it would be inappropriate to constrain all parameter values to be the same across the three school sectors. Despite these methodological differences, their results and conclusions were similar to those from their earlier study.

speculated that this trend could be due to the rapid increase in student, and especially of disadvantaged student, enrolments into Catholic schools, to legislated changes in the minimum school leaving age, or to increases in the number of funded university places, over this time period.

Our study adds to the literature in that we utilise a rich, current and nationally representative dataset to estimate school sector effects on the academic development of individual, Year 5 school students who have not previously changed school sector. Primary school provides the foundation for study in secondary school and Year 5 occurs towards the end of primary school. By restricting our analysis to children who do not switch sectors prior to Year 5, we reduce the confounding effects of uncertain previous school sector enrolment, which have occurred in studies that have focused on secondary school students. We may also reduce the impact of unobservables that have affected studies seeking to explain differences in more long term outcomes such as school completion, university commencement and university completion. In the following section we state our model and provide detailed information on our data.

III. Model and Data

Several specifications of the following model were estimated in order to gauge the influence of control variables on estimates of school sector effects:

$$NAPLAN\ score_i = \beta_0 + \beta_1 Catholic_i + \beta_2 Independent_i + \beta_3 Child_i + \beta_4 Household_i + \beta_5 Environment_i + \varepsilon_i$$

Catholic and *Independent* are binary variables indicating school sector, *Child*, *Household* and *Environment* are vectors of control variables and the subscript refers to child i. Specification I has no controls. Child and household characteristics as well as attributes of the local environment are progressively included to give Specifications II, III and IV of the model. We hypothesise that school sector effects decrease substantially between Specifications I and IV.

We estimate the model using data from the Longitudinal Study of Australian Children (LSAC),[5] the first and most extensive nationally representative survey of Australian children throughout their development. The LSAC follows two cohorts of children, one born between March 2003 and February 2004 and the other born between March 1999 and February 2000. Major surveys were conducted in 2004 (Wave 1) and every two years thereafter (Waves 2 through 5), with mail-out questionnaires in the intervening years. Information is collected from the study child, his or her parents, childcare workers and teachers. In addition, information is linked from the Australian Census, Medicare Australia and, importantly for this study, Australia's National Assessment Program Literacy and Numeracy (NAPLAN).

The LSAC sample was selected using a two-stage clustered design. At the first stage, a random selection of postcodes (stratified by state/territory and by metropolitan versus ex-metropolitan area) was chosen. A random sample of children in each age cohort was then selected from each postcode using the Medicare enrolments data base, which is a comprehensive data base of Australia's population. The older 'K cohort' is the focus of this study. It is a broadly representative sample of Australian children who were aged 4-5 years in 2004, with the exception of children living in remote areas.[6]

The NAPLAN was implemented in 2008 and was designed to assess the literacy and numeracy skills of Australian students. In May of each year, standardised testing of students in Years 3 and 5 (primary school) and Years 7 and 9 (secondary school) is conducted.

[5] The study, Growing Up in Australia, the Longitudinal Study of Australian Children, is conducted in partnership between the Department of Social Services (DSS), the Australian Institute of Family Studies (AIFS) and the Australian Bureau of Statistics (ABS). The findings and views reported in this paper are those of the authors and should not be attributed to the DSS, the AIFS or the ABS.

[6] Cost constraints resulted in eligibility for only 60 per cent of children living in remote areas. A number of other factors precluded involvement in the survey but are not considered to impact the representativeness of the sample: the exclusion of postcodes which contained fewer than six eligible children; children who with siblings already selected; and children with the same or similar name to a child listed on the national death index. See Soloff, Lawrence and Johnstone (2005) for further discussion of the LSAC sample design.

Students' academic capabilities are determined by separate examinations in reading, writing, spelling, grammar and numeracy. Construction of each examination follows the nationally agreed 'Statements of Learning' and focuses on the skills developed throughout the school curriculum (Australian Curriculum and Reporting Authority (ACARA), 2010). All eligible students are expected to take the examinations, with the exception of students with an intellectual disability and those who have recently immigrated and/or have limited English-speaking ability. Students who are absent on the day of examination are required to sit at a later time, preferably within the same week.[7]

Raw test results are vertically scaled and equalised across school years (ACARA, 2013). Vertical scaling implies, for example, that a score of 500 in Year 3 represents the same absolute academic capability as a score of 500 in Year 5. As a result, absolute gains in academic capability can be tracked over time at both the school level and for individual students. Equalisation across school years means that examination results can be compared across cohorts, such that a Year 3 score of 500 in 2008 represents the same academic capability as a Year 3 score of 500 in 2010. This equalisation process involves samples of students from each state sitting an 'equating' examination as well as the current year's examination to allow for comparisons of difficulty. Scaled examination scores range from 0 to 1000.

Year 5 NAPLAN results for 2010, based on school level data and classified by school sector are presented in Table 1. On average, independent schools performed at a higher level than Catholic schools and both performed better than government schools on all five NAPLAN examinations. The last row of the table also shows that, on average, annual

[7] Parents can choose to withdraw their children from NAPLAN testing and there is evidence that some schools persuade poorly performing students to absent themselves from the tests. The latter seems to have become more common over time.

progress between Years 3 and 5 ranges from 35.7 points for writing to 48.3 points for grammar. Annual student progress provides a benchmark against which to judge the effect of attending a non-government primary school on academic development, and will be the metric primarily used in discussing the results of this study.[8]

NAPLAN results of LSAC participants have been linked at the individual level since 2008, offering a rich insight into the school performance of Australian children. The majority of LSAC children from the K cohort began school in 2005 and completed Year 5 in 2010. However, a substantial number were either one year ahead or one year behind this main 'stream'. Year 5 NAPLAN scores for LSAC participants exist for 2010 (the majority), 2009 (early starters) and 2011 (late starters). Aggregating the three streams is not problematic for estimation purposes provided there are no time-varying influences on academic development from the education system, and no cohort effects. For example, there must be no benefit from beginning school in 2005 rather than 2006. In support of these assumptions, no significant differences in population NAPLAN scores have been observed between 2009 and 2010, nor between 2010 and 2011 (Daraganova, Edwards & Sipthorp, 2013).

The sample used in our econometric analysis is restricted to K-cohort children with matched Year 5 NAPLAN scores and observed covariate information. We also require the children to be in the same school sector in Years 1, 3 and 5, as switching obscures the effect of school sector in our (cross-sectional) analysis of NAPLAN results in Year 5. Table 2 shows the number of observations in our final sample and the numbers lost in its

[8] An alternative approach is to report school sector effects in standard deviations, otherwise known as Cohen's d. Based on a synthesis of over 800 meta-analyses on the effect of educational interventions and student background characteristics on academic outcomes, Hattie (2008) suggests an effect size of 0.40 or more standard deviations is in the 'desirable range'. Since the majority of interventions are found to positively influence outcomes, those that improve marks more than 0.40 standard deviations are deemed worthwhile. For the average NAPLAN population gains in Table 1, one standard deviation in scores corresponds to 1.1 to 1.3 years progress. This implies that an advantage of 0.40 – 0.50 years (4.8 to six months) progress equates to the lower bound of Hattie's desirable range.

construction. Attrition accounts for the loss of observations between Waves 1 and 4 of the LSAC survey, but weights that correct for non-response bias and variables that take account of the complex nature of the original sample design are provided in the LSAC dataset and are used in the analysis reported in this paper. Our final sample contains 2,689 LSAC children, most of whom sat the Year 5 NAPLAN examinations in 2010.[9] Some children did not complete all five examinations and consequently the sample available for estimation varies across learning domains, from 2,656 for numeracy to 2,671 for reading.

School sector is recorded in the linked LSAC-NAPLAN file as government, Catholic or independent. Government schools are those operated by the state, offering education to students at no fee (though a voluntary contribution from parents is often requested). Catholic schools are those governed by the Catholic Education Commissions and Catholic Education Offices of each state and territory. Finally, the independent school system represents a heterogeneous body of private schools, more than 85 per cent of which provide religious instruction. Religious affiliations range from various Christian denominations to Muslim, Jewish and Hare Krishna. As presented in Table 2, 68 per cent of our 2,689 sample children attended government schools, 22 per cent attended Catholic schools and 10 per cent attended independent schools.

IV. Descriptive Statistics

Table 3 presents Year 5 NAPLAN results calculated using our sample both before, and after, the imposition of the constraints detailed in Table 2. The first point to note is that the loss of observations from 3,659 to 2,689 increased the mean test scores but had little

[9] In 2011 the writing examination changed from narrative to persuasive writing. This is problematic for longitudinal analysis of students' or schools' performance over a period spanning 2011. However, it is not a problem for the analysis of the type undertaken in this paper because the proportion of students in our sample who took the Year 5 NAPLAN tests in 2011 is not significantly different across school sectors.

effect on the differentials among pairs of school sectors.[10] In both samples, all differentials are statistically significant except those for spelling, grammar and numeracy between children attending Catholic and government schools. The second point to note is that, although the mean scores based on our samples are consistently larger than the mean scores reported in Table 1, the differentials among pairs of sectors are reasonably consistent, given Table 1 is based on school-level data and Table 3 is based on data at the individual level.

Table 4 gives descriptive statistics, which reveal statistically significant differences for most control variables between children attending government and non-government schools. Children in independent schools are a little older at the time of the Year 5 NAPLAN test. Children in government schools are more likely to be Aboriginal or of Torres Straight Island origin, and are more likely to have a mother who smoked during pregnancy.[11] The "Who Am I?" test taken when the child is 4-5 years old is a measure of school readiness and is included as a measure of the child's innate ability. Children in government schools are more likely to live in a single-parent household, in a household without an employed parent, and are less likely to live in a household with at least one highly educated parent. Their weekly, equivalised, household incomes[12] are also lower on average and they are less likely

[10] The imposition of restrictions on our sample, particularly the requirements of no change of school sector and no missing data on child characteristics, results in a disproportionate loss of observations for children attending independent schools and, to a lesser extent Catholic schools, compared with government schools. Since this had little effect on the school sector differentials in Table 3, we do not pursue this issue further.

[11] The latter is thought to interfere with the developmental process between conception and birth and has been found to correlate with later intellectual capacity (Olds, Henderson and Tatelbaum 1994).

[12] Weekly household income was converted to 2014 dollars, using the consumer price index, and equivalised by dividing by the square root of the number of people in the household. The square root scale was chosen because it is simple and widely used.

to have access to a computer at home. The neighbourhoods in which they live are more disadvantaged and less safe, on average.[13]

V. Results

Estimates of Catholic and independent school effects are presented in Table 5. Applying the annual progress measures given in the last row of Table 1, the coefficients were converted into months of progress and appear in parentheses. We repeated the estimation using normalised NAPLAN scores and report the normalised coefficients in square brackets. Specification I indicates that children in independent schools are at least four months more advanced than their government school counterparts in all five NAPLAN learning domains, and over nine months more advanced in reading and writing. Independent school children are also at least four months more advanced than children in Catholic schools. The latter children are more advanced than children in government schools by approximately 3.5 months in reading and 5.6 months in writing but not significantly different in spelling, grammar or numeracy.

However, once child characteristics are taken into account (Specification II) these school sector effects are reduced substantially in size and several become statistically non-significant. With household characteristics held constant (Specification III), only three effects remain significantly different from zero: children in Catholic schools are approximately 1.9 months less advanced in spelling and 2.2 months less advanced in numeracy than government school children; Catholic school children are 2.6 months less advanced in numeracy compared with children from independent schools. These effects remain when environmental characteristics are held constant (Specification IV) and, in addition, there is some evidence

[13] The controls for household and environmental characteristics were averaged over the waves of LSAC prior to when NAPLAN tests were taken.

that children from independent schools are three months more advanced in reading than children in government schools.[14]

In summary, there is little evidence that children in non-government schools achieve higher academic outcomes than children in government schools once relevant, observable characteristics of the child and his or her household are taken into account. In fact, there is some evidence that children in Catholic schools perform at a lower level than children in government schools. The coefficients in Table 5 can be considered upper bounds on school sector effects, given the lack of control for unobserved heterogeneity. This obviates the need to use instrumental variable methods to control for selection bias arising from unobservables that are positively correlated with both NAPLAN test scores and the propensity to attend a non-government school.

Full results for Specification IV appear in Appendix A. Coefficients of covariates generally align with expectations and the existing literature. The age of the child when taking the Year 5 NAPLAN examination, school readiness as measured by his or her score on the 'Who Am I?' test at age 4-5 years, having at least one parent with university-level education, household income and living in a neighbourhood with a high socio-economic status all have positive and statistically significant effects on academic performance – all relationships that are well established in the literature. On the other hand, being Aboriginal or of Torres Strait Island descent and having a mother who smoked during pregnancy both have negative and statistically significant effects on NAPLAN scores, which is also consistent with previous findings. Interestingly, girls score higher than boys in reading, writing, spelling and grammar

[14] As a sensitivity test, the estimation was repeated allowing separate regressions for the three school sectors but it had little effect on the results. The only statistically significant results were as follows. Children in independent schools were ahead of children in government schools by four months in reading and three months ahead in numeracy. Children in Catholic schools were behind children in government schools by two months in numeracy.

but boys achieve higher numeracy scores. Parental employment levels, having access to a computer at home, living in a single-parent family, the number of siblings, living in a safe neighbourhood and living in a remote area all have the expected signs but are non-significant.

Finally, the Index of Community Socio-Educational Advantage (ICSEA) was added as a control (see the final column of Table 5 and the last row of Table 4). The ICSEA is a numerical scale applicable to the school that the child attends. It combines the education levels and occupations of the parents of students attending the school, the degree of remoteness of the school, the percentage of students in the school who are indigenous and the percentage of students in the school who have a language background other than English (Gonski *et al.*, 2011, p.81). The ICSEA was developed to identify schools serving similar student populations. We include it as a proxy for peer effects. The notion that student outcomes are dependent on the characteristics of their peers is well established in the literature (e.g. Sacerdote, 2011). Given the heterogeneity of student characteristics across school sectors, there is potential for peer effects to influence estimates of Catholic and independent school effects. Controlling for peer effects should offer a more accurate measure of the effect of organisational characteristics of Catholic and independent schools. Once ICSEA is included, there is no statistically significant difference in achievement levels of children in independent schools and other children. However, children in Catholic schools are estimated to be 2.6, 2.7 and 3.8 months less advanced in grammar, spelling and numeracy, respectively, than children in government schools.

VI. Conclusion

This study has investigated whether school sector effects exist in standardised examinations of five academic learning domains for a cohort of Year 5 students enrolled in Australian primary schools. The raw data depict substantial Catholic and independent school sector advantages over government schools. But after holding constant a range of student,

family and other covariates, government school students perform no worse than independent school students, and somewhat better than their Catholic school counterparts, particularly in numeracy. Our results contrast with some earlier Australian studies but are consistent with results from more recent studies which indicate a steadily closing academic development gap between government and non-government schools over the last two decades.

Our results provide no empirical support for theories expounding the superiority of non-government education. Of course parents may be attracted to non-government schools for their differentiated values and discipline regimes, their religious instruction and/or their extra-curricular activities (Independent Schools Council of Australia, 2008, Beavis, 2004). Hence, whilst there may now be no significant, sectoral, academic advantage at the primary school level, it is still likely that non-government schools continue to satisfy the broader educational preferences of some parents and students.

It is also possible that the increased competition for students from non-government primary schools has improved the performance of all primary schools (Misra, Grimes & Rogers, 2012; Hoxby, 1994). To the best of our knowledge no study has investigated this effect in Australia though Jensen, Weidmann, and Farmer (2013) raise doubts about the competitive influence of Australian non-government schools.

In addition to theoretical implications, our results raise questions concerning the allocation of scarce resources: since the mid-1970s, the Commonwealth and State governments have allocated public funds on a per-capita basis to non-government schools (Campbell, 2009). In 2010, government funding for recurrent and capital expenditures, per full-time equivalent student, averaged $13,807 for government primary schools, $12,649 for Catholic primary schools, and $12,352 for independent primary schools. At first blush, subsidising non-government schools to this extent may seem like a good deal for government: non-government schools achieved very similar learning outcomes (at least in

Year 5) for around nine per cent less government funding. But when we consider expenditures per student from all sources across the sectors the respective figures are $14,304 for government schools, $14,420 for Catholic schools, and $17,607 for independent schools. From the perspective of opportunity cost, independent schools cost society around 20 per cent more per student for only marginally better academic development gains.

One limitation of our study is that we do not control for heterogeneous treatment effects. Although we find no evidence of non-government primary school advantage for the general population, these results may not necessarily hold for specific sub-populations. For example, Sander (1996) found Catholic school effects to be entirely driven by disadvantaged students. Consequently, future research could investigate whether school sector effects are found for students from low socio-economic status families. [15]

Finally, although academic development is a key parental expectation of primary schools, the social and emotional development of students is also important. The LSAC data set includes information on parent reported social and emotional functioning and so future work could investigate school sector effects specifically in these important developmental domains.

[15] All figures in this paragraph were calculated using data from file 'lsacmyschool_gr.dta', provided with LSAC_Wave 5_GR_R2_2014.

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Table 1. School Level NAPLAN Performance, by School Sector

		NAPLAN Score, Year 5, 2010 (3,699 schools)				
A. School Sector		Reading	Writing	Spelling	Grammar	Numeracy
Government	mean	483.1	482.3	484.2	495.5	487.3
	st dev	35.1	29.4	30.2	37.9	35.3
	n	2215	2214	2214	2214	2212
Catholic	mean	497.3	496.6	492.7	509.7	493.2
	st dev	24.5	21.0	21.5	26.3	23.6
	n	704	704	704	704	704
Independent	mean	520.9	509.5	506.4	530.7	517.7
	st dev	29.1	24.0	23.6	30.2	30.0
	n	473	471	473	473	472
Differences in Performance						
Catholic - government	mean	14.2	14.3	8.5	14.2	5.9
		***	***	***	***	***
Independent - government	mean	37.8	27.2	22.1	35.2	30.5
		***	***	***	***	***
Independent - Catholic	mean	23.6	12.9	13.7	21.0	24.6
		***	***	***	***	***
B. All Sectors						
Year 5, 2010	mean	494.4	491.2	490.9	506.3	495.4
Year 3, 2008	mean	407.5	419.8	404.9	409.6	402.8
Annual Progress	mean	43.5	35.7	43.0	48.3	46.3

Source: File ‘lsacmyschool_gr.dta’, provided with LSAC_Wave 5_GR_R2_2014.
Notes:
1. Averages were weighted by total school enrolments.
2. ***, **, * indicate significant differences at the 0.1, 1 and 5 per cent levels, respectively.

Table 2. Number of Children in the Sample

	Government	Catholic	Independent	All Sectors
Wave 1 (2004)				4983
Wave 4 (2010)				4169
With NAPLAN Year 5 Results (2009-11)	2,366	789	504	3,659
Same School Sector	2,228	676	347	3,251
Child Characteristics	1,906	591	287	2,784
Household Characteristics	1,851	580	276	2,707
Local Environment	1,834	579	276	2,689
Other Sampling Controls	1,834	579	276	2,689
Year 5 NAPLAN in 2009	454	125	42	621
Year 5 NAPLAN in 2010	1,284	436	217	1,937
Year 5 NAPLAN in 2011	96	18	17	131
Reading	1,822	577	272	2,671
Writing	1,809	577	275	2,661
Spelling	1,815	577	275	2,667
Grammar	1,815	577	275	2,667
Numeracy	1,809	574	273	2,656

Source: LSAC_Wave 5_GR_R2_2014.

Note: One LSAC child who completed Year 5 NAPLAN in 2008 was excluded from our sample.

Table 3. Estimates of NAPLAN Performance, by School Sector

		NAPLAN Score, Year 5, 2010 (Sample of 3,659 Children)				
A. School Sector		Reading	Writing	Spelling	Grammar	Numeracy
Government	mean	492.2	482.8	487.9	502.9	492.5
	s.e.	2.6	2.0	2.2	2.7	2.3
	n	2,350	2,336	2,342	2,342	2,332
Catholic	mean	504.1	498.2	492.5	511.1	494.5
	s.e.	3.5	2.9	2.8	3.5	2.8
	n	785	785	785	785	782
Independent	mean	525.2	510.2	503.6	533.1	514.7
	s.e.	4.4	3.4	3.2	4.4	4.2
	n	499	502	502	502	499
Differences in Performance						
Catholic - government	mean	11.9 **	15.4 ***	4.6	8.2	1.9
Independent - government	mean	33.0 ***	27.4 ***	15.7 ***	30.2 ***	22.2 ***
Independent - Catholic	mean	21.1 ***	12.0 **	11.1 *	22.0 ***	20.2 ***

		NAPLAN Score, Year 5, 2010 (Sample of 2,689 Children)				
B. School Sector		Reading	Writing	Spelling	Grammar	Numeracy
Government	mean	497.0	486.0	490.4	509.4	495.3
	s.e.	2.8	2.3	2.3	2.8	2.4
	n	1,822	1,809	1,815	1,815	1,809
Catholic	mean	509.6	502.4	494.4	517.0	498.2
	s.e.	3.8	3.1	3.0	3.5	2.9
	n	577	577	577	577	574
Independent	mean	533.1	514.0	506.3	539.0	519.8
	s.e.	5.2	4.3	4.1	5.5	4.7
	n	272	275	275	275	273
Differences in Performance						
Catholic - government	mean	12.6 **	16.6 ***	3.9	7.7	2.8
Independent - government	mean	36.2 ***	28.0 ***	15.9 ***	29.6 ***	24.5 ***
Independent - Catholic	mean	23.6 ***	11.3 *	12.0 *	22.0 ***	21.6 ***

Source: LSAC_Wave 5_GR_R2_2014.
Notes:
1. Means and standard errors were calculated using svy commands to account for complex random sampling and attrition between waves.
2. ***, **, * indicate significantly different from zero at the 0.1, 1 and 5 per cent levels, respectively.

Table 4: Descriptive Statistics by School Sector

Variable	Government	Catholic	Independent	C-G	I-G	I-C
Child Characteristics						
Mean age in months at Naplan test	125.54	125.62	126.88		***	**
% female	48.38	51.41	52.86			
% indigenous	4.05	0.70	0.55	***	***	
Mean WAI test score at age 4-5 years	63.79	65.19	65.56	*	*	
% mother smoked during pregnancy	23.86	13.14	6.74	***	***	*
Household Characteristics						
Highest parental level of employment:						
% employed	88.41	97.47	96.55	***	***	
% unemployed	2.86	0.84	0.68	***	***	
% not in labour force	8.73	1.69	2.77	***	***	
Highest parental level of education:						
% less than Year 11	8.01	5.74	2.85		***	
% Year 11 or 12	11.10	7.82	4.59	*	***	
% certificate or diploma	46.45	43.17	34.05		***	*
% bachelor degree	12.56	20.07	26.40	***	***	*
% higher degree	17.70	20.01	29.02		***	**
% other	4.18	3.19	3.09			
Mean, equivalised, weekly h'hold income ($00)	8.74	9.99	13.34	***	***	***
% with access to a computer at home	84.91	90.73	90.45	***	***	
% single-parent family	16.57	7.39	9.90	***	**	
Mean number of siblings	1.56	1.62	1.45			*
Neighbourhood Characteristics						
Neighbourhood SEIFA index	1002.37	1012.83	1023.52	**	***	
% living in safe neighbourhood	91.85	94.58	94.66	**		
% living in remote area	3.86	3.29	1.68			
ICSEA Index	1011.82	1059.84	1095.44	***	***	***

Source: LSAC_Wave 5_GR_R2_2014.

Notes:

1. Means and standard errors were calculated using svy commands in STATA to account for complex random sampling and attrition between waves.
2. *, ** and *** indicate significantly different from zero at the 5%, 1% and 0.1% levels, respectively.

Table 5: Estimates of School Sector Effects

		Regression Specification											
		I		II		III		IV		ICSEA-Index			
Reading	Catholic	12.60	**	3.59		1.17		0.98		4.96			
		(3.5)		(1.0)		(0.3)		(0.3)		(-1.4)			
		[0.2]		[0.0]		[0.0]		[0.0]		[-0.1]			
			***		**								
	Independent	36.16	***	21.47	***	9.80		10.85	*	1.31			
		(10.0)		(5.9)		(2.7)		(3.0)		(0.4)			
		[0.4]		[0.3]		[0.1]		[0.1]		[0.0]			
Writing	Catholic	16.65	***	8.24	*	4.45		4.32		-0.02			
		(5.6)		(2.8)		(1.5)		(1.5)		(0.0)			
		[0.2]		[0.1]		[0.1]		[0.1]		[0.0]			
			*										
	Independent	27.98	***	14.25	***	4.30		4.79		-1.82			
		(9.4)		(4.8)		(1.4)		(1.6)		(-0.6)			
		[0.4]		[0.2]		[0.1]		[0.1]		[0.0]			
Spelling	Catholic	3.93		-4.53		-6.77	*	-6.92	*	-9.60	**		
		(1.1)		(-1.3)		(-1.9)		(-1.9)		(-2.7)			
		[0.1]		[-0.1]		[-0.1]		[-0.1]		[-0.1]			
			*										
	Independent	15.90	***	2.60		-4.62		-4.15		-8.01			
		(4.4)		(0.7)		(-1.3)		(-1.2)		(-2.2)			
		[0.2]		[0.0]		[-0.1]		[-0.1]		[-0.1]			
Grammar	Catholic	7.65		-1.86		-5.11		-5.12		-10.52	**		
		(1.9)		(-0.5)		(-1.3)		(-1.3)		(-2.6)			
		[0.1]		[0.0]		[-0.1]		[-0.1]		[-0.1]			
			***		*								
	Independent	29.60	***	13.94	*	3.66		4.52		-3.80			
		(7.4)		(3.5)		(0.9)		(1.1)		(-0.9)			
		[0.3]		[0.2]		[0.0]		[0.1]		[0.0]			
Numeracy	Catholic	2.84		-5.11		-8.59	**	-8.83	**	-14.54	***		
		(0.7)		(-1.3)		(-2.2)		(-2.3)		(-3.8)			
		[0.0]		[-0.1]		[-0.1]		[-0.1]		[-0.2]			
			***		***		*		*				
	Independent	24.45	***	11.64	*	1.56		2.13		-6.05			
		(6.3)		(3.0)		(0.4)		(0.6)		(-1.6)			
		[0.3]		[0.2]		[0.0]		[0.0]		[-0.1]			

Source: LSAC_Wave 5_GR_R2_2014.

Notes:

1. Regressions were performed using svy commands in STATA to account for complex random sampling and attrition between waves.
2. *, ** and *** beside a coefficient indicates significantly different from zero at the 5%, 1% and 0.1% levels, respectively.
3. Asterisks on the line between coefficients indicates a significant difference between children in Catholic and independent schools.
4. Coefficients expressed in months of progress are in parentheses; coefficients calculated using normalised NAPLAN scores are in brackets.

Appendix A: Full Regression Results, Specification IV

	Reading		Writing		Spelling		Grammar		Numeracy	
Variable	Coef	P-value	Coef	P-value	Coef	P-value	Coef	P-value	Coef	P-value
Catholic school	0.98	0.793	4.32	0.170	-6.92	0.021	-5.12	0.134	-8.83	0.004
Independent school	10.85	0.036	4.79	0.266	-4.15	0.343	4.52	0.428	2.13	0.634
Age at Naplan test (months)	1.84	0.000	1.64	0.000	1.48	0.000	1.94	0.000	1.82	0.000
Female	7.60	0.029	18.20	0.000	5.70	0.048	14.00	0.000	-23.10	0.000
Indigenous	-20.20	0.015	-31.30	0.000	-34.90	0.000	-30.40	0.033	-25.30	0.002
WAI test score at age 4-5 years	3.02	0.000	2.60	0.000	3.19	0.000	3.17	0.000	3.23	0.000
Mother smoked during pregnancy	-13.20	0.002	-9.60	0.014	-11.60	0.004	-14.40	0.004	-12.80	0.000
Highest parental level of employment:										
unemployed	17.80	0.389	-3.50	0.842	28.30	0.133	21.60	0.390	10.40	0.582
not in labour force	-5.50	0.616	-17.80	0.064	-15.80	0.109	-12.20	0.335	-9.60	0.340
Highest parental level of education:										
less than Year 11	-12.70	0.096	-10.80	0.152	-3.70	0.582	4.40	0.554	0.40	0.952
Year 11 or 12	8.60	0.138	5.00	0.344	14.70	0.006	14.90	0.034	11.40	0.027
bachelor degree	29.40	0.000	18.30	0.000	14.60	0.000	35.00	0.000	31.60	0.000
higher degree	22.90	0.000	18.60	0.000	12.30	0.001	26.70	0.000	21.50	0.000
other	16.20	0.053	0.30	0.968	-3.20	0.668	23.80	0.013	8.80	0.203
Equivalised, weekly, h'hold income	0.70	0.023	0.93	0.001	0.74	0.001	0.52	0.073	0.63	0.008
Access to a computer at home	17.80	0.014	5.80	0.369	3.40	0.558	19.50	0.028	10.60	0.088
Single-parent family	5.30	0.450	-7.10	0.230	-5.90	0.369	-3.20	0.657	-2.70	0.672
Number of siblings	-5.92	0.001	-1.25	0.431	-1.41	0.336	-3.67	0.057	0.57	0.710
Neighbourhood SEIFA index	0.15	0.000	0.07	0.011	0.09	0.000	0.13	0.000	0.11	0.000
Safe neighbourhood	3.40	0.693	11.50	0.160	-0.50	0.958	-10.70	0.307	11.00	0.214
Remote area	-6.80	0.474	-6.90	0.421	-13.10	0.085	-2.10	0.838	-13.80	0.100
Constant	-101.70	0.044	15.79	0.735	1.20	0.978	-80.05	0.121	-64.98	0.116
Goodness-of-fit, F-statistic	39.17	0.000	26.22	0.000	29.42	0.000	37.31	0.000	35.09	0.000
N	2671		2661		2667		2667		2656	