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The impact of school size and school consolidations on quality and equity in education

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The impact of school size and school consolidations on quality and equity in education*

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Table of Contents

List of figures

Executive Summary (English)

A well-functioning educational infrastructure is one of the core elements of education policy. When designing education policy, knowledge about the complex effects that can arise with changes in the educational infrastructure is crucial. Currently, the issue of school reform is extremely relevant in the European Union due to both the demographic development and the recent economic crisis. This report discusses the available empirical evidence on the effects of school size and school consolidations on important outcomes such as student performance, inequality, attendance rates and parental involvement.

Taking a theoretical perspective, school size can be viewed as one of many inputs into the production of education. In addition, changes in school size may lead to changes in other inputs, for example class size, and thus affect educational production indirectly as well. Similarly, school consolidation is expected to affect important inputs into educational production such as school size and peer quality. While school size is likely to be related to quality, it is important to keep in mind that changing school size will typically lead to changes in costs as well, for example through economies of scale.

While there is a number of studies on the effects of school size and school consolidations, many of these studies are likely to suffer from biases, for example, due to unobserved factors. This report focuses on evidence from the field of economics of high methodological standard. This implies that the results are more directly informative about the consequences of policy implementation.

The empirical evidence on the effects of school size suggests that school size is an important input into educational production. School size affects as diverse outcomes as student achievement, attendance, parental involvement and youth violence. Most of the existing evidence suggests adverse effects of school size on attendance rates, dropout rates and social outcomes. Particularly, the evidence suggests that larger schools are associated with lower parental involvement, less connectedness and more youth violence. However, especially with respect to student achievement, the empirical evidence is mixed with respect to the direction of the effects. The relationship between school size and student performance is context-dependent. The empirical evidence on school consolidations suggests adverse effects on student achievement in the short run. In addition, displaced students are generally harmed more than receiving students when schools are closed. Finally, the evidence suggests that the effects vary with the types of schools that are closed.

The report also provides a brief discussion of how the existing evidence can be informative for designing future school policy in the European Union. This discussion highlights the importance

of conducting a detailed analysis of the effects of school size that is context-specific. It is crucial that all benefits and costs are taken into account in the process of determining the optimal school size. Furthermore, school size is only one dimension of school policy and is very closely related to grade span, grade size and class size.

The mixed evidence on the effects of school size on academic achievement suggests that optimal school size depends on the context, such as the country, region, degree of urbanization, level of education or student composition. Thus, it is not possible to provide a magic number in the form of an optimal school size. Moreover, if part of the aim of school policy is to reduce inequality, it becomes important to assess the effects of school size on the entire distribution of student achievement. In addition, disadvantaged students tend to be more affected by changes in school size than other students suggesting that school policy is especially important in areas with a large fraction of disadvantaged students. Consequently, changes in school size are likely to lead to changes in inequality. The existing evidence on the effects of school consolidations suggests that there are adverse effects of school consolidations in the form of disruption and changes in school quality - at least in the short run. The presence of these short-run adverse effects suggests that more resources should be devoted to consolidating schools to counter the adverse effects experienced by students who are exposed to consolidation. Finally, closing relatively low-performing schools and moving the displaced students to relatively high-performing schools is potentially a reasonable strategy for policymakers that may help reduce inequality and segregation.

In conclusion, school size is an important determinant of many student outcomes. However, school size is just one dimension of school policy and in the process of reform and improvement of the educational infrastructure in the European Union, all relevant dimensions should be considered. While the reviewed empirical evidence does not provide a clear roadmap for school reform in the EU countries, it does yield valuable insights into the complex problem of understanding the effects of school size and school consolidations. The substantial variation in school size and educational infrastructure in general - both across and within countries – in the European Union warrants the need for further high-quality research on the effects of school size and school consolidations in different contexts.

Executive Summary (German)

Eine gut funktionierende Bildungsinfrastruktur ist ein zentrales Element von Bildungspolitik. Bei der Gestaltung von Bildungspolitik ist es unabdingbar, die komplexen Effekte, die mit Änderungen der Bildungsinfrastruktur einhergehen, zu kennen. Im Moment ist das Thema Schulreform wegen der demographischen Entwicklung und der momentanen Wirtschaftskrise in der Europäischen Union extrem relevant. Dieser Bericht diskutiert die vorhandene empirische Evidenz zum Einfluss von Schulgröße und Schulzusammenlegungen auf wichtige Ergebnisgrößen wie Schülerleistungen, Ungleichheit, Anwesenheitsquoten und die Beteiligung der Eltern.

Aus theoretischer Sicht kann Schulgröße als einer von vielen Bildungsinputs in der Bildungsproduktionsfunktion verstanden werden. Darüber hinaus können Änderungen in der Schulgröße zu Änderungen anderer Bildungsinputs führen, z.B. zu einer Änderung der Klassengröße, was wiederum die Bildungsproduktionsfunktion indirekt beeinflussen kann. Gleichermaßen wird erwartet, dass Schulzusammenlegungen wichtige Inputs in der Bildungsproduktionsfunktion wie etwa Schulgröße und Peer-Qualität beeinflussen. Während Schulgröße wahrscheinlich in einem Zusammenhang mit Bildungsqualität steht, ist es wichtig zu berücksichtigen, dass eine Veränderung der Schulgröße automatisch auch eine Änderung der Kosten herbeiführt, so z.B. durch Skaleneffekte.

Während es viele Studien zu den Effekten von Schulgröße und Schulzusammenlegungen gibt, leiden viele dieser Studien unter einem Schätz-*bias*, unter anderem auf Grund von unbeobachteten Faktoren. Dieser Bericht konzentriert sich auf empirische Evidenz in der ökonomischen Literatur, die einen hohen methodologischen Standard erfüllt. Dies impliziert, dass die Ergebnisse direkter über die Konsequenzen einer politischen Umsetzung der jeweiligen Reformen informieren können.

Die empirische Evidenz zu Effekten von Schulgröße lässt darauf schließen, dass Schulgröße ein wichtiger Faktor in der Bildungsproduktionsfunktion ist. Die Schulgröße beeinflusst unterschiedliche Ergebnisse wie Schülerleistungen, Anwesenheit, elterliche Beteiligung und Jugendkriminalität. Der Großteil der empirischen Evidenz lässt nachteilige Effekte von Schulgröße auf Schulbeteiligung, Abbruchsraten und soziale Ergebnisse vermuten. Im speziellen legt die empirische Evidenz nahe, dass größere Schulen mit weniger elterlicher Beteiligung einhergehen sowie mit weniger Verbundenheit und mehr Jugendkriminalität. Im Gegensatz dazu kommt die empirische Evidenz zu gemischten Ergebnissen, wenn es um die Richtung der Effekte von Schülerleistungen geht. Der Zusammenhang zwischen Schulgröße und Schülerleistungen hängt vom jeweiligen Kontext ab.

Die empirische Evidenz weist auf kurzfristige negative Effekte von Schulzusammenlegungen auf Schülerleistungen hin. Darüber hinaus werden versetzte Schüler stärker getroffen als Schüler in Schulen, die solche Schüler aufnehmen. Schließlich legt die empirische Evidenz nahe, dass die Effekte für unterschiedliche Schultypen, die geschlossen werden, unterschiedlich sind.

Der Bericht beinhaltet außerdem eine kurze Diskussion darüber, wie die vorliegende empirische Evidenz für die Gestaltung von zukünftiger Politik in der Europäischen Union genutzt werden kann. Diese Diskussion betont, wie wichtig es ist, die Effekte von Schulgröße detailliert und kontext-spezifisch zu analysieren. Es ist unabdingbar, Kosten und Nutzen vollständig abzuwägen, wenn es darum geht, die optimale Schulgröße zu bestimmen. Darüber hinaus ist die Schulgröße nur ein Aspekt von Schulpolitik und eng mit Stufenabständen, Stufen- und Klassengröße verbunden.

Die gemischte empirische Evidenz zu den Effekten von Schulgröße auf akademische Leistungen lässt vermuten, dass die optimale Schulgröße vom Kontext, d.h. von Land, Region, Urbanisierungsgrad, Bildungsniveau und Schülerzusammensetzung abhängig ist. Deshalb ist es unmöglich eine magische Zahl in Form von einer optimalen Schulgröße anzugeben. Wenn ein Ziel von Schulpolitik die Reduzierung von Ungleichheit ist, wird es darüber hinaus wichtig, die Effekte von Schulgröße auf die komplette Verteilung von Schülerleistungen zu bewerten. Darüber hinaus sind benachteiligte Schüler von Änderungen der Schulgröße stärker betroffen als andere Schüler, weshalb sich ableiten lässt, dass Schulpolitik in Gegenden mit einem großen Anteil an benachteiligen Schülern besonders wichtig ist. Daraus lässt sich schließen, dass Änderungen in der Schulgröße wahrscheinlich zu Veränderungen der Ungleichheit führen. Die vorliegende empirische Evidenz über die Effekte von Schulzusammenlegungen lässt vermuten, dass die Effekte von Schulzusammenlegungen in Form von Unterbrechungen und Veränderungen in der Schulqualität – zumindest kurzfristig – negativ sind. Die Tatsache, dass es diese kurzfristigen negative Effekte gibt, legt nahe, dass Schulen, die von einer Zusammenlegung betroffen sind, mehr Ressourcen zur Verfügung gestellt werden sollten um diesen negativen Effekten entgegenzuwirken. Relativ leistungsschwache Schulen zu schließen und deren Schüler in relativ leistungsstarke Schulen umzusiedeln ist eine sinnvolle Strategie, die dazu beitragen kann, Ungleichheit und Segregation zu reduzieren.

Es lässt sich zusammenfassen, dass Schulgröße ein wichtiger Bestimmungsfaktor von Schülerleistungen ist. Schulgröße ist aber trotz allem nur ein Aspekt von Schulpolitik. Im Reformprozess und bei der Verbesserung der Bildungsinfrastruktur der Europäischen Union sollten alle relevanten Aspekte betrachtet werden. Während sich aus der betrachteten empirischen Evidenz kein klarer Fahrplan für Schulreformen in EU Ländern ableiten lässt, können wertvolle Einsichten über

das komplexe Problem zu den Effekten von Schulgröße und Schulzusammenlegungen gewonnen werden. Die wesentliche Variation in Schulgröße und der Bildungsinfrastruktur im Allgemeinen – sowohl über Länder hinweg als auch innerhalb einzelner Länder – rechtfertigt die Notwendigkeit weiterer qualitativ hochwertiger Forschung über die Auswirkungen von Schulgröße und Schulzusammenlegungen in unterschiedlichen Kontexten.

Executive Summary (French)

La mise en place d'infrastructures scolaires efficaces est un des éléments centraux de la politique éducative. Au moment de mettre au point ces politiques, il est donc crucial de comprendre les effets complexes qui peuvent faire suite à des changements au sein des infrastructures scolaires. Les réformes scolaires sont particulièrement d'actualité en Union Européenne du fait du développement démographique et de la récente crise économique. Ce rapport fait ainsi état des résultats d'études empiriques portant sur les effets de la taille des écoles et des regroupements scolaires sur des indicateurs clés que sont la performance des élèves, les inégalités, le taux d'absentéisme ou encore l'implication des parents d'élèves.

D'un point de vue théorique, la taille des écoles peut être vue comme un des nombreux facteurs affectant l'enseignement. Par ailleurs, les changements de la taille des écoles peuvent affecter d'autres facteurs, comme la taille des classes, et également affecter l'enseignement indirectement. De la même manière, les regroupements scolaires sont susceptibles d'affecter l'enseignement via d'importants canaux que sont la taille des établissements et la qualité des pairs. Bien que la taille des écoles soit vraisemblablement liée à la qualité de l'enseignement, il faut garder à l'esprit qu'un changement de taille est typiquement associé à un changement dans la structure des coûts, avec entre autres des phénomènes d'économie d'échelle.

S'il existe de nombreuses études sur les effets de la taille des écoles et des regroupements scolaires, beaucoup souffrent de biais, notamment à cause de facteurs non-observés. Ce rapport se concentre donc sur des études empiriques issues d'une littérature économique à hauts standards méthodologiques. Les résultats présentés apportent donc de précieuses informations sur les conséquences des politiques éducatives.

Les études empiriques montrent que la taille des écoles est un facteur important dans l'enseignement. Elle affecte la réussite des élève, l'absentéisme, l'implication des parents d'élèves ou encore la violence à l'école. La majeure partie des études suggèrent ainsi que la taille des établissements a des effets néfastes sur les taux d'absentéisme, de décrochage scolaire et sur d'autres dimensions sociales. En particulier, les chiffres suggèrent que de plus grandes écoles sont associées avec une moindre participation des parents, à l'affaiblissement des liens entre l'école et les familles et à davantage de violence chez les élèves. En ce qui concerne les résultats scolaires en revanche, les études sont partagées quant à la direction de l'effet de la taille des écoles. Le lien entre taille de l'établissement et la réussite des élèves dépend en effet grandement du contexte. Pour les regroupements scolaires, l'effet sur les résultats scolaires semble négatif à court terme, les élèves déplacés

après la fermeture de leur école étant davantage pénalisés que leurs camarades. Enfin, il semble que l'effet des regroupements scolaires dépende du type d'école qui a dû fermer ses portes.

Ce rapport montre aussi brièvement comment ces résultats peuvent se montrer utiles pour la conception des politiques éducatives au sein de l'Union Européenne. Il y est surtout souligné l'importance de mener des analyses sur les effets de la taille des écoles qui prennent en compte leur contexte. Il est en effet crucial que tous les coûts et bénéfices soient pris en compte pour déterminer la taille optimale pour les établissements scolaires. À noter enfin que la taille des écoles n'est qu'une dimension parmi d'autres des politiques éducatives et que cette question est très liée à celles du nombre de niveaux par établissement et de leur taille ainsi qu'à celle de la taille des classes.

Les résultats mitigés de l'effet de la taille des écoles sur la réussite scolaire suggèrent que le choix optimal doit prendre en compte des facteurs tels que le pays, la région, le degré d'urbanisation, le niveau d'éducation des parents ainsi que la composition des cohortes d'élèves. Il n'est donc pas possible de trouver un nombre magique qui serait la taille optimale pour une école. Par ailleurs, si un des buts d'une politique éducative est de réduire les inégalités, il est important d'évaluer l'effet de la taille des écoles sur la distribution des résultats scolaires toute entière. Les élèves issus de milieux défavorisés tendent ainsi à être plus affectés par la taille des établissements que leurs camarades si bien qu'il semble particulièrement important que la politique éducative se saisisse de ces questions dans les zones les plus pauvres. Les changements dans la taille des établissements peuvent donc avoir des effets sur l'inégalité. Les études disponibles sur les effets des regroupements scolaires montrent qu'ils ont des effets néfastes qui prennent la forme de perturbation et de baisse de qualité de l'enseignement – au moins à court terme. La présence de ces effets néfastes implique que davantage de ressources devraient être employées pour contrer les conséquences négatives du regroupement. Pour finir, fermer les écoles les moins performantes pour déplacer les élèves vers des écoles dont les élèves réussissent mieux peut s'avérer une stratégie payante pour les décideurs qui permettrait de réduire les inégalités et d'atténuer la ségrégation géographique.

En conclusion, la taille des écoles est un facteur important dans la vie scolaire des élèves. Cependant, ce n'est qu'une dimension parmi toutes celles qui sont à considérer dans le processus de réforme et d'amélioration des infrastructures éducatives de l'Union Européenne. Bien que les études mentionnées ici ne fournissent pas un plan d'action clair pour la réforme des systèmes éducatifs en Europe, elles apportent un éclairage constructif sur les problèmes complexes que sont la taille des écoles et les regroupements scolaires. La variabilité substantielle de la taille des établis-

sements scolaires en Union Européenne – à la fois au sein des pays et entre eux – ne fait qu'accroître le besoin de recherche de qualité sur les effets de la taille des écoles et des regroupements scolaires dans différents contextes.

1 Introduction

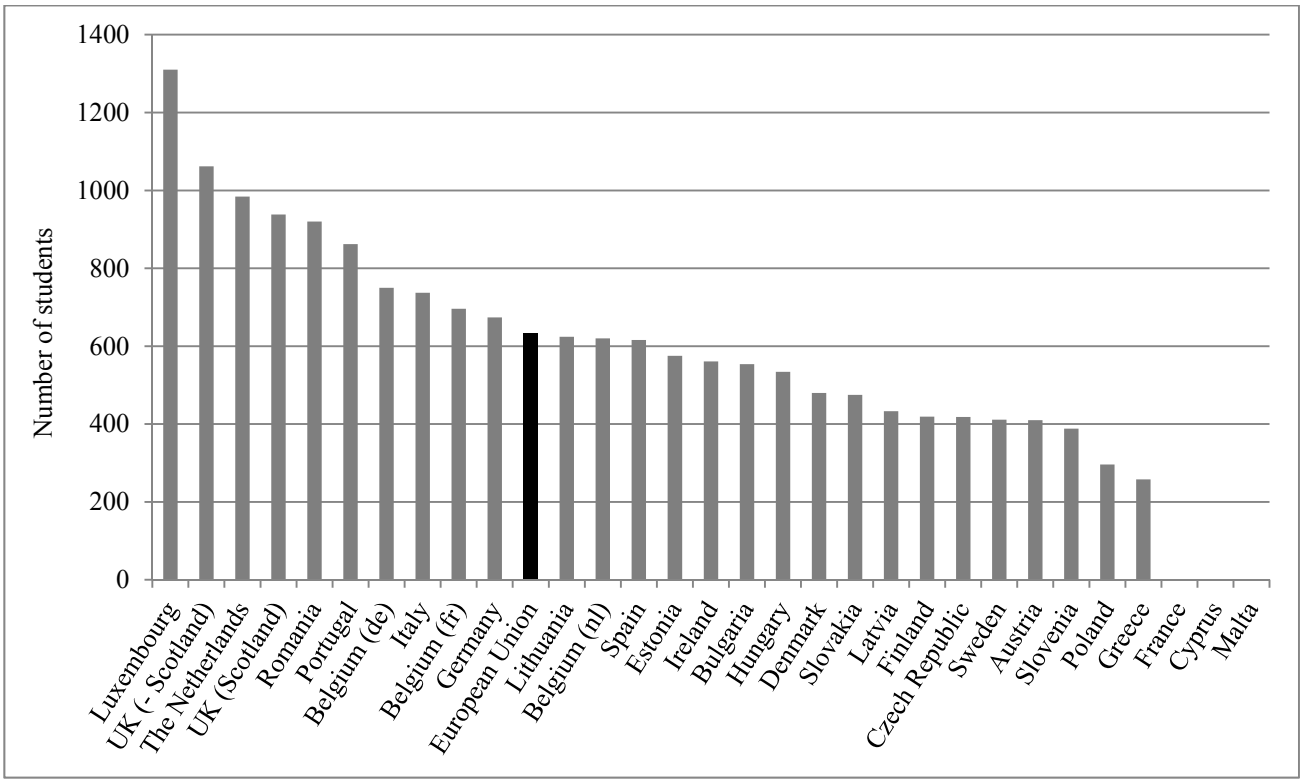
One of the key components of education policy is to set up a well-functioning educational infrastructure. This encompasses the interrelated issues of choosing school size, school location and the number of schools.[1] These choices made by policymakers potentially affect students' academic achievement, but may also affect as diverse outcomes as inequality, attendance rates and parental involvement. In order to design optimal school policy, it is important to have an understanding of the complex effects that can arise with changes in the educational infrastructure. This report focuses on the effects of school size and school consolidations on quality and equity.

The issue of shaping the characteristics of the educational infrastructure is as important as ever. In recent years, many European countries have consolidated schools according to a recent report by the European Commission/EACEA/Eurydice (2013). The demographic development in many European countries is a major contributing factor to the recent consolidations. But many countries also list the economic crisis as a contributing factor to school consolidation. School size varies substantially across the European Union. Figure 1 shows the median school size for 15-year-olds across countries in the European Union. Median school size ranges from 258 students in Greece to 1,310 students in Luxembourg. There is also substantial variation within countries. For example, in Germany the 10^{th} percentile of school size is 186 students while the 90^{th} percentile is 1,253 students.[2]

The demographic development in many of the transition countries in Eastern Europe has implied a substantial reduction of the number of school-aged children and this has fueled a consolidation movement, Coupé et al. (2015). For example, in Bulgaria, reforms and decentralization of the school system (the Bulgaria School Autonomy Reforms) motivated by the desire to increase general economic productivity growth have led to school consolidations, World Bank (2010).[3] In 2008 alone, 15 percent of all schools in Bulgaria were closed. While the aim of the reforms was to promote school autonomy and efficient public spending, the closure of a large number of small rural schools may also have increased dropout rates, World Bank (2010). This example illustrates the unintended, and in this case unwanted, effects that can arise with changes in the educational infrastructure.

[1] In most countries these are issues that policymakers have to address to some degree. To what extent policymakers can fully determine the educational infrastructure varies across countries.
[2] Numbers are taken from EACEA/Eurydice/Eurostat (2012).
[3] Several studies have established a strong link between educational achievement and economic growth; see e.g. Hanushek and Woessman (2012).

Figure 1: Median school size for 15-year-olds across countries in the European Union.



Source: Numbers from EACEA/Eurydice/Eurostat (2012) which are based on the OECD, PISA 2009 database.

This report provides an overview and discussion of the available empirical evidence on the effects of school size and school consolidations within the field of economics. In the following section, the report will give a brief introduction to the theoretical background of the relationship between school size, school consolidations and student outcomes. In section 3, the methodological challenges that arise in the context of estimating effects of school size and school consolidations are discussed. Sections 4 and 5 provide an overview of the empirical evidence for school size and school consolidations, respectively. Section 6 discusses policy implications for the EU policy agenda. Finally, section 7 concludes.

2 What economic theory has to say about school size and school consolidation

In the literature on economics of education, students' academic outcomes are generally considered as being determined from the educational production function.[4] The various inputs into the educational production function determine the output, for example student achievement. Many

[4] See, for example, Pritchett & Filmer (1999), Lazear (2001) and Checchi (2006).

school characteristics can be viewed as examples of inputs. Economic theory predicts that school size and school consolidations in general matter for the production of human capital.

2.1 Costs, quality and school size

While many studies – including this report - focus on how changes in school size may affect educational production through changes in *quality*, it is important to keep in mind that changes in school size, typically lead to changes in *costs* as well. The hypothesis that larger schools have lower costs per student due to economies of scale is probably the most often-heard argument in favor of school consolidation. School size is typically defined as the number of students in a school in the economics of education literature.

Table 1 provides a rough overview of the channels through which school size may affect cost and quality, respectively.[5,6] There is no overall consensus on what are the costs and benefits of small versus large schools. This is probably related to the fact that while some benefits accrue in some settings, in others they do not. For example, for an increase in school size, economies of scale may occur if initial school size is small, but diseconomies of scale may occur if initial school size is large. Changes in costs occur mainly due to economies (or diseconomies) of scale, but changes in the school infrastructure is also likely to affect transportation costs significantly as the distance to school changes for the individual student. The existing empirical evidence suggests that at least for very small schools increasing school size will lead to a reduction in unit costs; see the survey by Ares Abalde (2014).[7] The focus of this report is the effects of school size on quality. In terms of quality, large schools are potentially more diverse in terms of course portfolios, teachers and peers. Diversity generally means more flexibility, for example a more diverse peer composition allows schools to organize peer groups in specific ways that can enhance learning. Finally, large schools make it easier to have teachers that are specialized in a particular subject, for example Math, and are also more likely to be able to attract high-quality teachers, for example due to the increased flexibility within larger schools. On the other hand smaller schools may have a higher quality of social interactions, for example due to a relatively low student-to-teacher ratio. The small number of students can increase the connectedness that each student feels to the school.

[5] In the attempt to provide a relatively general overview, inspiration is taken from Leithwood & Jantzi (2009), Leung & Ferris (2008), Abdulkadiroğlu et al. (2013), Barrow et al. (2013) and Luyten et al. (2014).
[6] Ares Abalde (2014) provides a more detailed description of these channels.
[7] This is under the assumption of reasonable transportation costs.

Table 1: Channels through which increasing school size may affect cost and quality

	Advantages	Disadvantages
Cost	Economies of scale	(diseconomies of scale when size too large)
		Transportation costs
Quality	Diversity and flexibility (courses, teachers and peers)	
	Teacher specialization	
	Teacher hiring	
		Social interactions (e.g. student-to-teacher ratio)

One way to summarize the bottom part of Table 1 is that school size potentially affects both school quality, teacher quality and peer quality. These are generally considered important for student achievement and well-being in economic theory. As such they are important inputs into the educational production function which will be discussed in more detail in the following subsection.

A related issue that is rarely addressed in the literature on school size is that school size is inherently linked to the number of schools. And, the number of schools is important for the degree of competition between schools. For a fixed number of students, the number of schools effectively determines average school size. The literature on school competition hypothesizes that increased competition will improve school performance, but student sorting[8] may lead to adverse - or beneficial depending on the assumptions made - effects on some students, Hoxby (2000). Therefore, an increase in average school size is also expected to affect student performance through decreased school competition.

2.2 The educational production function

The educational production function relates educational inputs to educational output. The functional form of the educational production function is arguable very complex and there is little agreement on the exact form of the function, Krueger (1999). Four main categories of inputs are often considered: parental inputs, peer inputs, school inputs and neighborhood inputs. For given values of inputs, the educational production function gives the educational output. For example, an educational production function can relate student achievement to school size and all other relevant

[8] The concept of 'student sorting' refers to the fact that students with particular characteristics sort into particular schools implying a change in the distribution of student characteristics across schools.

inputs. Other types of outcomes such as attendance, dropout rates, educational attainment and social outcomes can also be analyzed in this type of framework. For reasonable ranges of inputs, it makes sense to think of the marginal product as positive but decreasing. This means that increasing the amount of a particular educational input, for example, books, improves learning, but at a decreasing rate.

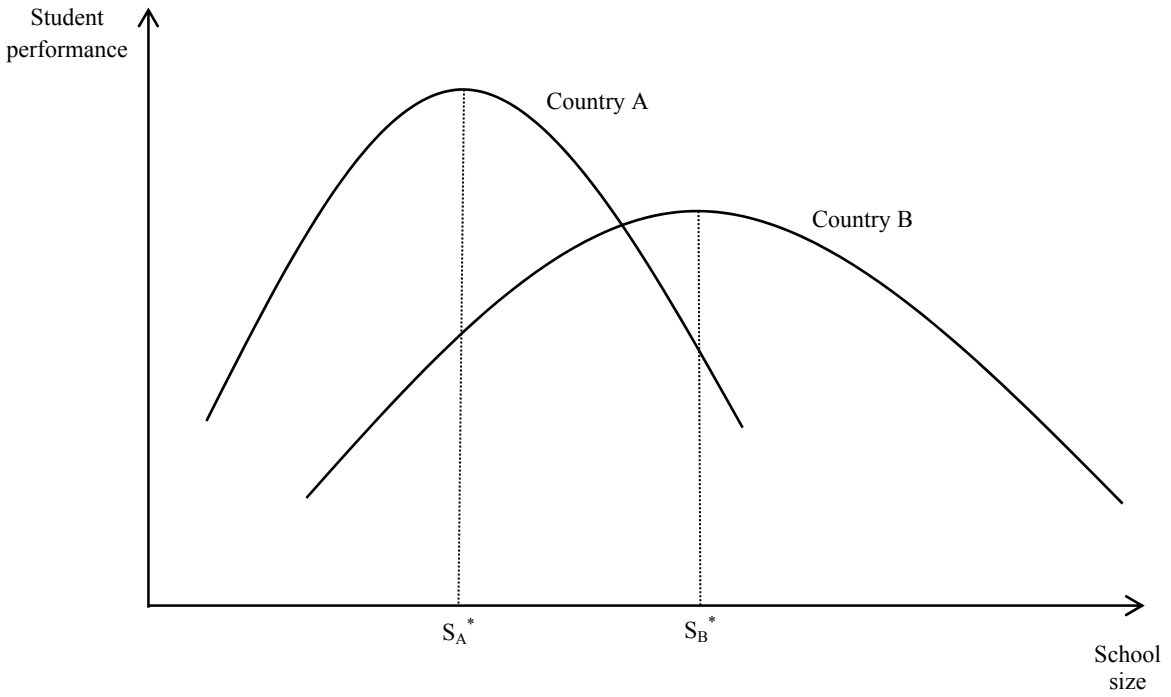
2.2.1 The role of school size

School size is considered one of the key inputs into educational production. School size potentially affects educational production both directly and indirectly since changes in school size may lead to changes in other inputs such as class size. While school size is typically defined as the number of students in the entire school, a student's class size is defined as the number of students in the student's classroom in the economics of education literature. Many educational inputs are heavily interrelated and school size is no exception in that it potentially affects a variety of different educational inputs. The effectiveness of other educational inputs may also vary with school size.

Theoretically, it makes sense that the relationship between school size and academic performance is inversely U-shaped.[9] This implies that an increase in size would lead to improved student performance in relatively small schools and lowered student performance in relatively large schools. Thus, there exists an 'optimal' school size that maximizes student performance. Optimal school size may differ for different types of students, different types of school infrastructure, and different countries and cultures, i.e. for different contexts.[10] Figure 2 shows a graphical illustration of an example where the relationship between school size and student performance varies across two countries. Consequently, optimal school size is smaller for country A (S_A^*) than for country B (S_B^*). For example, in countries such as Norway and Sweden where the population is very geographically dispersed, optimal school size is likely to be lower than in countries such as Luxembourg where the population density is very high.[11]

[9] There is not an overall consensus in the literature on the shape of the relationship between school size and academic performance, see, for example, the discussion in Schütz (2007).
[10] Lazear (2001) sets up a theoretical model where optimal class size differs for different types of students.
[11] Ares Abalde (2014) discusses school size policy and population dispersion.

Figure 2: An illustration of the relationship between school size and student performance.



2.2.2 The role of school consolidation

A number of studies have analyzed the impact of school consolidation. Of course, school consolidation is not an input into educational production *per se*, but since school consolidations are expected to affect school inputs and to some extent also peer, parental and neighborhood inputs, at least in the short run, educational production is expected to be affected by school consolidation.

School consolidations, and school moves in general, are often hypothesized to lead to disruption and changes in school quality for the affected students, Hanushek et al. (2004). School consolidations can affect various aspects of school quality through, for example, changes in school size and peer composition. One can think of a disruption effect as temporary changes in educational inputs such as a lower quality of instruction caused directly by the changes in school infrastructure, for example, due to teacher stress and confusion in the context of consolidation. By definition, the effect is expected to diminish over time. In comparison, changes in school quality are of a more permanent nature and reflect the fact that the students' school inputs have been explicitly changed. Since some types of students may react differently to changes in school quality and disruption, school consolidation may matter more for certain types of students. Thus, school consolidation may also affect inequality. For example, if disadvantaged students are harmed more from the disruption of school consolidation than more advantaged students, inequality will rise.

Summing up on the theoretical literature on the impact of school size and school consolidation, the economic theory of educational production provides an understanding of how and why different inputs may be related to student achievement. However, the sign and size of the effects of increasing school size or consolidating schools are left for empirical research to determine.

3 Methodological challenges

When the aim of the analysis is to inform policy decisions, it is important that the estimated parameters are policy-relevant. While it is simple to estimate the *correlation* between school size and student achievement, it is much more challenging to estimate the *causal* effect of school size on student achievement.[12] For the purpose of making policy recommendations, interest is typically in the latter. The causal effect will be informative about what will happen if school size is increased keeping other things constant. The correlation will not! An observed correlation between school size and student outcomes may simply reflect *unobserved factors* which affect both school size and student outcomes. Thus a policy reform affecting school size may have no impact on student outcomes.

As an illustration, suppose that school size and student achievement are positively correlated in a given population. This may reflect *causality*, namely that increasing school size leads to increases in student achievement. But it may also reflect *endogeneity bias*. Especially, unobserved factors that affect both school size and academic achievement will lead to a bias in the estimated relationship. For example, high-quality schools tend to be larger since they attract more students, but the quality of the school will also affect the academic performance of the students at the school. If the quality of the school is unobserved, this produces a correlation between school size and student achievement - even if school size has no causal effect on student achievement. Only in the theoretical scenario where students are randomly allocated to schools of different size, can the causal effect be identified simply by comparing students in schools of different size. Consequently, recent economic studies use advanced statistical techniques to identify the causal effect of school size.

[12] For a thorough discussion of the specification and estimation of educational production functions and explicit statistical models, see Todd & Wolpin (2003).

A similar issue arises in the analysis of school consolidations. Schools that are closed may not be comparable to schools that are not closed. For example, policymakers may have decided to close low-performing schools. Therefore, it makes no sense to simply compare the performance of students from schools that were closed with the performance of students from schools that were not. If low-performing schools are closed, such a comparison would suffer from a downward bias in the estimated effect of school closings.

While there are a variety of different inputs into the complex educational production function, the empirical literature focuses on estimating the effects of increasing one or maybe a few of these inputs at a time in a reduced-form model based on observational data. The interpretation of the estimated effect depends on the methods applied and the data used. In the following discussion of the empirical evidence, the focus will be on studies where causal parameters of interest are well-identified.

The exposition of the empirical evidence will be split into two sections since part of the literature focuses on effects of school size while another part focuses on effects of school consolidations. While these two strands of literature are related, they also differ along a number of dimensions and a separate treatment is given to ease exposition.

4 Empirical evidence on the effects of school size

There is an extensive literature in economics, sociology and education that covers the topic of school size and its relationship to a variety of outcomes, including student outcomes, social outcomes and costs.[1314] It is important to be aware that a large part of this literature does not really, or only to a very limited extent, address the methodological challenges mentioned above. Also, it can be challenging to summarize this literature, since the effects of school size potentially vary a lot depending on the context such as type of outcome, age group or level of education, country or region, urban or rural.[15] Since the theoretical effects of school size differ a lot depending on the

[13] Ares Abalde (2014), Luyten et al. (2014), Leithwood & Jantzi (2009), Darling-Hammond et al. (2006), Newman et al. (2006) and Andrews et al. (2002) all provide reviews of the literature on the effects of school size. Many of the studies included in these reviews are more or less correlational in nature.

[14] The choice of school district size and school size are closely related. Empirical studies of the effects of school size and school district size tend to be very similar, and some studies even consider the effects of school size and school district size jointly. If the initial size of the school district is small, then existing evidence suggests that an increase in school district size can lower costs, Andrews et al. (2002) and Duncombe & Yinger (2007). For academic performance, the evidence is more inconclusive. The literature on school district size is too extensive to be reviewed in detail here.

[15] The reviewed evidence stems from contexts where the extent of publicly provided education varies.

outcomes considered and studies often focus on one or two key outcomes, this section will discuss effects on separate outcomes in turn.[16]

4.1 Academic achievement and long-term student success

Aside from costs, the academic performance of students has been the focus of studies analyzing the effects of school size. While the older literature tended to be correlational in nature, a range of recent studies have used more sophisticated empirical strategies to address the methodological issues described above. Some literature reviews that are not particularly critical with respect to the methods applied tend to conclude that students from smaller schools perform better[17], while others are more cautious to draw solid conclusions[18]. In the following, recent key contributions are discussed in more detail. Most of these studies which address causality issues are based on data from the United States.

Primary school level: The majority of studies on the effects of school size tend to focus on secondary school size, i.e. typically children aged 12 to 18. Only a limited number of studies exist on primary school size. Using a relatively sophisticated research design, Kuziemko (2006) employs variation in school size induced by school openings, closings and mergers to identify the causal effect of school size on average 3rd grade math and language scores and average daily attendance. She uses school-level data on elementary schools in Indiana, US. According to her analyses, increasing school size leads to decreases in math scores and attendance rates. The results also suggest that the effect of school size increases in absolute terms over time, implying that the negative effects of attending a large school accumulate over time. Based on the estimates, she performs a back-of-the-envelope cost-benefit evaluation and concludes that the benefits of small schools outweigh the costs.

The other studies of elementary school size are less well-identified. In a study of elementary school size in the United States focusing on 6th and 8th grade students, Lee & Loeb (2000) also find that smaller schools increase students' learning as measured by test scores. The setting is Chicago inner-city elementary schools (K-8) and consequently results are probably mostly relevant for large urban school districts. Ready & Lee (2006) use a nationally representative survey from the United

[16] Some studies consider less standard types of outcomes that are not discussed in the following. Examples include Monk (1987) who finds that increasing school size up until a certain level had beneficial effects on curriculum comprehensiveness, Lee & Loeb (2000) who show teachers in larger schools have more positive attitudes regarding their responsibility for student learning, and Falch & Strøm (2005) who find that the relationship between school size and the probability of a teacher quitting his job is U-shaped.

[17] Leithwood & Jantzi (2009) and Andrews et al. (2002).

[18] Luyten et al. (2014), Darling-Hammond et al. (2006) and Newman et al. (2006).

States and find no significant effects of school size on literacy and mathematics tests in kindergarten class. They find statistically significant effects of school size for the first grade and these results suggest that students in smaller schools perform better. Finally, Driscoll et al. (2003) find a negative relationship between elementary school size and student performance using school-level data from California. A particularly interesting feature of their study is that they also estimate relationships between the size of middle school and high school and student performance and they only find a statistically significant negative estimate for elementary school size. While there is likely to be a number of differences between the different levels of schooling that make it hard to make meaningful comparisons, the results suggest that the effects of school size may vary across level of education.[19] The existing evidence suggests that there is a negative relationship between school size and academic performance at the primary school level.

Secondary school level: Some studies have considered the effect of secondary school size on academic performance in different parts of Europe and the United States and have come to different conclusions. Generally, these studies are not able to identify parameters that can be given a causal interpretation and therefore the results should be interpreted as reflecting correlations. Barnett et al. (2002) and Foreman-Peck & Foreman-Peck (2006) find positive relationships between school size and academic performance for Northern Ireland and Wales, respectively. In the first case, the academic performance is measured relative to cost-constrained benchmarks. Bradley & Taylor (1998) find that the relationship between school size and academic performance is inversely U-shaped in the United Kingdom while Sawkins (2002) finds that the relationship is U-shaped in Scotland. Lee & Smith (1997) suggest an optimal secondary school size of about 600-900 students based on nationally representative survey data from the United States. Also using nationally, representative survey data from the United States, Schneider et al. (2006) fail to find evidence that supports small schools. Bukowska & Siwińska-Gorzelak (2011), Capita (2012) and Coupé et al. (2015) all find a positive relationship between secondary school size and school performance in Poland, Moldova and Ukraine, respectively.

In the United States there has been a movement towards smaller schools or schools-within-schools in recent years. And, especially in the larger cities, e.g. New York City, Chicago and Philadelphia, reforms have introduced more small high schools during the 1990s and 2000s, Schwartz et al. (2013). This has spurred a number of high-quality evaluations of these types of

[19] Based on their literature review, Leithwood & Jantzi (2009) conclude that optimal school size differs across level of education. They conclude that optimal school size is lower for lower levels of education.

reforms.[20] Schwartz et al. (2013) evaluate the effects of small high school reform in New York City using variation in distance to schools to estimate the effect of attending a small high school. They find inconclusive evidence in terms of the effects of school size, since the effects of attending a small high school vary substantially depending on when the high school was founded – and newer high schools have additional resources and other specific characteristics that do not make them directly comparable to older high schools. Also, analyzing the effect of attending a small high school in New York City, but taking advantage of the fact that small high school attendance to some extent depends on admission lotteries; Abdulkadiroğlu et al. (2013) find beneficial effects of attending a small high school on a range of measures of academic performance. In addition, they show that small high schools have more engagement, monitoring, safety, collaboration among others. Barrow et al. (2013) use a strategy similar to that of Schwartz et al. (2013) and find that attending a small high school in Chicago increases persistence in school and the probability of graduation. They find no effects on academic achievement. Overall, the introduction of small high schools appears to have been beneficial for students along a range of dimensions. However, the estimated effect can generally not be interpreted as reflecting only the effect of size as these new small high schools often had other features that distinguished them from larger high schools, Iatarola et al. (2008). Overall, for secondary schools, a number of studies indicate a positive or insignificant effect of school size on student achievement.

Long-term effects: While it is of course of interest how school size is related to in-school outcomes such as academic performance, it is of ultimate interest to see whether school size has long-lasting effects on the educational and labor market careers. The evidence on the long-term effects of school size is very limited which is probably related to a lack of data since it is generally a challenge to link data on schooling with later outcomes. One exception is Humlum & Smith (2015) who estimate the effect of school size on students' long-term outcomes in Denmark. Using different empirical strategies taking advantage of variation within schools over time, variation within families over time, population variation in the school district, and school openings and closings, they conclude that school size has a very small positive, but statistically significant effect on long-term measures of student success such as high school completion and annual earnings at age 30.

For the United States, Berry & West (2010) use variation in the timing of school consolidations across states to analyze the effects of school size on the wages and educational attainment of white males born in the period 1920 to 1949. Students who attended smaller schools

[20] Schwartz et al. (2013), Barrow et al. (2013) and Abdulkadiroğlu et al. (2013).

had higher wages, higher returns to schooling and completed more years of schooling. In comparison, using a much more recent sample, Schneider et al. (2006)[21] find no significant effects of school size on students' college plans, but they do find that students from small schools are more likely to act on their college plans, for example in terms of actually filling out a college application.

Cross-country studies: As described above, the existing empirical evidence on the effects of school size does in no way provide a systematic picture of the school systems at different levels across Europe, and many of the research results stem from US data. Therefore, a crucial question is to what extent the results of the studies from some countries can be applied to other countries or settings. It may therefore be highly valuable to look at the results from cross-country studies which compare the same types of outcome variables and relate to measures of average school size though these studies typically are not able to address causality issues. In a large cross-country comparison including 51 countries and regions, Schütz (2007) shows that the shape and strength of the relationship between school size and achievement vary substantially across countries. The analysis is based on TIMSS (Trends in International Mathematics and Science Study) 2003 data on students in about 4th and 8th grade and considers the effect of school size on students' mathematics scores. This study is not able to identify parameters that can be given a causal interpretation. Nonetheless, the results demonstrate that the relationship between school size and student achievement can be either inversely U-shaped, U-shaped or linear depending on the country of analysis. To some extent this can be caused by differences in the range of school sizes in different countries, since one cannot estimate an inversely U-shaped relationship with data that covers only the 'linear' part of the relationship, see Figure 2. Estimating the relationship separately for students with different sociocultural and socioeconomic backgrounds suggests that in many countries the relationship between school size and achievement differs for disadvantaged students and advantaged students. However, the evidence is mixed with respect to the direction of the effect.

4.2 Heterogeneous effects and inequality

Most education inputs vary in effectiveness depending on the characteristics of the students. This also appears to be the case for school size. Since advantaged and disadvantaged students may respond very differently to changes in, for example, peer diversity and social interactions, they are also potentially differentially affected by changes in school size. Generally, the abovementioned studies suggest that

[21] Schneider et al. (2006) basically rely on controlling for observables so the results should not be given a strong causal interpretation.

school size tends to be more important for relatively disadvantaged students.[22] However, as suggested by the cross-country analysis of Schütz (2007), the evidence is mixed with respect to the direction of the effect. Consequently, changes in school size can lead to changes in inequality if certain groups of students are harmed or benefit more from changes in school size than others.

Lee & Smith (1997) find that school size is especially important for students in schools with many disadvantaged students defined as low-socioeconomic status or language-minority students, i.e. the adverse effect on student learning of deviation from the optimal school size is higher for disadvantaged students. If schools are relatively small, this suggests that inequality would be reduced by increasing school size. They also find that there is more equity in small schools, since student socioeconomic status has a lower impact on learning. Similarly, Barrow et al. (2013) find evidence that students with a learning disability benefited more than other students. The results of Humlum & Smith (2015) suggest a positive effect of school size and this effect is stronger for students from families with a low educational level. The latter two studies also analyze whether the effects of school size vary by gender and find that boys are more affected than girls.

4.3 Attendance, dropout rates and distance to school

Academic performance is arguably the outcome of main interest when considering the effects of educational inputs or interventions. Academic performance is closely linked to other types of educational outcomes such as attendance and dropout rates.[23] School size may affect attendance and dropout rates through several channels.

First, it is more or less self-evident that if policy-makers decide that schools in general should be larger, then some schools will have to be closed and average home-to-school distances will increase. While the likely higher transportation costs incurred with larger schools are often private costs, it is important to take these into account when determining the optimal school infrastructure, Kenny (1982) and Hanley (2007). Moreover, basic economic theory would predict that increasing distance to school and thereby the cost of attending school on any given day, lowers the probability of attending school. Consequently, an increase in distance to school can affect academic performance, for example, through fatigue effects or lower attendance.

Second, if school size adversely affects the nature of social interactions and relationships at the school, then attendance and dropout rates may also be affected.

[22] See Lee & Smith (1997), Humlum & Smith (2015) and Barrow et al. (2013). This is also confirmed by the literature review in Leithwood & Jantzi (2009).
[23] For example, Durden & Ellis (1995) show that class attendance affects academic performance in college.

Third, to the extent that larger schools can improve the learning environment due to increased flexibility and diversity, an increase in school size may have a positive impact on attendance and dropout rates. Theoretically, if the perceived gain of attending school increases, the probability of attending school also increases.

Three recent studies, Kuziemko (2006), Jones et al. (2008), both using data from the United States, and Foreman-Peck & Foreman-Peck (2006) all document negative relationships between school size and attendance at the primary or secondary levels. This is consistent with a hypothesis that the increase in transportation costs and any adverse changes in the school environment caused by an increase in school size dominate any potential beneficial effects.

The same type of result is found at the secondary level in most studies. For the United States, Schwartz et al. (2013) and Abdulkadiroğlu et al. (2013) find that attending a new small high school increases graduation rates. Interestingly, studies that find negative effects of school size on student performance also find negative effects on attendance or dropout, Foreman-Peck & Foreman-Peck (2006), Kuziemko (2006) and Abdulkadiroğlu et al. (2013). This suggests that if a particular size of school is preferred then it is preferred both in terms of academic performance and attendance. One exception from these results is a recent study by Humlum & Smith (2015) from Denmark which analyses dropout rates and completion of high school. Humlum & Smith (2015) find a positive relationship between school size and the probability of high school completion in Denmark.

4.4 Social outcomes

The majority of studies of the effects of school size focus on students' academic performance or related outcomes. However, the decision of school size may have more far-reaching consequences. In particular, public schools are also viewed as promoting some forms of social outcomes or social capital, such as social cohesion, trust and civic identity, for example through effects on parental interactions, Dee et al. (2006). From the more general perspective of behavioral economics, larger groups have also been shown to be associated with less cooperation and more free-riding, see Alencar et al. (2008).

A few studies investigate how the size of the school relates to certain social outcomes.[24] Dee et al. (2006) use data on American high school students and find negative relationships between school size and parental involvement and certain measures of social capital. Their results are only reliable for schools in rural areas. They acknowledge the potential selection bias in their estimates

[24] All of the studies on the effects of school size on social outcomes are based on data from the United States and Canada.

and estimate bounds on the estimates. Walsh (2010) compares outcomes in families over time and finds that an increase in school size leads to lower parental involvement. Theoretically, the extent of free-riding is expected to grow when the school gets larger implying that public good provision in the form of parental involvement decreases. In addition, Walsh (2010) finds evidence that suggests that parental involvement substitutes for school quality in the sense that parental involvement is higher for low-quality schools. Relatedly, Brunner and Sonstelie (2003) find that voluntary financial contributions are lower in larger schools.

The association between school size and youth violence is the subject of investigation in Ferris & West (2004) and Leung & Ferris (2008). Both studies find a positive correlation between school size and youth violence. Leung & Ferris (2008) argue that students in larger schools are more likely to be alienated from the other students and the teachers leading to frustration and eventually violent behavior. This hypothesis is supported by the findings of McNeely et al. (2002) who document a negative relationship between school size and school connectedness.

Overall, the available evidence suggests that larger schools are associated with less favorable social outcomes which is also the conclusion based on a large literature review in Luyten et al. (2014). However, it is not clear how important this relationship is in economic terms, making it hard to weigh these potential costs.

4.5 Other aspects of the effects of school size

This section will discuss two important aspects of the school size literature that are important to keep in mind, when discussing policy implications based on the existing evidence. First, as discussed in section 2.2.1, the general relationship between school size and academic achievement is likely to be nonlinear – and it is widely believed to be inversely U-shaped. Thus – at least theoretically – there exists an optimal school size. This reflects that schools that are very small have less flexibility etc., while schools that are too big suffer from bureaucracy, alienation, etc. In practice, the relationship between school size and academic achievement must to some extent be context-dependent. If the relationship between school size and academic achievement is inversely U-shaped then the vast majority of results in the literature can be reconciled, since studies with most schools below the optimal school size will tend to find positive effects, while studies with most schools above optimal school size will tend to find negative effects. Nonlinear effects are most likely to be found where there is a lot of variation in the size of the schools. In fact, when, for example, a positive effect of school size is found, it is often argued that this is a reasonable result because schools in the sample were relatively small; see for example, Humlum & Smith (2015) and

Coupé et al. (2015). Another reason why the effects of school size may be context-dependent is that for a fixed school size, the number of students at each grade level varies with the number of grade levels. Since the number of grade levels in schools vary widely across countries, this could generate substantial differences in the effects of school size if, for example, the number of students at each grade level is important.

Second, it can be somewhat confusing that studies on the effect of school size on academic achievement frequently discuss the implications for optimal school size without taking the costs of changing school size into account. Of course, the optimal school size must also depend on costs. Harris (2006) specifically argues that one cannot discuss the optimal allocation of resources without taking the costs into account – and decreasing school size generally increases costs. For example, small schools will typically have relatively high fixed costs, because even a small school needs to provide certain facilities for their students and the most productive use of resources may not be possible in small schools. Furthermore, one should take all costs into account including the private transportation costs that are likely to arise when school size is increased, Kenny (1982).[25] There is a substantial literature on the effects of school size on costs which is not reviewed here, see, for example, Andrews et al. (2002) and Falch et al. (2008).

5 Empirical evidence on the effects of school consolidation

The issues of school size and school consolidation are highly interrelated. One cannot implement school consolidation without changing the size of schools. And, one cannot fundamentally change the size of schools without opening, closing or merging schools. Part of the effect of school consolidation will therefore typically be attributed to the accompanying change in school size. Like school size, school consolidations potentially affect a variety of outcomes, including academic achievement, equity, attendance, school quality and peer composition. Since school consolidation is something that happens at a particular point in time, the effects hereof are likely to vary over time. From the perspective of the individual student, one can think of part of the effect of school consolidation as being temporary, also sometimes termed a disruption effect, and the other part as being more permanent and caused by the changes in school quality.[26] School consolidation does not only affect school size, it also potentially affects both the available choice sets, the degree of competition between schools and student sorting into different schools, de Haan et al. (2014). When

[25] Duncombe et al. (1995), Kuziemko (2006), Stiefel et al. (2009) and the reviewed studies in Andrews et al. (2002) suggest that cost savings can be incurred from school or school district consolidation if initial sizes are not too high.
[26] A similar terminology is used by Hanushek et al. (2004) who study voluntary student mobility.

considering the effects of school consolidation, it is therefore important to keep in mind that there are several potential channels through which student outcomes may be affected. Most studies are not able to disentangle the effects, but simply estimate the overall effect of school consolidation.

5.1 Academic achievement

The existing evidence on school consolidations is not as extensive as for school size.[27] However, recent studies from the United States, China, Netherlands and Denmark[28] use advanced statistical methods to uncover causal effects of school consolidation. One important aspect of school consolidations is that the effects of consolidations are likely to differ in the short and long run. In the short run, students, teachers and schools in general experience disruption of their usual tasks, networks etc. The existing evidence focuses on very short-run effects with de Haan et al. (2014) being a noteworthy exception.

It is generally acknowledged that students originating from closing schools and students originating from receiving schools face different changes when school consolidation is implemented. Whether or not school consolidation involves closings, mergers or both, it affects the composition of the student body. If a school is closed, students are *displaced*. Displaced students are sent to other schools where the existing student body constitutes the *receiving* students. The displaced and the receiving students are potentially differentially affected by the school closings since both disruption and changes in school quality are likely to differ for these groups. Specifically, the changes in peer composition are likely to be different. For example, closing low-performing schools would imply that displaced students experience an increase in school quality whereas the receiving students experience a decrease in school quality where school quality reflects peer group composition. As will be clear from the discussion of the evidence below, it is important to allow for heterogeneous effects of school consolidations on these two types of students.

Studies on the short-term effects of school consolidation on student achievement find that the effects of school consolidation vary considerably for displaced and receiving students, by years since consolidation, and by type of school closed. Engberg et al. (2012) and Brummet (2014) study the effects of school closings on math and reading scores in an anonymous urban district in the United States and in Michigan, respectively. Beuchert et al. (2015) analyze the effects of school consolidations in Denmark on reading scores. Liu et al. (2010) study the effects of a large-scale

[27] While the studies of the effects of school size were dispersed in the sense that they looked at effects of both primary and secondary school size, the studies of school consolidation are focused on consolidation at the level of primary education.

[28] The Dutch and Danish studies are unpublished at the time of writing this report.

merger program in two Chinese provinces. Academic achievement of the primary school students is measured by math and Chinese language scores. The nature of school consolidations in rural China is arguably very different from a European setting making the comparison with the European and US studies less useful. For example, the school consolidations in rural China implied sending some young children to boarding school.

The empirical strategies pursued in these studies are somewhat similar and use repeated observations of student test scores over time to eliminate endogeneity bias – in some cases combined with instrumental variables approaches. The general idea is that the achievement growth of students exposed to a school consolidation is compared with the achievement growth of students who were not exposed to a school consolidation. Differences in achievement growth are then attributed to the school consolidation. All of these studies are based on the assumption of parallel trends, i.e. in the absence of mergers or closings, the students who experienced a merger or closing would have had the same achievement growth as the students that did not experience a merger or closing.

While the abovementioned studies all agree that there are differential effects of school consolidation for displaced and receiving students, the conclusions vary slightly. Generally, displaced students are more adversely affected by school consolidations than receiving students. This could reflect a larger disruption effect on displaced students, who are forced to change schools, teachers and peers. This is to a lesser extent the case for receiving students. Brummet (2014) finds that both displaced and receiving students are adversely affected by school consolidation, while Engberg et al. (2012) and Beuchert et al. (2015) find that displaced students are adversely affected by school consolidation, but receiving students are not – or at least to a smaller extent.[29] In their study of primary school consolidation in rural China, Liu et al. (2010) do not find evidence of adverse effects on average student performance and if anything they actually find that receiving students benefit from the consolidations.

In line with the hypothesis that at least part of the short-run effect of school consolidations is caused by disruption, the adverse effects of school consolidation tend to diminish over time, Engberg et al. (2012), Brummet (2014), and Beuchert et al. (2015). The adverse effects of consolidation appear to be largest around the time of consolidation. Within 2-3 years, the effects

[29] There is a vast literature on peer effects that can be informative about what happens when student composition changes. For example, Angrist & Lang (2004) study a desegregation program in Boston and find little effect of sending students from Boston schools to more wealthy suburbs. Imberman et al. (2012) analyze the effects of displaced students after the hurricanes Katrina and Rita and find limited effects on the achievement of receiving students.

typically diminish considerably and become statistically indistinguishable from zero, Brummet (2014) and Beuchert et al. (2015). Engberg et al. (2012) find a large temporary negative effect on attendance, but this disappears after the first year suggesting that this reflects some form of disruption effect.

If policymakers decide to consolidate schools, they must also decide *which* schools to close and *where* to send the displaced students. While displaced students are harmed from school consolidations on average, Brummet (2014) finds that displaced students actually benefit from school consolidation if the closed schools are relatively low-performing. Similarly, Engberg et al. (2012) find that displaced students that were allocated to higher-performing schools were less adversely affected by school closings.[30] Closing relatively low-performing schools is likely to imply a positive change in school quality for the displaced students, at the very least in terms of an increase in peer quality. Correspondingly, the receiving students in the relatively high-performing schools are likely to face a decrease in peer quality. The results in Brummet (2014) also suggest that closing schools that perform similarly to neighboring schools has no effect after three years while closing relatively high-performing schools has negative effects on student performance – even after three years. In some cases displaced students are all sent to the same school, and in other cases displaced students are scattered across different neighborhood schools. The short-term effects of school consolidation are higher when fewer students are sent to the modal receiving school which is consistent with a hypothesis that the disruption in peer networks generates adverse effects, Brummet (2014).

While school consolidation typically involves the physical relocation of students from one school to another, Beuchert et al. (2015) study a type of administrative school merger where two or more, typically smaller, schools are merged but remain at separate physical locations. They find little initial effect of these administrative mergers, but after a couple of years there is some suggestion that the beneficial effects of these mergers begin to materialize.

de Haan et al. (2014) provide a detailed analysis of the effects of a large school consolidation reform in the Netherlands. The reform was implemented in the years 1994 to 1996 and as a consequence the number of primary schools was reduced by 15 percent and average school size increased from 162 to 216 students. The reform changed how the minimum required school size

[30] The same type of result is found by Sacerdote (2012) and Imberman et al. (2012) who study the effects of student displacement in the wake of hurricanes Katrina and Rita on displaced and receiving students, respectively. The displacement meant that students from relatively low-performing schools were moved to relatively high-performing schools. It led to increases (after an initial decrease) in the achievement of displaced students and no effects on receiving students on average.

was determined as a function of municipality characteristics. They investigate how changes in the number of schools affect mean achievement at the school level. To address endogeneity concerns they compare schools within the same municipality and use variation in the minimum required school size to identify the effect of the number of schools. Their main result is that an average reduction in the number of schools by 15 percent increased average achievement by about 6 percent of a standard deviation. Of particular interest is the fact that they are able to explore four potential channels through which the change in the supply of schools affects student achievement: segregation, school size, pure supply and closing of low-performing small schools. The conclusion is that the estimated achievement effects to a large extent are induced by increases in school size. Since initial school sizes were relatively low, it seems plausible that economies of scale were not fully utilized in the Dutch system prior to the reform. Compared to other studies, de Haan et al. (2014) focus on students that are fully exposed to the effects of school consolidation and their study is probably the one that comes closest to estimating long-term effects of school consolidation.

5.2 Heterogeneous effects and inequality

Often one of the main aims of school consolidation – besides reducing costs - is to promote equality of opportunity by providing the same type of high-quality education for all. In an education system with many small schools, the quality of inputs received by students in different schools is likely to vary considerably. School consolidation tends to reduce this variation. In addition, decreasing the number of schools generally reduces the possibilities of student sorting and thereby potentially school segregation.

The discussion above suggested that displaced students are generally harmed more than receiving students from school consolidations. If displaced students tend to be relatively disadvantaged students then these results imply that school consolidation increases inequality in terms of achievement gaps. The results in Engberg et al. (2012) and Brummet (2014) suggest that any adverse effects of consolidation on displaced students are minimized in the context where students from relatively low-performing schools are moved to relatively high-performing schools. Therefore, this type of consolidation would also tend to minimize any increases in inequality.

The effectiveness of educational interventions may be very dependent on the life-stage at which they are implemented, Heckman (2000). The analyses of Liu et al. (2010) support the hypothesis that school consolidation has effects that vary with the age of the child. Specifically, younger students – both displaced and receiving – are actually adversely affected by the school mergers in rural China while the academic performance of older students is improved. However, the

findings of Beuchert et al. (2015) suggest that effects are stronger for older students. Why results differ across these two studies is not clear; the differences may be related to the very different settings of the two studies.

Whether the effects of school consolidations vary with other school and student characteristics, is more uncertain. The results of Engberg et al. (2012) indicate that whites may be less adversely affected than African Americans. Heterogeneity of effects is investigated for a variety of subgroups in Beuchert et al. (2015), but in many cases the estimated effects for subgroups are statistically indistinguishable from each other. They find that effects on displaced students tend to be larger if the closed school was small or located in a rural area.

In an attempt to study the relationship between school consolidation and wage inequality, Berry (2006) finds little evidence that the school consolidation movement in the United States in the period 1930 to 1970 affected wage inequality. However, the study does not explicitly study the effects of school consolidation and the sample is limited to white males.

In countries or regions with large minority groups, some extent of school segregation is common, for example, Roma and non-Roma in some Central and Eastern European countries, Kertesi & Kézdi (2010, 2012), blacks and whites in the United States, Guryan (2004), and immigrants and natives in many European countries, Schneeweis (2011). If the school system is segregated then this poses an additional challenge for school policy. Specifically, one could hypothesize that school consolidation in a very segregated school system may lead to different types of effects than those discussed above depending on the dimensions of segregation. The effects of school consolidation in segregated school systems are of particular interest since school consolidations are a potential policy instrument for desegregation, Kertesi & Kézdi (2013).[3132] Iatarola et al. (2008) show that the introduction of small high schools in New York City was related to changes in segregation. Their analysis is inconclusive in the sense that some groups of students became more segregated while others became less segregated. Segregation often involves a relatively high-performing population group and a relatively low-performing population group. As such, some of the results discussed above pertaining to, for example, the closing of low-performing schools may be informative about the effects of consolidation in the presence of school segregation.

[31] Kertesi & Kézdi (2012) document a positive relationship between the number of schools and Roma/non-Roma primary school segregation in Hungary.

[32] Kertesi & Kézdi (2013) show that Roma/non-Roma primary school segregation has been increasing from 1992 to 2006. They find that the level of segregation is significantly related to student mobility, the share of Romani population and the local educational policies. They hypothesize that the introduction of free school choice has increased inequality due to the fact the high-status students have higher mobility.

For example, the raw test score gap between Roma and non-Roma students is substantial, but almost disappears when socioeconomic background is taken into account suggesting that socioeconomic background and not ethnicity is the most important dimension, Kertesi & Kézdi (2011, 2014). The effects of closing relatively low-performing schools may therefore to some degree be informative about the effects of closing schools with a high concentration of Romani students.[33] Of course, the existing evidence cannot inform about any culture-specific effects that may arise in a particular cultural context.

5.3 Attendance, dropout rates and distance to school

There is very limited evidence on the effects of school consolidation on attendance and dropout rates. Only one of the abovementioned studies include attendance as an outcome measure and they find a large negative effect on attendance rates of displaced students but the effect disappears within the first year, Engberg et al. (2012). Overall, there is not sufficient evidence on the effects of school consolidations on attendance and dropout rates to draw policy conclusions.[34] What can be said is that school consolidation will typically increase distance from home to school and any potential effects of this should be weighed when considering school consolidations as a policy tool.[35]

5.4 Other aspects of the effects of school consolidations

In the literature on the effects of school consolidations, the focus has undoubtedly so far been on the effects on students' academic achievement. While this perspective is obviously important – especially since deteriorating academic performance is sometimes the primary motivation for school consolidation – there are other issues that deserve a short mention. First of all, studies tend to ignore effects on costs making it hard to evaluate the entire policy of school consolidation. Second, school closings are often believed to have detrimental effects on the surrounding neighborhood in terms of population flight, reduced housing values among others.[36] Third, the narrow focus on

[33] Kirshner et al. (2010) present some qualitative evidence from a high school closure in the United States that suggests that policies that target specific types of schools for closings may cause stigmatization of the students from the closed school.

[34] Liu et al. (2010) has some information on educational inputs and characteristics of the school before and after the merger. As expected, the school consolidation program led to an increase in the distance from home to school, increases in class size and for the displaced students in particular: increases in teacher quality, building quality and the prevalence of modern teaching facilities in the classroom. While the increase in distance to school is likely to decrease attendance, this is not addressed in the paper and therefore it remains speculation.

[35] There is plenty of empirical evidence linking distance to school in general with attendance and enrollment in developing countries, for example, Burde & Linden (2013) show that introducing village-based schools increases school enrollment substantially in Afghanistan and Vuri (2010) show that distance to primary school increases school attendance in Ghana.

[36] Egelund & Lausten (2003) provide a qualitative study and discussion of the effects of school closings in Denmark on the local communities.

academic achievement is not directly informative about potential effects on non-cognitive skills which have repeatedly been argued to be important in the context of educational interventions, see for example, Heckman (2000). Finally, school consolidation generally affects the market forces in education. For example, by decreasing the supply of schools, competition between schools and the choice sets of parents are potentially reduced. Reduced parental choice can lead to higher private school enrollment, Hoxby (2000).

6 Conclusions and implications for school policy in the European Union

There are two reasons why changes in school infrastructure in the EU countries have been particularly pressing in recent years. First, the demographic development in many EU countries implies that the number of school-aged children has been decreasing. Second, resources are scarce – especially in the wake of the economic crisis – implying that many countries and local governments are eager to reduce costs. It is important for policymakers to consider whether the current school infrastructure is optimal in this new context. This report has reviewed the existing economic literature on the effects of school size and school consolidations. It has found that school size is an important determinant of student outcomes, for example as measured by achievement and attendance. However, school size is just one dimension of school policy and any attempt to reform and improve school systems in EU countries should consider all relevant dimensions. In this section, implications of the reviewed empirical evidence for school policy in the EU countries are discussed.

First, it is important for policymakers to take all the potential benefits and costs of changing school size into account. In order to assess whether the current school infrastructure is optimal, one must weigh the benefits and costs of changing school size carefully. While it seems obvious that all costs must be taken into account, a simple thing such as the transportation costs incurred by students is often not included in analyses of the costs of changing school size. From the perspective of society, these costs are important. In addition, the existing empirical evidence suggests that any analysis of a policy that affects school size should consider that school size potentially does not only affect costs, but also academic performance and attendance in school, long-term educational success and social outcomes such as parental involvement. Particularly, the reviewed evidence suggests that larger schools are associated with lower parental involvement, less connectedness and more youth violence.

Second, it is not possible to provide a magic number in the form of an optimal school size. On the contrary, it is well-documented that one size does not fit all in regard to this question. That being said there seems to be a consensus in the literature that schools should be neither 'too big' nor 'too small'. Optimal school size is context-dependent and is likely to vary with country, region, degree of urbanization, level of education, student composition, student background to mention a few. There is substantial variation in school size both within and between EU countries. This warrants a need for further high-quality research on the effects of school size in different contexts to inform policy decisions.

Third, the choice of school size is ultimately intertwined with the choices of grade span, grade size and class size. One cannot change school size holding all of these variables constant. Therefore, changes in school policy should not focus on changing one narrow dimension like school size. A broad perspective is valuable. Generally, large-scale implementation should always be accompanied by considerations about general equilibrium effects to avoid situations like the shortage of qualified teachers in California after a large-scale reduction in class sizes documented by Jepsen & Rivkin (2009).

Fourth, there is considerable evidence that students who are generally considered disadvantaged, for example students with low socioeconomic status, language-minority status, low parental education level etc., are more affected by changes in school size than other students. This suggests that school size considerations are especially important in areas with a large fraction of disadvantaged students. In particular, if the aim of school policy is to lower inequality, it becomes important to assess the impact of school size on the distribution of student achievement. Unfortunately, given that the relationship between school size and student achievement is context-dependent, the existing evidence does not inform about the direction of the effect of school size. If the effect of school size is positive, then increasing school size would reduce inequality, but if the effect of school size is negative then increasing school size would increase inequality. This further underlines the need for high-quality research that can provide evidence on the effects of school size in different countries and for different groups of students.

Fifth, in order to fundamentally change average school size, policymakers will have to implement school consolidations or open new schools. Besides changing school size, school consolidations can have other important effects through changes in school quality and disruption effects - especially in the short run. Existing evidence suggests that especially displaced students are harmed in the short run. The short-run adverse effects of consolidations suggest that more resources

should be allocated to consolidating schools to counter the adverse effects experienced by students who are exposed to consolidation. Furthermore, the possibility of spill-over effects on students in receiving schools should be taken into account.

Finally, the existing evidence suggests that closing relatively low-performing schools and moving the displaced students to relatively high-performing schools is potentially a reasonable strategy for policymakers. This type of strategy also has the advantage of potentially reducing inequality and segregation.

Thus, while the existing empirical evidence on the effects of school size and school consolidations does not provide a clear roadmap for school reforms in EU countries, it does provide important insights into the different dimensions of the effects of school size and school consolidations which are important for analyzing and understanding the consequences of future reforms of the educational infrastructure. There is a large scope for future research in this area to investigate how and why the effects of school size differ for different contexts and relatedly to explore the mechanisms through which school size affects academic performance and other important outcomes. In addition, recent school consolidations in the European Union provide an excellent opportunity for analyzing the complex effects of school consolidations.

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