School Performance in Australia: Is There a Role for Quasi-Markets?

by

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WORK IN PROGRESS, NOT TO BE QUOTED

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Abstract

Recent changes to the organisation of Australia's education system have raised the possibility of implementing wide-ranging market reforms. In this paper we discuss the scope for introducing reforms similar to the UK's "quasi-market" model. Firstly, we discuss the role of school league tables in providing signals and incentives within a quasi-market model. Specifically, we compare a range of unadjusted and model-based league tables of primary school performance in Queensland's public education system. These comparisons indicate that model-based tables that account for socio-economic status and student intake quality vary significantly from the unadjusted tables. Secondly, we test for school competition effects in the existing regulated education market. The results indicate that competition between government schools has a positive effect on school efficiency while competition from the non-government sector has a negative effect.

1 INTRODUCTION

The debate about the appropriate method of providing mass education has a long history and has focused on the merits of alternative state and market-based approaches. A trend towards increased state provision of education was evident until the late 1970s and early 1980s when "New Right" governments in the US, UK and elsewhere began to introduce reforms that emphasised a greater role for market forces. As Tooley (1996) notes, governments can intervene in education by regulating its content (e.g.: with respect to curriculum and testing), its demand (through compulsory attendance laws), and through determining the level of funding and provision. State-based provision is generally characterised as a situation where the government funds "free" schooling from general taxation revenue and centrally administers the education system according to non-market criteria. This model is thought to be effective at internalising the social benefits of education, such as citizenship, support for democratic institutions and knowledge spillovers[1]. Most importantly, it is argued that state provision of education is needed to avoid the greater social segregation and income inequality that would eventuate in a market-based system.

In contrast, advocates of market-based approaches to education argue that inequality of educational opportunity will exist even under a centralised system of state provision (Chubb and Moe 1988, Smith and Tomlinson 1989). Furthermore, it is argued that state provision is associated with higher levels of technical and allocative inefficiency. In turn, the existence of these inefficiencies leads to a lower level of resources and services, thereby limiting the scope to reduce educational inequality and under-achievement (Hoxby 1996).

In Australia, the debate on the role of market forces and state provision in the education system has intensified in recent years. Most notably, there has been an ongoing, high-profile debate on the funding of non-government schools and the efficacy of "voucher"-

type mechanisms in allocating funding between private and state-run schools (Buckingham 2000, Macklin 2002). However, there have been two other significant policy developments in the organisation of primary and secondary education in Australia. Firstly, in 1998 the Coalition Government (under then Education Minister David Kemp) mandated the introduction of standardised literacy and numeracy testing across Australian primary schools. Comprehensive testing programmes were introduced for students at the Year 3, 5 and 7 level in order to measure progress on nationally agreed benchmarks for literacy and numeracy skills[2]. This reform was significant because it overcame the political resistance to the use of testing as a major performance indicator that existed among some stakeholders in the education sector.

Secondly, in the wake of the Kemp reforms, state governments have begun to make use of test-score and other data in allocating funds and organising service delivery. In particular, the Victorian government has recently taken a major step in releasing school-level information on Year 12 academic results and other school characteristics to the public. This means that, for the first time in Australia, parents, the media and other interested parties are able to construct "league tables" of relative school achievement. Indeed, the Victorian government's move was welcomed by the media and gained some popularity with the general public for this reason (Yaman and Nason 2002).

These developments are reminiscent of reforms to the British education system in the late 1980s and early 1990s. The Thatcher Government's 1988 Education Reform Act ushered in the most important series of changes to the organisation of state education in Britain since the 1944 Education Act. The government's aim was to liberalise the provision of public education and promote the concepts of parental choice, school competition and managerial decentralisation. A number of policy measures were implemented to facilitate this agenda including: the introduction of pupil-based formula funding, the publication of school examination results ("league tables"), the establishment of a powerful school inspection agency and the promotion of school-level governance. However, these reforms are best described as a market-oriented modification of the system of public provision rather than a full privatisation of the education system *a la* a voucher model. Le Grand (1991) and others (Bradley et al 2000, Glennerster 1991) have therefore characterised the British system as a "quasi-market" where market mechanisms play a significant role in determining the economic efficiency of a publicly provided education system.

In Australia, the emergence of a national testing system and the public release of school-level academic results raises the possibility of future market-oriented reforms. Therefore, in this paper we analyse the performance of Australian schools and reflect on what lessons can be learnt from the British experience with quasi-markets. Specifically, we measure the technical efficiency of a large sample of Queensland primary schools using the method of data envelopment analysis (DEA), a common approach in the education economics literature (Worthington 2001). In turn, we use the results of this analysis to discuss the determinants of school performance and the efficacy of using publicly available "league tables" of school-level achievement to facilitate parental choice and competitive discipline in the education system. Such league tables are a major component of the quasi-market policy framework and an analysis of how they signal school quality and promote competition is of vital interest to Australian policy debates.

Indeed, our analysis indicates that a simple, "unadjusted" league tables system has the potential to have both perverse and beneficial effects on the efficiency of the education system. The balance of these effects hinges on the extent to which "raw" league tables convey information about school efficiency or quality. The results of our DEA models indicate that league tables based on average scores do not adequately reflect the influence of socio-economic factors and student intake quality on school performance. In turn, we conclude that any Australian quasi-market model utilising league tables must be designed in a detailed "evidence-based" fashion that balances the dynamic costs and benefits of introducing market mechanisms.

We believe that this comparison with the British system is justified for a number of reasons. Firstly, the direction of current policy developments (particularly the Victorian reforms) indicates that Australian governments are more likely to change the education system in ways that are consistent with a quasi-market rather than a "school-choice" model[3]. Secondly, the idea of quasi-markets has received high-profile attention from members of both sides of politics who are interested the interface between markets and government (Abbot 2000, Botsman and Latham 2002). Despite this interest, academic research in Australia that explicitly addresses these issues has been limited. Thirdly, attempts at microeconomic reform in other sectors of the economy have been plagued by design and implementation problems (Quiggin 1996). Detailed research on school performance is therefore needed to prevent reform proceeding in an ill-conceived or piecemeal fashion.

This paper is organised as follows. Firstly, we review the evidence on the British quasi-market with a special reference to its institutional structure. In turn, we use this review to motivate some specific questions for the analysis of school performance in Australia. The third section outlines the methodology of the study with respect to educational production functions and the use of data envelopment (DEA) analysis. Fourth, we discuss the results of our DEA analysis with special reference to the influence of socio-economic variables and student intake quality. Finally, we review the policy implications of the study with respect to the use of school league tables, arguably the central component of the quasi-market model.

2 EVIDENCE ON QUASI-MARKETS IN EDUCATION

The British quasi-market in education evolved as the result of a collection of policy changes in the late 1980s and early 1990s rather than as the outcome of a detailed, pre-conceived plan. Table 1 provides an overview of quasi-market forces in terms of factors such as decentralisation, incentives, information, choice and voice. This allows us to identify the major components of the quasi-market along with their main functions. For example, the introduction of formula funding (based on age-weighted pupil numbers) and open enrolment was instrumental in exposing the distribution of schooling resources to the forces of demand and supply. Local school management and governance complemented this by facilitating decentralisation and allowing schools to differentiate themselves in terms of services and quality. Arguably, the publication of school performance tables was the most significant change. It provided parents with information on school quality (broadly defined) and schools with an incentive to improve their academic performance. In combination with the other reforms, this promoted competition between schools and was a major driver of performance improvement in the education system during the 1990s (Bradley et al 2000).

Early discussions of the quasi-market raised the concern that market mechanisms could amplify inequality in the education system (Glennerster 1991) and this continues to be a theme in applied research on the topic. Firstly, it has become clear that schools have responded to the quasi-market reforms in ways consistent with the operation of market forces (Bradley et al 2000). Most notably, the introduction of quasi-market forces affected the allocation of pupils between schools. For example, the dependence of new student admissions on the comparative exam performance of schools increased in the first four years of the quasi-market. This indicates that parental choice was influenced by school performance, as reported by the published league tables. Furthermore, school sizes fluctuated in patterns consistent with increased competition – high performing schools (measured in terms of exam performance) expanded in size while less effective schools lost enrolments (Bradley and Taylor 1998).

In regard to equity, a further analysis by Bradley and Taylor (2002) found that social segregation in the composition of schools increased under the quasi-market. Again, high-performing schools experienced a reduction in the number of pupils coming from less wealthy families while less successful schools experienced the opposite effect. However, the presence of competitive forces also appeared to be related to a significant improvement in performance, as measured by exam results. Other research focusing on social segregation has shown that parents are sensitive to differences in school performance, as reflected by house prices (Cheshire and Shepard 2002, Gibbons and Machin 2001).

Specific aspects of the quasi-market's contribution to widening inequality have been addressed in a number of studies (Adnett and Davies 2002, Goldstein and Spiegelhalter 1996, Mayston 2000, Wilson 2003). The role of league tables has been a major theme in this research. In particular, these studies have emphasised how the measures used in the *School Performance Tables* and other indicators work to exert competitive pressure within the quasi-market. Different performance indicators create different incentives for "gaming the system", that is, adjusting schooling policies to maximise test scores indirectly rather than value-adding to the skills of every student. For example, schools can operate "cream-skimming" policies where they are selective with either their intake of students or with their choice of which students undertake key exams. Furthermore, the specification of particular performance targets and benchmarks also encourages schools to concentrate on the education of students just below or above these targets in order to maximise average school performance. This has the potential to skew resources and effort away from students at alternate ends of the ability distribution.

Arguably, the key message of this critique of the quasi-market is that adverse institutional incentives can alter the relationship between maximisation of school performance and the development of student's human capital. This makes the identification of such adverse incentives and behavioural responses a key policy issue.

Recent reforms undertaken at the state and federal level in Australia have parallels with the development of the UK quasi-market. The Kemp reforms in the area of literacy and numeracy testing have created a new source of academic output measures for use in performance appraisal and resource allocation models. More recently, the Victorian government's initiative of releasing school-level academic performance indicators is reminiscent of the initial *School Performance Tables* system in the UK. In particular, the Victorian tables report raw or unadjusted indicators, that is, they do not control for the heterogenous backgrounds and abilities of students across schools. This problem applies even for the “transition profile” of post Year 12 destinations that is reported as part of the Victorian model (see Table2). As the critique outlined above suggests, this approach can limit the effectiveness of quasi-market mechanisms. In turn, we can pose two practical questions for the consideration of quasi-markets in the Australian education system. Firstly, how well do unadjusted league tables perform as signals of school performance, given the important role of socio-economic status and student intake quality ? And secondly, to what extent are market forces – particularly those related to school competition - already operating in Australia’s regulated education system?

3 METHODOLOGY AND DATA

Methodology

The methodology of our study is based on the estimation of an educational production function for schools using the frontier measurement technique of data envelopment analysis (DEA). This is a useful approach since it allows us to discuss the educational production function (EPF) in the context of a method that has a firm foundation in neo-classical production economics.

Following Hanushek (1979:354) educational production functions are “generally statistical analyses relating observed student outcomes to the characteristics of students, their families, and other students in the school, as well as the characteristics of schools”. The majority of EPF studies use some type of standardised test score as their measure of output. However, it is also possible to incorporate other types of outcomes as outputs, for example, student absence rates, success in tertiary entrance or student satisfaction. At the school-level, the production function describes how schools transform student inputs into the specified output. A school-level production function can be defined as follows:

$$A_{it} = f\left(B_i^{(t)}, P_i^{(t)}, S_i^{(t)}, I_i\right) \qquad (1)$$

where for the *i*th school, A_{it} = average achievement at time *t*; B_i^t = a vector of inputs related to the average family background characteristics of students (cumulative to time t); S_i^t = a cumulative vector of school inputs (e.g.: resources, teacher quality), P_i^t = a vector of average peer influences operating among students at the school, cumulative to time *t*; and I_i = a vector representing the average level of innate or prior ability of the students at the school.

The technical relationships expressed in this production function can then be translated into a framework based on efficiency measurement (Coelli et al 1998, Worthington 2001). The three central concepts here are technical, allocative and productive efficiency. These concepts are illustrated in Figure 1 for the output-oriented case involving two outputs (y_1 and y_2) and one input (x_1). The production possibilities curve is represented by ZZ' which gives the combination of outputs for a given levels of input. The firm A operates below the production possibilities frontier such that the distance AB represents technical inefficiency. Practically, this can be interpreted as the amount by which outputs could be increased without additional inputs. Using price information, we can draw an isorevenue line as DD'. The distance BC can then be interpreted as the extent of allocative inefficiency since it represents the cost reductions that could occur if production took place at the economically efficient point B'. Total economic efficiency equals the sum of technical and allocative efficiency, defined either as a ratio (0A/0C) or as a distance representing economic inefficiency (AC).

Linear programming methods can then be used to construct a non-parametric piece-wise frontier or surface with efficiency measures calculated relative to this surface. Given data on K inputs and M outputs for N firms, we represent these as a column vectors x_i and y_i for the *i*th firm. Then for each firm we obtain a measure of outputs over all inputs, such as $u'y_i$ / $v'x_i$ where u is an M×1 vector of output weights and v is K×1 vector of input weights. Optimal weights can then be found by solving the multiplier problem:

$$\begin{aligned} &\max_{u,v}\left(u' y_i\right) \\ &\text{st} \quad v' x_i = 1, \qquad (2) \\ &u' y_j - v' x_j \le 0, \end{aligned}$$

$$u, v \geq 0$$

An equivalent duality result can be derived as an envelopment problem:

$$\min_{\theta,\lambda} \theta$$

$$\text{st} \quad -y_i + Y\lambda \geq 0$$

$$\theta x_i - X\lambda \geq 0$$

$$\lambda \geq 0$$

where θ is a scalar and λ is a N×1 vector of constants. The value of θ obtained from this problem represents the efficiency score for the i-th firm where θ = 1 denotes a fully efficient firm operating on the production frontier. The linear programming problem is solved for every firm to construct a piece-wise linear isoquant that is consistent with the case of constant returns to scale (CRS). A variable returns to scale (VRS) can be explored by adding a convexity constraint such as N1'λ=1 to the envelopment problem. Such a constraint allows us to construct the production frontier as a convex hull of intersecting planes that envelops the data more closely than the conical CRS hull.

Constructing a production frontier based on the type of school-level production function specified in equation (1) raises some special methodological challenges. Firstly, as a public-sector application, frontier measurement of educational production is faced with the common problems of ill-defined input prices, non-competitive markets, and imposed environmental conditions (Worthington 2001). Secondly, the correspondence between educational inputs and outputs is difficult to identify. For example, it is difficult to understand how expenditures on schooling translate into outputs and how various inputs (e.g.: ability, family inputs, school inputs) interact over time (Hanushek 1979, Todd and Wolpin 2003). As a result, the DEA application in our next section compares a number of input-output specifications and uses the two-stage method to examine the determinants of efficiency scores. The two-stage method involves formulating a DEA model with "traditional" inputs in the first stage and then regressing the resulting efficiency scores against school characteristics to assess the determinants of school efficiency.

Data

In this study we use three different data sources to construct an overall database on primary school performance in Queensland. Firstly, we use student administrative records from Education Queensland (the Queensland education department) to calculate school output measures based on average test scores. Specifically, these output measures are the average scaled numeracy and literacy scores for each school. This administrative data also provides us with some demographic information on students such as their gender, whether they are an Aboriginal and Torres Strait Islander (ATSI) or from a non-English Speaking Background (NESB), and residential postcode. In some cases, these demographic variables have been used to create variables on average school-level characteristics, most notably the proportion of ATSI students at a school.

Secondly, further demographic variables are created by linking the student administrative records to 2001 Census data on the socio-economic characteristics of postcode areas. School-level socio-economic indicators are therefore constructed by weighting the school-level measure according to the residential distribution of students attending the school. Finally, personnel data (based on Education Queensland's human resource information system) is used to calculate input variables describing the teaching labour force at each school. This includes inputs related to teacher and teacher aide hours, school managers and average teacher experience. Full details on the calculation of these variables are given in Appendix A.

The scope of this database provides a unique opportunity to investigate school performance in the public education system of a major Australian state. Table 3 reports information on the distribution of government and non-government school students across the states. Queensland accounts for 20.4% of all Australian primary students in government schools (versus 33.7% and 26.3% for NSW and Victoria respectively). Non-government schooling is slightly less popular in Queensland with only 24.2% of primary students attending versus 28.2% (NSW) and 30.6% (Victoria). An interesting feature of the Queensland education system is its high proportion of ATSI students. In 2001

Queensland had 22,205 ATSI students enrolled at the primary level, approximately 28.1% of all of Australia's indigenous primary students. The state is therefore in line with Western Australia and Tasmania with ATSI students representing around 6% of total primary enrolments (see Table 4).

Our sample is based on a student cohort that is tracked from 1999 (Year 5) to 2001 (Year 7). Education Queensland's student number system allows us to identify 27,000 "continuing students", that is, students who stayed at the same school from Year 5 to Year 7. We calculate school-level average test scores for this group of continuing students since their performance can be related to more closely to their school's performance.

Table 5 provides some summary statistics for the 906 schools in our sample[4]. Queensland primary schools have an average enrolment (school size) of 289 students across Years 1-7. Schools are split between those located in urban areas (45%), rural areas (37%) and remote areas (18%). However, the majority of *students* are located in urban areas (X%), indicating that rural and remote schools have smaller average enrolment numbers. While the average proportion of indigenous students per school is 9% the high standard deviation also indicates that the distribution of indigenous students across schools is uneven. Average teacher experience or tenure stands at approximately 10.8 years per individual teacher and, on average, there are 1.84 managers (e.g.: principals, vice-principals) present at each school.

Average school test scores by socio-economic category are reported in Table 5(a). Two measures of socio-economic structure – based on average income and the proportion of adults with degree/diploma qualifications in the school's catchment area – are presented. There is a large gap between the top 25% of schools by socio-economic status and the rest. Test scores for schools in the top quartile are approximately 15-20 points higher than for the next quartile. Surprisingly, in many cases average test scores for schools in the bottom quartile are higher than those for the middle two quartiles. This can be explained by the larger concentration of ATSI students in these middle quartiles. The average proportion of ATSI students for schools in the middle quartiles is approximately 11% compared to 7%-9% for the other quartiles. Table 5(b) reports average test scores by quartile for schools a low proportion of ATSI students (less than 10%). This reveals a more traditional pattern with average test scores declining as the proportion of adults with degree and diploma qualifications falls. However, the inter-quartile variations between quartiles 2-4 are flat at best when socio-economic status is measured in terms of average income.

4 RESULTS

(i) Models and Efficiency Scores

We construct three models of school performance that utilise different combinations of inputs and outputs within a DEA framework. These models have been formulated to shed light on different aspects of school performance and therefore different types of possible efficiency rankings or league tables. Our main objective is too examine how school performance varies according to both socio-economic structure and the average prior ability of students at a school. A literature stretching back to the Coleman et al (1966) report has emphasised the role of socio-economic factors and prior ability in determining educational performance. If either or both of these factors influence the measurement of school performance then there will be implications for how quasi-market forces could be expected to operate in Australia's public education system.

Firstly, we must clarify how our study defines "school performance". Principally, we are concerned with school performance from a production economics perspective consistent with the EPF outlined above. That is, schools are seen as firms or "decision-making units" (DMU's) responsible for using resource inputs to produce educational outputs. The vector of inputs includes labour and capital inputs, together with environmental inputs related to the characteristics of the student body. As discussed, school outputs are typically defined in terms of academic test scores, although other non-academic outputs can be included. Here we focus on outputs based on academic test scores since (i) such an approach allows us to make consistent comparisons with output measures based on "raw" average scores and (ii) data limitations prevent us from considering other potential outputs, such as absence rates, student satisfaction, or the quality of non-cognitive skills. Therefore our models define school performance in terms of the economic efficiency of schools. This contrasts for example with multi-faceted, qualitative discussions of school performance in the educational statistics literature (Rowe 2000).

The four models are described in Table 7. Each model uses Year 7 literacy and numeracy scores as outputs. Furthermore, note that each of these models reflect different relationships in the school-level production function outlined in equation (1) above. Model 1 is simplest model, using only teacher labour force variables as part of its input vector. This model corresponds most closely with a simple or "raw" model of school efficiency that ranks schools according to their average test score. Model 2 adds socio-economic variables into the inputs vector as non-discretionary inputs. These include input variables describing the income in the school's catchment area, diploma / degree qualifications in the catchment area, and the proportion of indigenous students attending the school. These environmental variables were chosen to allow for variation across a number of socio-economic characteristics. For example, schools in some areas may benefit from an environment where the catchment area population has high levels of human capital as well as high levels of income. Other schools may be exposed to a local population with high incomes but lower levels of human capital and so on. Finally, Model 3 is formulated as a "value-added" model. That is, it includes prior ability as part of the input vector in order to measure how efficient schools are at producing increases in average test scores relative to their student's performance in Year 5. Model 3 also incorporates socio-economic variables as non-discretionary inputs. Therefore, among our three models, Model 3 is the most complete representation of the school-level production function outlined in the previous section.

A summary of the efficiency scores produced by these different models is reported in Table 8. Model 1 is characterised by mean efficiency scores of 47.1 and 55.0 for the CRS and VRS models respectively. The minimum efficiency score of 5.0-5.4 also indicates that this model has a wide range. Overall, this indicates that a large degree of technical efficiency exists among schools when a vector of labour-inputs is included as the only input. The inclusion of socio-economic variables in Model 2 has a dramatic effect. Mean efficiency scores rise to 79.8 and 82.2 for the CRS and VRS models. The range is more limited with a minimum score of 42.5 for both models. The addition of prior ability in Model 3 stimulates further improvements. The mean CRS and VRS efficiency scores rise to 93.8 and 95.1 respectively, with minimum scores of 77.3-77.4. Clearly then, the inclusion of environmental variables in Models 2 and 3 reduces the degree of technical inefficiency in school performance that is evident in Model 1. Furthermore, the small differences in mean CRS and VRS efficiency scores across the models suggests that scale economies played a limited role in explaining the efficiency of the primary schools analysed in this sample.

A comparison of the distribution of efficiency scores across the models is shown in Figure 2. There is both a large level and slope shift when moving from Model 1 to Models 2 and 3. Furthermore, there is a level shift of approximately 0.3 between Models 2 and 3. Interestingly, the distribution of scores for Models 2 and 3 begin to converge as we approach higher the efficiency scores. Therefore, the introduction of prior ability in the first stage seems to have a greater effect on technical efficiency in the lower half of the score distribution.

As a check on the robustness of our results, Table 9 presents DEA estimates where the least and most efficient schools are omitted from the analysis. This is performed 3 times recursively for model 1 to model 3 respectively. The reported results suggest that our DEA estimates are robust to efficiency outliers.

(iii) Rank Correlations.

The Spearman rank correlations in Table 10 offer some further comparative information on Models 1-3. Firstly, it is important to note the differences between comparisons of school based on average test scores (ie: a "raw" or unadjusted league table of schools) and rankings based on the application of DEA methods. The Spearman rank correlation results in Table 10 indicate that the correlation between the raw and model-based rankings was low, ranging between approximately 0.26 and 0.38. In contrast, there is a stronger correlation between Models 1 to 3. Between all models, the rank correlation coefficient ranged between 0.53 (Model 1 and Model 3) to 0.65 (Model 1 and Model 2).

Interpreting these rank correlations is difficult since we do not have an indicator of the "true" efficiency ranking of schools or indeed statistical distribution results. However, two conclusions can be drawn. Firstly, it is interesting to note that the rank correlations are stable across Models 1-3. This indicates that there may be some robustness in the results, including systematic patterns of school performance. Secondly, to the extent that the "raw" league table rankings depart from our DEA-based measures we can say that the raw rankings convey limited information regarding the influence of socio-economic factors and prior ability on school performance. As a result, it can be argued that the role of "raw" league tables in providing signals of school efficiency or quality is at best limited.

(iv) Determinants of Efficiency – Second-Stage Tobit

Finally, regression analysis is used to provide some evidence on the determinants of school efficiency. We use the results from Model 1 as our measure of school efficiency as this only includes those inputs which are directly in the control of the school / education department. Furthermore, efficiency may be related to scale economies, we examine this by utilising the CRS results and including school enrolments to investigate the impact of school size on efficiency. Socio-economic variables (income level), and variables identifying schools with a high proportion of indigenous students, and the location of the school (remote and rural) are also included. Finally, a fixed effects model is estimated to account for local area effects (Model 2) while two variables are added to the basic model to examine the potential effects of inter-school competition (Model 3).

Efficiency scores are limited to the [0,1] interval, and some scores lie on the upper limit of one, as a result a Tobit model is used which allows for right censoring of the dependant variable (Y_i). This provides:

$Y_i = \beta' x_i + \varepsilon_i$ if Y_i<1;

Y_i = 1 otherwise.

Where Y_i is the efficiency score of the ith school.

Regression estimates are provided in Table 11. School efficiency is positively related to school size, indicating the presence of scale economies, although the negative sign on the quadratic term implies that this effect diminishes as school size increases. School efficiency is positively related to the income levels of student background, indicating that socio-economic background can be categorized as an input into school production. Conversely, school efficiency decreases with the proportion of school students that are indigenous, this is indicative of the difficulties involved with indigenous education in Australia. At the same time, schools in remote locations also suffer a 4 point penalty to measured technical efficiency. These last two results are of particular interest as many schools with high proportions of indigenous students are located in remote areas of Queensland. This means that, other things being equal, these schools will tend to perform poorly in either "raw" league table or simple school input-based models of technical efficiency. This is a concern as clearly neither indigenous composition of students or regional location of school is in the control of school decision makers.

The fixed effects term in Model 2 is defined at the local government area (LGA) level and therefore accounts for region-specific variations in school efficiency. Such region-specific effects are important insofar that they could be collinear with variables such as average income, rural school and remote school. Here, the inclusion of the fixed effects term improves the precision of the estimates for average income, rural school and remote school, while the magnitude of the co-efficients is similar to the basic model.

Model 3 uses two variables to test for the potential effects of inter-school competition. The number of government schools per LGA is used to represent the potential competition a school faces from other government schools in the local area. That is, where catchment areas overlap there is potential for schools to compete in terms of reputation and perceived performance. However, these effects are likely to be weak in the absence of clear signalling mechanisms, such as league tables. Despite this the variable representing competition among government schools is significant at the 5% level. Furthermore, the co-efficient estimate indicates that the hypothetical introduction of a new school in an LGA raises the efficiency of affected schools by 0.16 of a percentage point. The other variable tested is one representing competition from non-government schools within an LGA. Competition from non-government schools has the potential to exert two opposite effects. It can either increase efficiency by encouraging government schools to maintain and improve their performance or it can reduce efficiency by attracting the best students (usually from higher socio-economic backgrounds) in a process of “cream-skimming”. Empirically, we find weak evidence of a negative effect from non-government school competition – approximately 0.17 of percentage point for each additional non-government school in an LGA at the 10% significance level.

It must be noted that this can only be interpreted as preliminary evidence of competitive effects. Further data and more complex variables are needed to establish the effects with more certainty. Sentences on other studies of competition and school reform.

5 CONCLUSION

Recent reforms to Australia’s primary and secondary education system have resulted in an increased emphasis on performance measurement and an increased role for market mechanisms. In this context, it is useful to look to the UK’s experience of quasi-markets to ask questions about possible policy directions for Australia. We have used this background to motivate two questions. Firstly, how well do unadjusted school league tables perform as signals of school performance, given the important role of socio-economic status and student intake quality? Secondly, to what extent are market forces – particularly those related to school competition - already operating in Australia's regulated education system? Answers to these questions are critical to evaluating the potential success of quasi-market reforms in Australia.

Our analysis of a large database of Queensland primary schools provides some insights into these issues. On the first question, there are striking differences in the school performance rankings that are suggested by a "raw" league table that uses average test scores and the rankings produced by model-based methods that account for socio-economic factors and intake quality. The raw league table rankings are consistent with model-based rankings in only 22%-38% of cases, depending on model structure. Given that we do not know the "true" distribution of school efficiency or quality it is difficult to evaluate how accurate the raw and model-based rankings are in practice. However, the limited correlations between the raw rankings and model-based rankings suggest that the former measures do not adequately reflect the influence of socio-economic factors and intake quality. In practice then, raw league tables understate the performance of schools in disadvantaged socio-economic areas.

Briefly, this means that an Australian quasi-market model centred on an unadjusted league table would face important signalling and incentive problems. The main problem with using unadjusted test scores as signals of school performance is that it increases the scope for schools to "game the system". That is, using unadjusted league tables as the principal performance indicator in a quasi-market model opens up a route for schools to improve their (perceived) performance by optimising the structure of their student body, either in terms of socio-economic composition or prior academic ability. Furthermore, as this performance indicator is adopted by parents as a determinant of school choice it exerts a pressure for increased social segregation between schools, as found in the UK system by Bradley and Taylor (2002). In turn, these problems could be expected to affect the nature of the equity-efficiency trade off that would result if market-oriented reforms were implemented in Australia. The trade-off would be effected in two ways. Firstly, as student composition becomes more polarised, social segregation would obviously reduce the equity of outcomes between schools. Secondly, to the extent that improvements in performance (as measured by raw average test scores) are secured through "gaming" by schools then this would artificially inflate the magnitude of the system-wide efficiency gains.

In terms of our second question, the results of the second stage Tobit regression indicate that school efficiency in our sample is affected by inter-school competition, albeit weakly. Specifically, our results suggest that increased competition between government schools has the potential to increase school efficiency. On the other hand, the results also suggest that the interaction between government and non-government schools must be managed carefully to avoid "cream skimming" and other negative effects associated with competition between the two systems. Of course, our results are subject to the caveat that these competitive effects need to be established with more certainty using further data and more complex models of competition. However, it must be noted that the UK evidence indicates that inter-school competition was a driving force of efficiency gains (Bradley et al 2002). The findings presented above therefore raise the prospect that competition could have similar benefits for the efficiency of the Australian system, if managed correctly.

This last caveat is of special importance. Australian policy-makers *do* have an opportunity to design and manage a more effective framework for primary and secondary schooling. The UK experience has produced research and data that is able to inform the Australian situation. In addition, as Leigh and Wolfers (2003) argue, compared to previous eras Australian policy-makers now have the opportunity to engage in more detailed "evidence-based" policy development. This can be described as "the notion that policy ideas should stand or fall on the basis of research and trials, rather than opinion polling and supposition". In conclusion, we suggest that further use of the type of administrative data used in this study has the potential to fuel this process of evidence-based policy development.

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FOOTNOTES

[1] Gradstein and Justman (2000), for example, present a theoretical model that shows that public education increases social cohesion.
[2] See the *National Report for Schooling 2000 – Preliminary Paper* (MCEETYA, 2001) for an outline and discussion of these benchmarks.
[3] By "school choice" model we mean an explicitly privatised, voucher-centred system as per many US proposals. Glennerster (1991:1268) points out that the British model falls short of a full market solution because (a) funding cannot follow students into the private sector and (b) the entry of new providers is restricted.
[4] A number of schools (160) were omitted from the analysis due to missing observations or very low enrolment numbers (5 students or less).

Table 1: Educational Reforms and Quasi-Market Forces

	Preconditions for Quasi-Markets				
Educational Reform	*Decentralised Decision-Making*	*Incentives*	*Information*	*Choice*	*Voice*
Formula Funding	√	√	-	-	-
Local Management of Schools	√	-	-	-	-
Open Enrolment	-	-	-	√	-
Opting-Out	√	-	-	√	-
Technology Colleges	-	-	-	√	-
School-site governance	√	-	-	-	-
School Performance Tables	-	√	√	-	√

Source: Bradley et al (2000:359).

Table 2: School Performance Information in Australia (Year 12), 2002.

State / Territory	*Information*
New South Wales	Publishes names and schools of students with achieving more than 90% in each subject.
Victoria	School-by-School information on: - Median study scores in the Victorian Certificate of Education - Rates of satisfactory completion. - Post-Year 12 "Transition Profile" of student employment and education destinations.
Queensland	Assessment is school-based with no information made public.
South Australia	A list of students who achieve a perfect Year 12 score is published, though no comparative data is made available.
Western Australia	Year 12 results are made available to newspapers for a fee and are subsequently published.
Tasmania	Names and schools of the students achieving in the top 0.5% are published.
ACT	Publishes the average University Admissions Index for each school.
Northern Territory	Names, schools and scores of the top 20 students are published each year.

Sources: Yaman and Nason (2002); Kosky (2002).

Table 3: Government and Non-Government Schooling by State , 2001.

	(1) Proportion in Government Schools (%)	*(2) Proportion in Non-Government Schools*	*(3) Share – All Government School Students, Australia (%)*	*(4) Share – All Non-Government School Students, Australia (%)*
New South Wales	71.8	28.2	32.7	33.7
Victoria	69.4	30.6	22.7	26.3
Queensland	75.8	24.2	20.4	17.1
South Australia	71.7	28.3	8.3	8.6
Western Australia	74.4	25.6	10.3	9.3
Tasmania	77.7	22.3	2.6	2.0
Northern Territory	80.2	19.8	1.5	1.0
Australian Capital Territory	66.0	34.0	1.5	2.1
Australia	72.4	27.6	100	1.000

Source: ABS (2002) Schools, Australia (Cat: 4221.0).

(1) Proportion of all primary students attending government schools.
(2) Proportion of all primary students attending non-government schools.
(3) Given state or territory's share of all government primary school students in Australia.
(4) Given state or territory's share of all non-government primary school students in Australia.

Table 4: Indigenous Students by State, 2001.

	(1) Indigenous Students – Total	*(2) All Students – Total*	*(3) Proportion Indigenous Students (%)*	*(4) Share - Australian Indigenous Students (%)*
New South Wales	22,208	630,261	3.5	28.1
Victoria	4,101	453,766	0.9	5.2
Queensland	22,205	372,316	6.0	28.1
South Australia	5,002	159,400	3.1	6.3
Western Australia	12,211	191,633	6.4	15.5
Tasmania	2,806	46,872	6.0	3.6
Northern Territory	9,780	25,675	38.1	12.4
ACT	630	32,490	1.9	0.8
Australia	78,943	1,912,413	4.1	100.0

Source: ABS (2002) Schools, Australia (Cat: 4221.0).

(1) Total number of primary indigenous students.

(2) Total number of primary indigenous and non-indigenous students.

(3) Proportion of primary indigenous students.

(5) Given state or territory's share of all primary indigenous students in Australia.

Table 5: School Characteristics, 2001.

	Mean	*Std Dev*
School Enrolment	288.73	250.35
Urban School	0.45	0.50
Remote School	0.18	0.38
Rural School	0.37	0.48
School Prop. Indigenous	0.09	0.15
School Average Income	391.15	63.37
School Literacy Year 7	678.53	44.81
School Numeracy Yr7	675.33	49.79
School Numeracy Yr5	591.96	42.73
School Literacy Year 5	604.99	40.12
Teacher Experience	3961.61	1860.87
Teacher Hours	494.72	415.76
Manager FTEs	1.84	1.20
Observations	906	

Table 6 (a): Average School Test Scores by Socio-Economic Status

	(1) *Mean Literacy Year 7*	(2) *Mean Numeracy Year 7*	(3) *Mean Literacy Year 5*	(4) *Mean Numeracy Year 5*	(5) *Average Proportion ATSI*	(6) *School Size*
Income						
Quartile 1	690.1	688	615.5	603.8	0.08	346
Quartile 2	674.9	670	598.5	586.8	0.11	315
Quartile 3	671.6	668	599.5	587.3	0.114	273
Quartile 4	677.6	675.6	603.9	589.9	0.072	221
Degree / Diploma						
Quartile 1	693.4	690.3	619.3	606.6	0.07	328
Quartile 2	672.7	668.9	597.8	586.2	0.11	290
Quartile 3	672.5	671.3	600.6	587.6	0.10	268
Quartile 4	675.5	670.9	599.8	587.5	0.09	270

(1) Average Year 7 Literacy score per school. Scaled score between 500-900.
(2) Average Year 7 Numeracy score per school. Scaled score between 500-900.
(3) Average Year 5 Literacy score per school. Scaled score between 500-900.
(4) Average Year 5 Numeracy score per school. Scaled score between 500-900.
(5) Average proportion of ATSI students per school.
(6) Average school enrolments.

Table 6(b): Average School Test Scores by Socio-Economic Status, where Proportion ATSI < 0.1

Income	(1) *Mean Literacy Year 7*	(2) *Mean Numeracy Year 7*	(3) *Mean Literacy Year 5*	(4) *Mean Numeracy Year 5*	(5) *Average Proportion ATSI*	(6) *School Size*
Quartile 1	700.9	696.9	623.9	610.0	0.08	346
Quartile 2	687.4	683.9	610.9	599.8	0.11	315
Quartile 3	683.0	680.0	610.6	598.5	0.114	273
Quartile 4	686.1	685.5	610.6	595.2	0.072	221
Degree / Diploma						
Quartile 1	703.7	701.1	627.1	613.5	0.07	328
Quartile 2	688.0	685.0	610.7	599.1	0.11	290
Quartile 3	682.8	683.9	611.7	599.0	0.10	268
Quartile 4	682.4	675.8	605.7	590.7	0.09	270

(1) Average Year 7 Literacy score per school. Scaled score between 500-900.
(2) Average Year 7 Numeracy score per school. Scaled score between 500-900.
(3) Average Year 5 Literacy score per school. Scaled score between 500-900.
(4) Average Year 5 Numeracy score per school. Scaled score between 500-900.
(5) Average proportion of ATSI students per school, calculated at Year 7 (2001).
(6) Average school enrolments, calculated at Year 7.

Table 7: Overview of DEA Models

	Model 1	*Model 2*	*Model 3*
		Inputs	
Teacher Hours	√	√	√
Manager Numbers	√	√	√
Teacher Experience	√	√	√
Diploma and Degree Qualifications		√	√
Average Personal Income		√	√
Proportion of School Indigenous		√	√
Year 5 Prior Ability (Literacy)			√
Year 5 Prior Ability (Numeracy)			√
		Outputs	
Year 7 Literacy	√	√	√
Year 7 Numeracy	√	√	√

Table 8: DEA Models of School Efficiency.

	Model 1		*Model 2*		*Model 3*	
	CRS	VRS	CRS	VRS	CRS	VRS
Mean	47.1	55.0	79.8	82.2	93.8	95.1
Min	5.0	5.4	42.5	42.5	77.3	77.4
Max	1.000	1.000	1.000	1.000	1.000	1.000
% Share Efficient	1.1	3.1	6.1	9.9	10.6	19.2

TABLE 9 Stability of DEA, Jacknife Results.

			Number of Efficient Schools	*Mean Efficiency*
Model 1	1st Jacknife	CRS	10	47.2
		VRS	28	55.0
	2nd Jacknife	CRS	10	47.2
		VRS	28	55.1
	3rd Jacknife	CRS	10	47.3
		VRS	28	55.1
Model 2	1st Jacknife	CRS	56	79.9
		VRS	90	82.2
	2nd Jacknife	CRS	56	80.0
		VRS	90	82.2
	3rd Jacknife	CRS	56	80.0
		VRS	90	82.3
Model 3	1st Jacknife	CRS	96	93.9
		VRS	174	95.1
	2nd Jacknife	CRS	96	93.9
		VRS	174	95.2
	3rd Jacknife	CRS	96	93.9
		VRS	174	95.2

Table 10: Spearman Rank Correlation Coefficients - Models 1 to 3.

		Model 1	*Model 2*	*Model 3*
Raw League Table	Literacy	0.2686	0.3067	0.3409
	Numeracy	0.2138	0.3540	0.3900
	Composite	0.2490	0.3515	0.4034
Model 2	CRS	0.5631		0.6338
	VRS	0.4888		0.6611
Model 3	CRS	0.4769		
	VRS	0.6336		

TABLE 11 Determinants of School Efficiency (CRS Model 1) – Tobit Results

	(1) Basic		*(2)Fixed Effect*		*(3)Competition*	
	Coef	t-ratio	Coef	t-ratio	Coef	t-ratio
School Enrolment	0.06	7.63	0.06	7.61	0.06	7.77
School Enrolment^2	$-3*10^{-5}$	-3.38	$-3*10^{-5}$	-3.55	$-3*10^{-5}$	-3.49
Remote School	-3.27	-1.62	-6.81	-1.71	-1.42	-0.63
Rural School	1.79	1.08	3.69	1.91	2.86	1.57
Proportion of Indigenous Students	-30.38	-7.04	-29.78	-5.68	-30.59	-7.07
Income Level	0.02	2.22	0.05	3.07	0.02	2.16
Number of Govt Schools in LGA					0.18	2.39
Number of Non-Govt Schools in LGA					-0.16	-1.55
Constant	27.32	6.18	36.09	2.61	23.79	5.11
Pseudo r^2	0.04		0.06		0.04	
Observations	906		906		906	

(1) Basic model. Includes school enrolment, remote school, rural school, proportion ATSI and catchment area average income.
(2) Fixed Effect model: Includes fixed effect models for local area efects.
(3) Competition Model: Adds variables representing competition to the basic model. Variables include: number of government schools in the local government area (LGA) and non-government schools in the LGA.

Figure 1: Technical and Allocative Efficiencies from an Output Orientation

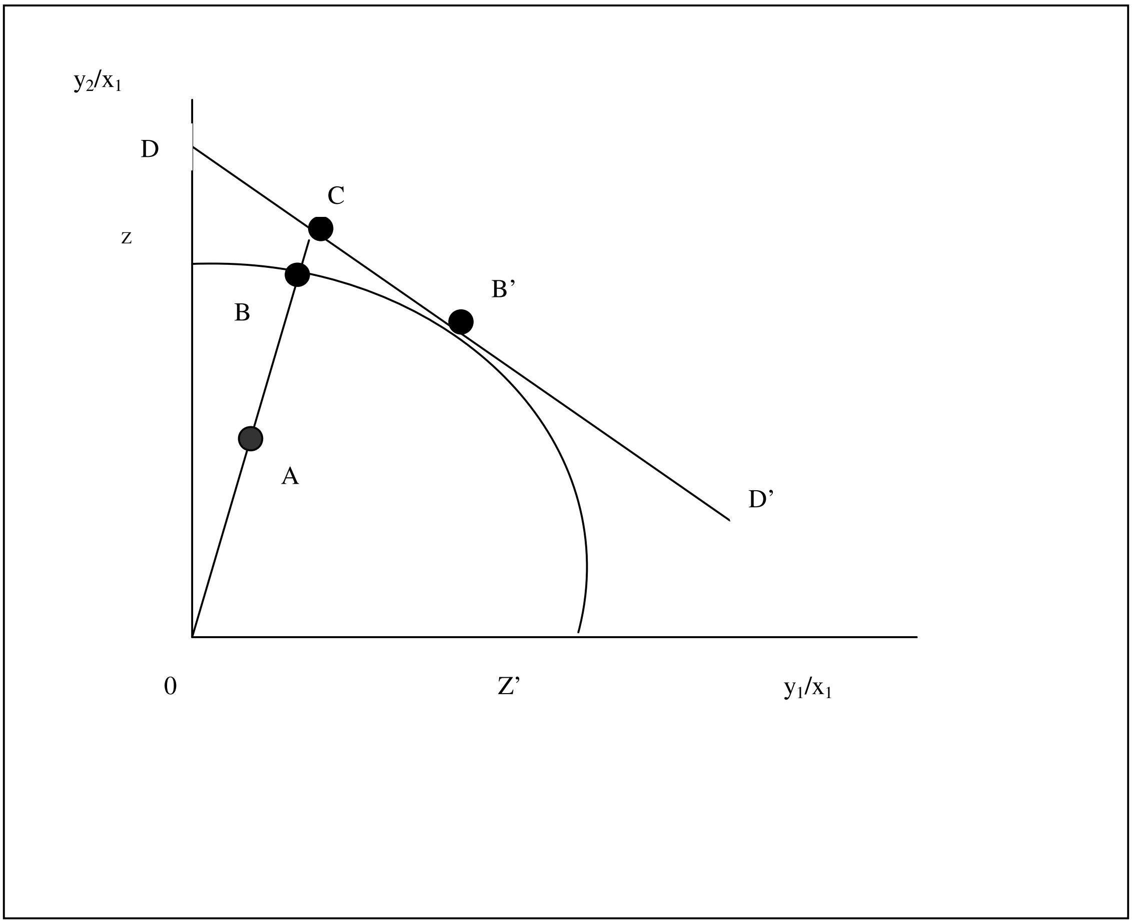

Figure 2 - Distribution of Efficiency Scores Across Three Models (CRS)