



Long-term effects of school size on students' outcomes



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ABSTRACT

We estimate the effect of school size on students' long-term outcomes such as high school completion, being out of the labor market, and earnings at the age of 30. We use rich register data on the entire population of Danish children attending grade 9 in the period 1986–2004. This allows us to compare the results of different fixed effect and instrumental variables estimators. We use the natural population variation in the residential catchment areas and school openings and closures to instrument for actual school size. We find a robust positive but numerically fairly small relationship between school size and alternative measures of long-term success in the educational system and the labor market. The positive impact of school size seems mainly to be driven by boys and students from families with a low educational level.

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1. Introduction

School size is an important policy parameter. During recent decades a major consolidation process has taken place in many OECD countries that resulted in a rapidly declining number of schools and school districts and an increase in average school size, see Newman et al. (2006) for the US. The same development is observed in Denmark where schools on average have been fairly small but during the latest decade the political focus has unambiguously been to increase school size, see Feilberg (2013). Policymakers often appear to prefer large schools due to scale economies associated with administrative costs and most often the arguments behind school consolidation have been cost savings and economies of scale. Only recently, an opposite movement has started in some countries toward smaller schools. In the US, the Small Schools Initiative has got support from rich private foundations like the Bill and Melinda Gates Foundation to invest in small school projects. School size may also have effects on the local community and this may in practice be one of the more

important arguments in favor of small schools and against school consolidation. Closing a local school may have negative effects on social activities in the local community and in the long run it may also have implications for the social composition of residents in the community which may generate more negative peer effects, see Egelund and Laustsen (2006). However, in this study we restrict our analysis to the more direct long-term effects of school size on students' educational and labor market careers.

There is a growing literature on the impact of class size on student outcomes, see for instance Fredriksson, Öckert, and Oosterbeek (2013) for a recent study from Sweden which in many respects has a school system similar to the Danish primary and secondary school system. In line with many other studies, they find that larger school classes have a causal negative effect on school outcomes in the short run as well as on long-run outcomes in the labor market. The empirical research on the impact of school size on children's cognitive and noncognitive skills is more sparse and the results are more mixed. Most of the studies find negative, but numerically small effects of larger schools when controlling for parental inputs and other background characteristics, see the recent survey in Leithwood and Jantzi (2009). But even if the effects of school size are numerically small, school size is a political instrument which is much more amenable to change

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by policymakers than parental background. Thus, even small effects of school size on students' academic achievement and behavior may have important consequences for policy decisions. Our definition of the effect of school size is the total policy effect of school size, i.e. including both the direct effect of school size and any potential indirect effects, such as an effect through class size.

While most existing studies have focused on the in-school performance of children or short-run effects of school size, we mainly consider the long-run consequences of school size, for example, educational attainment after compulsory school and the earnings capacity later in life at the age of 30. While estimates of the effect of school size on short-run outcomes (typically test scores or behavioral measures while attending school) of course are informative, it is crucial to know whether these potential short-run effects also translate into differences in the long run, see the general discussion of the effect of school inputs on student outcomes in [Hanushek \(2006, chap. 14\)](#). We consider outcomes that are generally considered to be affected by both cognitive and noncognitive skills. In a sense this allows us to obtain a more overall picture of the effects of school size than if we considered more narrow outcomes that measured particular forms of either cognitive or noncognitive skills.

The study is based on register data on the total population of students in grade 9 in Denmark during the period 1986–2004. We follow the students until 2010. For these students, who are typically 16 years old when they complete grade 9, we focus on the educational outcomes 6 years later, i.e. at the age of 22. For students in the cohorts from 1986 to about 1998, we also observe earnings at the age of 30.² The richness of the data allows for the comparison of different alternative estimators that are often used in the empirical literature on the causal relationship between school characteristics and student outcomes. As the point of departure, we estimate the effect of school size by simple OLS including a wide range of individual-level characteristics available in the register data such as birth order, family type, and parental earnings and education. In addition, alternative fixed effect strategies based on schools and siblings are employed. Finally, we implement two different instrumental variables strategies based on natural population variation in the catchment area and school openings and closings, respectively.

Based on the wide range of estimators implemented, our results show a robust and positive, but numerically fairly small, relationship between school size and alternative measures of long-term success in the educational system and the labor market, such as the probability of high school completion and earnings at the age of 30. This result is also robust to controlling for grade 9 exit exam grades. The positive impact of school size seems mainly to be driven by boys and students from families with a low educational level.

In [Section 2](#) we give an overview of the existing evidence on the effects of school size. In [Section 3](#) the institutional context is described. [Section 4](#) describes the data and offers some descriptive statistics of Danish schools while [Section 5](#)

describes our empirical strategy. Finally, [Sections 6](#) and [7](#) present the results of our analyses and [Section 8](#) concludes.

2. Earlier empirical research on school size and student outcomes

The estimates of the impact of school size in the literature vary considerably and based on the existing research it is not easy to give an unambiguous policy advice about school size, see the survey in [Leithwood and Jantzi \(2009\)](#). First, the results may of course vary across countries because of institutional differences. Second, the notions 'small schools' and 'large schools' vary from country to country. In some countries average school size is relatively large, for instance in the UK, where many of the studies are based on an average school size of around 1,000 students. Average school size also varies considerably in US studies, ranging from a few hundred students to very large average school sizes, see the survey in [Newman et al. \(2006\)](#). As examples, [Iatarola, Schwartz, Stiefel, and Chellman \(2008\)](#) and [Bloom, Thompson, and Unterman \(2010\)](#) categorize schools with less than 500–550 students as 'small schools' in their studies of US high schools which is considerably higher than the average school size for all Danish public elementary schools analysed in this study, see [Section 3](#) and [Blom-Hansen \(2004\)](#), [Heinesen \(2005\)](#), and [Feilberg \(2013\)](#).

Some studies aim at identifying an optimal school size, and this figure also seems to vary considerably. [Bradley and Taylor \(1998\)](#) find that the optimal school size (based on a study of English schools) is larger for older children, for children aged 11–16 it is about 1,200 students and for children aged 11–18 it is about 1,500 students. The dependent variable in their study is exam results of the students. However, their study does not control for potential endogeneity of school size and a later study from Wales indicates that the optimal school size for children in secondary school (age group 11–16) is about 600 students, see [Foreman-Peck and Foreman-Peck \(2006\)](#), who use school attendance as their dependent output variable.

Third, 'optimal' depends on which objective function is being optimized. The above results concern student performance (grades or test scores, school attendance etc.). If the focus instead is on minimizing costs per student, the survey of US schools by [Andrews, Duncombe, and Yinger \(2002\)](#) indicates an optimal school size of about 300–500 for elementary schools and 600–900 for high schools. [Barnett, Glass, Snowdon, and Stringer \(2002\)](#) apply a Data Envelopment Analysis to UK secondary school data in order to identify 'optimal school size' in the case of two key objectives: school costs and student achievement. They find that schools with more than 1,000 students (the largest group in the study) performed relatively better than smaller schools with less than 1,000 students when taking both cost effectiveness and school grades into account.

Some studies focus on other social outcomes. Small schools may have less alienation effects, [Strang \(1987\)](#). Students, parents and teachers in small schools may feel more 'connected' to the school, more responsible for the overall functioning of the school and may be more involved in school activities compared to large schools, see [McNeely, Nonnemaker, and Blum \(2002\)](#). Thus, small schools often have more extracurricular activities than large schools

² For the last couple of cohorts, we only observe earnings for the oldest members of the cohorts, though.

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