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The effects of increasing compensatory resource allocation on student achievement

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The effects of increasing compensatory resource allocation on student achievement

Evidence from the Equity grant in the Swedish compulsory school[a]

by

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Abstract

Substantial and persistent differences in learning outcomes between schools largely caused by school segregation is a recurrent issue in many countries and is seen as a threat against equality of opportunity. Compensatory resource allocation policies are sometimes used to mitigate this problem, but the evidence on the effects of such policies is limited. In this paper, we evaluate a large compensatory grant in Sweden, the Equity grant, which was launched by the government in 2017/2018 with the aim of improving the prospects of success for students with a disadvantaged background. The grant, which has since increased to more than SEK 7 billion per year, is allocated based on a socioeconomic index. We examine the relationship between education provider index and teacher-to-student ratio in the years before and after the introduction of the grant and find that teacher-to-student ratios are significantly more compensatory as the grant is introduced and then gradually expanded. Overall, however, we do not see that the increased teacher resources among providers serving disadvantaged students led to smaller test score differences between providers serving advantaged and disadvantaged students respectively. However, in grade 9, where the effect on class size is most pronounced, there are indications of improved student performance, which also translate into increased high-school enrollment.

Keywords: education providers, disadvantaged students, compensatory resource allocation, equity grant, learning outcomes
JEL-codes: I22, I24, I28

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1 Introduction

Reducing differences in learning outcomes between students from different socioeconomic background, i.e., increasing equality of opportunity, is a central aim in many countries. Empirical studies, however, have consistently documented strong associations between parental characteristics and student performance, as measured by grades, test results and further educational attainment (for overviews see, e.g., Holmlund, Sjögren and Öckert 2020; Currie and Goodman 2020). School segregation by socioeconomic background, which is caused by both residential segregation and school choice (e.g. Holmlund, Sjögren and Öckert 2020), potentially reinforces the strong connection between parental background characteristics and student performance through mechanisms related to the quality of the learning environment (e.g., Åslund et al., 2011; Chetty and Hendren, 2018). While potential negative effects of school segregation on equality of opportunity arguably is best addressed by policies directly aimed at combating school segregation (e.g., Ludwig et al. 2008), such policies are hard to implement. An alternative approach is to direct additional compensatory resources to schools with students from disadvantaged backgrounds with the aim that schools use the funding to improve the learning environment and increase equality of opportunity. But the usefulness of such policies depends on whether compensatory resource allocation can reduce differences in learning outcomes between schools with different socioeconomic student composition.

In this paper, we test whether one of the largest compensatory government grants in recent years in Sweden helped closing the achievement gap between students in more and less disadvantaged schools. This grant, the so-called Equity grant, targets education providers[1] and is primarily used to increase personnel in schools. It was introduced in the academic year of 2017/2018 and has gradually increased to around SEK 7.5 billion (USD 0.73 billion) per year. While education providers that serve the most advantaged students only are entitled to a negligible sum, providers with many students from a disadvantaged background can increase their spending per student by up to 15 % thanks to the grant.

Using administrative education data from the academic years of 2013/14–2022/23, we use a difference-in-differences estimation framework to estimate the causal effect of the grant on the quantity and quality of teacher inputs, and student attainment at different grade levels. We show that the introduction led to an increased teacher-to-student ratio among providers serving more

[1] Most education is provided by public schools run by the 290 municipality administrations in Sweden. The average municipality runs around 13 public schools. There are also around 560 independent education providers (businesses or other organizations) that run free schools (privately run schools funded by public money). Most independent education providers run only one or a small number of schools, but there are also some larger providers that run schools across the country. When the term education provider is used in the paper it thus refers to the 290 municipalities and the roughly 560 independent providers.

disadvantaged students – a result that is in line with the proposed use of the grant. Despite this positive effect on teacher *quantity*, we find that this comes with a slightly lower average teacher *quality*. We then evaluate whether the additional resources also translated into higher test scores but find, on average, small and insignificant effects on test scores in Swedish and mathematics. We do find, however, some indication of positive effects for students in the last year of compulsory school, grade 9. This is also the grade where we see the most pronounced reductions in class size. Correspondingly, we also see clear positive effects on high school eligibility. When testing for heterogeneous effects, we see that effects are strongest for students with migration background, i.e. a group where additional resources can have stronger marginal effects.

Our paper contributes to the literature on the effects of school resources on schooling outcomes in general, and the effects of compensatory resource allocation in particular. There is a growing consensus that more resources generally improve learning outcomes. This includes studies on expenditures in general (e.g., Jackson, Johnson and Persico 2016; Jackson 2020; Jackson and Persico 2023; Jackson and Mackevicius 2024; Krueger 1999; Holmlund, McNally and Viarengo 2010; Gibbons, McNally and Viarengo 2018; Rothstein and Schanzenbach 2022), as well as studies analyzing class size (e.g., Angrist and Lavy 1999; Fredriksson, Öckert and Oosterbeek 2013; Fredriksson, Öckert and Oosterbeek 2016). Several papers have found particularly positive effects for disadvantaged students (Biasi 2023; Biasi, Lafortune and Schönholzer 2025; Cascio, Gordon and Reber 2013; Fredriksson, Öckert and Oosterbeek 2016).

However, the literature is more limited with respect to studies directly concerned with compensatory funding policies, i.e., policies that allocate relatively more resources to schools or districts with many disadvantaged students. While there is some evidence that compensatory resource allocation policies can reduce the gap in learning outcomes between schools with weak and strong student composition (Machin, McNally and Meghir 2004, 2010; Lafortune, Rothstein, and Schanzenbach, 2018), there are also studies finding insignificant effects of such policies (Borgen et al. 2025; Leuven et al. 2007; van der Klaauw 2008). We contribute to these studies by analyzing one of the largest compensatory resource allocation programs in recent years in Sweden to study how education providers use additional resources and how this translates into students' educational achievements.

Leuven et al. (2007), in an attempt to explain their insignificant effects, point out that the effects of introducing a policy that allocates more resources to disadvantaged districts partly depend on how compensatory the resource allocation was prior to the new policy. Arguably, the marginal effects of compensatory policies (and resources in general) are decreasing and at some point it is just not possible to increase school results in disadvantaged districts relative to more advantaged districts with *even more* compensatory policies. But we know little about just how far

compensatory resource allocation can be pushed before further changes in a compensatory direction become ineffective. Evaluating nation-wide polices that allocate more resources to disadvantaged districts in a system that is already compensatory can thus give valuable knowledge and inform policy decisions in countries that face remaining differences in learning outcomes between schools with different proportions of disadvantaged students despite having at least some degree of compensatory resource allocation.

The paper has the following structure: Section 2 starts with an overview of the Swedish compulsory school system and the principles for school funding. We then present the details of the Equity grant. In section 3, we describe the data and how we estimate the socioeconomic index of the different education providers. The empirical strategy is outlined in section 4. In section 5, we present our estimates of the effects of the Equity grant. Section 5.3 concludes.

2 The Swedish compulsory school system and the Equity grant

2.1 The Swedish compulsory school system

In 2021, there were around 1.1 million students enrolled in the Swedish compulsory school system which covers the preschool grade (age 6) and grades 1–9 (age 7–16).[2] In the same year, the total cost for the compulsory school system was reported to be SEK 136 billion which amounts to 2.5 percent of GDP (Skolverket 2022a). The schooling infrastructure is made up of almost 5,000 schools organized by around 850 education providers. Sweden operates a voucher-based school choice system in which parents can apply to publicly or independently run schools for their children. No matter the type of school, there are no tuition fees. If a school is oversubscribed, the students are typically ranked by the distance between their home address and the school. Thus, although parents can *apply* to any school, the chances of the child ultimately being *accepted* to a school far from the home address are in practice quite limited. Residential segregation by socioeconomic background, which is substantial in Sweden, therefore also leads to pronounced school segregation by socioeconomic background. Some independent schools also consider queue time which tend to generate a higher likelihood of being enrolled for children from advantaged backgrounds. Accordingly, there are large compositional differences between students in public and independent schools (Holmlund, Sjögren and Öckert 2020).

Each of the 290 municipalities in Sweden is an individual education provider, and these municipality administrations are responsible for approximately 4,000 public schools covering 85 % of the students.[3] The remaining schools are run by around 560 (mostly small) independent

[2] Students following the standard education path start the preschool grade in August the year they turn 6, and graduate from grade 9 in June the year they turn 16.
[3] Own calculations based on the administrative data.

providers (businesses or other organizations). All schools, i.e. both publicly and privately run, are funded by the local municipality governments that mainly get their revenues from the municipality tax. However, different types of central government grants are also an important source of revenue for the municipalities. The local municipality governments decide on the size of the school voucher, i.e., the sum of money that follows the student to the school where he/she enrolls. This sum is the same for all schools that operate within the same municipality no matter if it is a public school run by the municipality administration or a free school run by an independent education provider. Across municipalities there is substantial variation in both the level and the construction of the school voucher. Many, but not all, municipalities have for a long time divided the voucher into two parts; one basic sum that is constant across all students and one component that is differentiated by the socioeconomic background of the students (SKR 2018). This construction compensates schools that receive relatively many disadvantaged students. Since 2014, the Education Act explicitly states that municipalities should have a compensatory component in their resource allocation algorithm (Skollagen 2010:800; Prop 2013/14:148).

Unfortunately, because of scattered policies and documentation across municipalities, it is hard to characterize the degree of compensatory funding in the Swedish school system and how it has evolved over time. However, while overall spending generally is not available for individual schools, there is high-quality register data on students and teachers at the school level making it possible to compare, e.g., teacher-to-student ratios across schools with different student socioeconomic composition. Holmlund, Sjögren and Öckert (2020) show a clear compensatory pattern in Sweden when they compare the teacher-to-student ratios in schools with weak, average and strong student composition over the period 1995–2017. The compensatory pattern becomes more pronounced over time. However, they do not find any clear differences in teacher quality across the different schools.[4] If anything, teacher quality tends to be somewhat lower in schools with a weaker student composition suggesting that it might be hard to recruit high-quality teachers to these schools. Thus, while the teacher input is compensatorily allocated in a quantitative perspective, the overall picture is more complex.

2.2 The Equity grant

The school voucher paid by the municipality governments is the main source of funding for the schools. However, during the last 15 years the importance of central government funding through different types of grants, with specific aims and conditions, that the education providers can apply for has gradually increased (SOU 2022:53). The central government uses these grants to

[4] It should be noted that teacher quality is hard to capture since formal qualifications typically are quite weakly correlated with teacher value-added measures (e.g. Leigh 2010).

influence, e.g., teacher career paths and how the schools work with pedagogical development, and the grants can be seen as a partial centralization of a decentralized school system. There are many different grants (around 70 in 2019) and several of the grants have (small) compensatory components (Riksrevisionen 2020). Following an increasing school segregation by socioeconomic background (Holmlund, Sjögren and Öckert 2020), and a 2017 government report that recommended increased compensatory resource allocation to improve equity in the Swedish school (SOU 2017:35), the compensatory part of the central government funding has been greatly increased and concentrated with the introduction of the Equity grant in the academic year of 2017/18.[5]

The idea behind the Equity grant, which is still ongoing in 2025 and scheduled to continue until further notice, is to allocate additional funding to compulsory school education providers (i.e. municipalities and independent providers) according to the socioeconomic composition of students in their schools. To characterize the socioeconomic composition of the students, the Swedish National Agency for Education in collaboration with Statistics Sweden use student-level administrative data to estimate the association between different socioeconomic background variables (e.g., immigrant background and parental education and earnings) and the likelihood of finishing compulsory school *without* fulfilling the grade requirements to be eligible for basic high school programs.[6] The results from the estimation are then used to predict the likelihood of high school *ineligibility* for all students in compulsory school. In a final step, to calculate a socioeconomic index per education provider, the average predicted probability of high school ineligibility among students served by a certain education provider is divided by the corresponding nation-wide average probability and then multiplied by 100 (Statistics Sweden 2017). Thus, education providers with a high index value have a relatively weaker student composition and are allocated a larger grant per student. The index ranges from about 35 to about 500. The process of obtaining the index is repeated every year so that a provider's index can vary from year to year depending on changes in the student composition. Education providers need to apply to receive the grant and the take-up rate has hovered around 90 % since the introduction.[7]

In 2017, only providers with an index value above the median were eligible for the Equity grant which amounted to SEK 500 million this year. Among the eligible providers, the amount

[5] To be precise, the Equity grant was actually introduced in 2018. The grant that was introduced in 2017 was called the Equality grant and these two grants coexisted in 2018. Then, the two grants were merged and lived on under the name the Equity grant. Since the Equality grant had more or less the same structure as the Equity grant and since it was relatively substantial in 2017, we consider the academic year of 2017/18 as the start of the Equity grant.

[6] The model is estimated on grade 9 students, i.e., students in the last year of compulsory school. Typically, around 15 % of grade 9 students finish compulsory school without fulfilling the grade requirements to be eligible for basic high school programs. To be eligible for high school, students must have a "Pass" grade in Swedish, English and mathematics. In addition, they need to reach the "Pass" requirement in five other subjects. Students are taught in 17 different subjects.

[7] Small independent providers are overrepresented among providers who don't apply for the grant (Statskontoret 2021).

per student depended on the value of the index. In 2018, the grant increased to SEK 1.5 billion and was expanded to cover all providers (but those with low index values were only eligible for very small amounts). The gradual expansion then continued, and the grant amounted to SEK 6.2 billion and SEK 7.5 billion in 2021 and 2024 respectively (see overview in Table A1).[8] In 2021, the size of the grant corresponded to about 4.6 % of the overall cost of Swedish compulsory education (Skolverket 2022a). The available Equity grant per student for a given provider is given by Equation (1):

$$Provider\ grant/student = \frac{Provider\ index}{100} * Sweden\ avg.grant/student \qquad (1)$$

From Equation (1), it is clear that the grant per student for a given provider is a linear function of the provider's index. If the provider's index is at the nation-wide average, i.e. 100, the resulting grant per student is naturally also at the average. A provider with an index value of 200, indicating a relatively weaker student composition, is instead eligible for an amount per student twice as large as the nation-wide average. In 2020, the maximum and minimum amount per student amounted to SEK 16,000 and SEK 850 respectively. To put this into perspective, we can note that SEK 16,000 corresponded to about 14 % of the average cost per student in 2020 (Skolverket 2021).

There are relatively few restrictions on the type of spending that the additional funds can be used for. The main principle is that the money should be used to finance "new" activities that can improve equity and the learning environment in the schools. Thus, providers are not allowed to finance already ongoing activities with the Equity grant in order to reduce their own spending, . Providers can, e.g., use the money to hire more teachers, set up pedagogical training programs for the teachers, improve the quantity and quality of teaching resources and strengthen the work concerned with the students' health. Importantly, however, the grant cannot be used for investing in premises. Evidence from Statskontoret (2021) and Skolverket (2022b) show that providers mainly use the grant to finance additional staff (mostly but not only teachers).

[8] The grant is scheduled to continue at a similar size in the coming years. Note, however, that our administrative education data only include information up until the academic year of 2022/23.

3 Data

3.1 Data sources

We use administrative education data covering all students and teachers in Swedish compulsory schools. These education registers can further be linked to other population-wide registers where we can connect children and parents and add information on demographic and socioeconomic characteristics. We focus on the period covering the academic years of 2013/14–2022/23 which allows us to follow the development both before and after the introduction of the Equity grant (introduced in 2017/18).

The key registers for our analysis are the *Student register* and the *Teacher register* which give a snapshot of the situation in the Swedish schools in October each year. The *Student register* contains a list of all students who are enrolled in the preschool grade and grades 1–9 on October 15 and shows the school that the students attend. To this register, we can add background variables for the students and their parents from the *Multigenerational register* and the *LISA-register*. Among other things, this includes information about gender, immigrant background, education levels and earnings. The data enable us to count the number of students per provider and characterize the socioeconomic composition of the students. The *Teacher register* contains a corresponding list of teachers in the Swedish schools and includes indicators of the teachers' competence, e.g., years of teaching experience, educational background and whether they have a teacher certification for the subjects that they are currently teaching. We also observe their contracted hours. By combining the *Student register* and the *Teacher register* it is possible to calculate the teacher-to-student ratio at the provider level.

The wages of the teachers are not included in the *Teacher register* but can be sourced from the *Wage structure statistics*. This is also an annually updated register which contains employer-reported employee full-time wages. The reporting takes places in the fall each year. All public workplaces (and thus all public schools) are included in the survey but only about 50 % of the private sector workplaces. Large workplaces are overrepresented in the private sector sample. Since most teachers work in public schools, the wage coverage for teachers is good but not complete.[9] By regressing the wage on the indicators of the teachers' competence, we can obtain predicted wages for all teachers based on their experience and formal qualifications (as in Holmlund, Sjögren and Öckert 2020). The predicted wages of the teachers capture the extent to which the education provider employs teachers with qualifications that are highly valued on the teacher labor market. We consider this a measure of teacher quality, although we recognize that the concept of teacher quality is complex and not always captured by formal qualifications (Leigh

[9] In any given year, we lack wage data for about 11 % of the teachers.

2010). Finally, the deviation between actual wages and predicted wages can be informative about wage-setting practices.

With regard to student performance measures, we have results from grade 3 (age 10), 6 (age 13) and 9 (age 16). We focus on results from standardized national tests in Swedish and mathematics, as these results are consistently available for grades 3, 6 and 9. Earlier evaluations of interventions/programs in the Swedish school system have typically used results from the standardized national tests as the main outcome since these results are seen as more objective and comparable across schools/providers than the subject grades (Holmlund, Häggblom and Lindahl 2024; Grönqvist, Öckert and Rosenqvist 2025). In grade 3, students don't receive overall test grades but we observe how many points they are awarded on the different subtests within Swedish and mathematics respectively. In grade 6 and 9, we have data on the test grades. An A–F grading scale is used where F represents "Fail". There is a point value attached to each grading step according to the following schedule: A=20, B=17.5, C=15, D=12.5, E=10 and F=0. We standardize the test results to have mean 0 and standard deviation 1 within grade and test year. The national tests are normally taken in the spring, but unfortunately, due to the pandemic, there were no national tests in the spring of 2020 and 2021.[10] But we do observe national test results from the spring of 2022 and 2023 pertaining to the academic years of 2021/22 and 2022/23.

For grade 9 students, we also analyze a binary variable which captures high school eligibility. A student must have a subject grade of "Pass" or better in Swedish, English, mathematics and at least five other subjects to be eligible to start a high school program (in total there are 17 subjects). The share of grade 9 graduates eligible for high school has hovered around 85 % during our study period. We also study actual enrollment in a high school program.

3.2 Estimating the pre-reform socioeconomic index from micro data

In section 2.2, we outlined the construction of the Equity grant and how it is allocated on the basis of the education providers' socioeconomic index. The official index which is calculated by Statistics Sweden and used for the grant allocation is, however, only available in the post-reform period. It was estimated for the sole purpose of allocating the Equity grant money and does therefore not exist in the pre-reform years. From an evaluation perspective this is unfortunate since we must be able to compare the pre- and post-reform relationship between the socioeconomic index and outcomes related to resources and student performance in order to assess the effect of the grant. However, Statistics Sweden has provided a description of how they

[10] In the spring of 2018, the grade 9 test in mathematics leaked and many schools were forced to replace the regular test with a replacement test. Unfortunately, there are no results available for schools using the replacement test. Consequently, around 75% of grade 9 students have missing information on the test in mathematics this year. We have excluded this test altogether from our analysis.

derive the index (Statistics Sweden 2017), making it possible for us to *approximately* replicate the index with the micro data that we have access to. While we have similar micro data as Statistics Sweden, we don't have access to exactly the same variables as they do. Because of this discrepancy, we cannot perfectly replicate the official index with our micro data, but the correlation between our index and the official index is, on average, close to 0.9 in the post-reform period. Since the post-reform correlation between our index and the official index is high, we argue that it is reasonable to construct a pre-reform index for the academic year of 2016/17 based on our approach.

Following Statistics Sweden very closely, we estimate the pre-reform index in the following way. First, using student-level graduation data from grade 9 in the pre-reform years (2013–2016) combined with background information on the students and their parents, we regress a dummy that takes the value 1 if the student does *not* fulfill the grade requirements to be eligible for high school on the following variables: a dummy for being a girl, a dummy for being born abroad, the highest education level of the parents, the income group of the parents, a dummy for parents being separated and the total number of children in the family (see Table A2). Based on the coefficient estimates from this regression, we predict the probability of *not* being eligible for high school for each student in the October 2016 edition of the *Student register* (i.e., students enrolled in grades 1–9 and the preschool grade).[11] Using the predicted values at the individual level, we then create education provider averages. We then normalize education provider averages by the median education provider average and multiply it by 100. The average education provider thus has the value 100, and higher values of the index mean weaker student composition. In what follows, we will refer to this index as the 2016-index or the pre-reform index. The distribution of the 2016 education provider index is shown in Figure A1. Note that in our empirical specifications, we divide the index by 100 so that coefficients on the index should be interpreted as predicted changes in an outcome when we move 100 points (approximately 2 standard deviations) up along the index.

3.3 Pre-reform descriptions

Our analysis data from the academic years of 2013/14–2022/23 contain more than 10 million student-year level observations. In Table 1, we show how the 2016-index at the provider level was related to teacher resources and student learning outcomes in 2016/17 (i.e., the last year

[11] The *Student register* also includes asylum seekers with temporary personal numbers that cannot be linked to other registers with background information. Thus, the prediction model cannot be applied on these individuals. Instead, we follow Statistics Sweden and impute values based on the actual share that were not eligible for high school among asylum seekers who finished grade 9 in the previous year. Sometimes asylum seekers are placed in "introduction" schools, resulting in a very high share of asylum seekers in some schools. We exclude schools in which the share of asylum seekers is above 0.5.

before the Equity grant). The different outcomes are simply regressed on the 2016-index using a linear specification. All the resulting slope coefficients are significant at the 1 % level, and they should be interpreted as the predicted change in the outcome variable for a 100-step increase in the index. Note that these are associations and not causal relationships. The teacher-to-student ratio is strongly positively associated with the index confirming the results from Holmlund, Sjögren and Öckert (2020) that the teacher input, at least in terms of quantity, was compensatorily allocated already before the introduction of the Equity grant. A 100-step increase in the index is associated with an increase in the teacher-to-student ratio by about 0.011 which can be compared to the overall mean of 0.077. For class size, which has a mean of 22.3, the corresponding number is a reduction by 2.5 students. Regarding teacher wages, the table shows that a higher index value comes with lower teacher wages – both in actual wages and predicted wages. To predict teacher wages, we regressed wages on indicators of the teachers' competence (years of teaching experience, educational background and whether they have a teacher certification for the subjects that they are currently teaching). Thus, this outcome could be seen as a measure of teacher quality where we account for observable predictors of wages.

On the other hand, despite the compensatory pattern for teacher quantity, there is a sharp negative relationship between student results and the index. This is of course expected since the index captures the average *predicted* student attainment for students enrolled with the education provider. A 100-step increase in the index is associated with a decrease in student test results by almost 50 % of a standard deviation. The Equity grant is expected to make the relationship between the index and the teacher-to-student ratio even more positive and the question is if that could make the negative relationship between the index and student learning outcomes less negative.

Table 1 Descriptives and pre-reform index to outcome relationships

Outcome variable	Coefficient	Mean
Teacher resources		
Teacher-to-student ratio (full time equivalent teachers per student)	0.011***	0.077
Class size	-2.5***	22.3
Log of actual monthly teacher wage	-0.066***	10.4
Log of predicted monthly teacher wage	-0.014***	10.4
Residualized log of actual monthly teacher wage	-0.057***	0.006
Student learning outcomes		
National tests in Swedish and mathematics (standardized)	-0.478***	-0.004
High school eligibility (dummy)	-0.172***	0.837
High school enrollment in academic or vocational program (dummy)	-0.188***	0.814

Note: The table shows mean values for the different outcome variables and their linear relationship to the provider socioeconomic index (i.e., $outcome = \alpha + \beta index$). The index and the outcomes are measures in the academic year of 2016/17. The coefficient represents the predicted change in the outcome variable for a 100-step increase in the index. The estimation is performed at the student level, i.e., each observation is a student. */**/*** refers to statistical significance at the 10/5/1 percent level.

4 Method

The goal with the empirical analysis is to determine whether the index-to-outcome relationships on display in Table 1 have been affected by the Equity grant. To do so, we employ an event-study difference-in-differences specification where we follow the development of the relationship between the 2016-index and the outcomes both before and after the introduction of the compensatory grant. We fix the index at the 2016 level so that providers have the same index throughout the study period.[12] Consequently, the analysis only includes education providers that existed in 2016. Since we know that school segregation has been increasing in Sweden during the last decades (Holmlund, Sjögren and Öckert 2020), the model adjusts for differential trends in student composition between providers serving advantaged and disadvantaged students by controlling for detailed individual background characteristics that are highly correlated with test results.

Intuitively, with the model we try to resemble a situation in which differences in student composition between providers stay constant over time so that changes in the relationship between the 2016-index and learning outcomes should not be caused by differential changes in student composition. Using this method, the effect of the Equity grant is identified under the assumption that the relationship between the 2016-index and the outcomes, conditional on student background controls, would have stayed constant after 2016 in the absence of the reform. While it is impossible to directly test this assumption, we can investigate if the relationship between the 2016-index and the outcomes was stable in the period before the Equity grant to get an indication

[12] If index values change between 2016 and later years, there will be some measurement error in the treatment variable for later years which biases the estimates toward zero.

of the validity of the assumption. To simultaneously check for pre-reform stability and post-reform effects, we estimate the model in Equation (2):

$$y_{ipt} = \sum_{t=2013, t\neq 2016}^{2022} \beta_t 1[Year = t] * Index_p + \theta_t + \rho_p + \boldsymbol{\delta x}_{ipt} + \varepsilon_{ipt} \quad (2)$$

We observe a student *i* served by education provider *p* at year *t*. θ_t and ρ_p represent year and provider fixed effects. The vector of student level background controls, $\boldsymbol{x}_i$, includes the following variables: gender, detailed birth country indicators for the students and their parents, the education level of the parents, the income of the parents, the total number of children in the family and a dummy for being an asylum seeker. The variable *Index* corresponds to the 2016-index as explained in section 3.2. β_{2013}–β_{2015} are pre-preform parameters that are used to assess the validity of the identifying assumption, while β_{2017}–β_{2022} capture potential effects of the Equity grant. A dynamic specification for the effects is particularly important in this setting since the size of the grant increased substantially between 2017 and 2022 (SEK 0.5 billion to SEK 6.55 billion). As outcomes, we first look at measures of teacher quantity and quality. In some sense, this represents a first stage estimation although the grant could also be used for other types of expenditures. However, if the grant did not affect the relationship between the 2016-index and the teacher-to-student ratio it is less reasonable to expect effects on learning outcomes. With respect to learning outcomes, we focus on standardized national tests in Swedish and mathematics taken by students in grades 3, 6 and 9.

We acknowledge that there are threats to identification. First, it is possible that the pandemic impacted providers serving advantaged and disadvantaged students differentially. However, it should be noted that schools in Sweden remained open throughout the pandemic (although there were some elements of distance learning). There are also results suggesting that learning outcomes of students in Sweden were relatively unaffected by the pandemic (Betthäuser, Bach-Mortensen and Engzell 2023). Second, we cannot rule out that providers with low and high 2016-index experienced differential trends in student composition in dimensions that we cannot observe and control for. To some extent, we can look at pre-reform estimates to assess this concern but still it is a source of uncertainty.

Finally, it is important to consider the continuous nature of the treatment. All providers receive at least some funding from the Equity grant and there might be heterogeneous effects across the different providers. Consider a case in which all providers improve the learning outcomes of their students when they have more resources, but providers with a low index (i.e. strong student composition) improve more for a given increase in resources. In such a scenario, we could end

up estimating zero effects with our model in Equation (2), even though all providers benefitted from the reform. Thus, the model is not equipped to capture effects of more resources per se, instead, it is set up to assess if gaps between providers with low and high index have changed following the reform.

5 Results

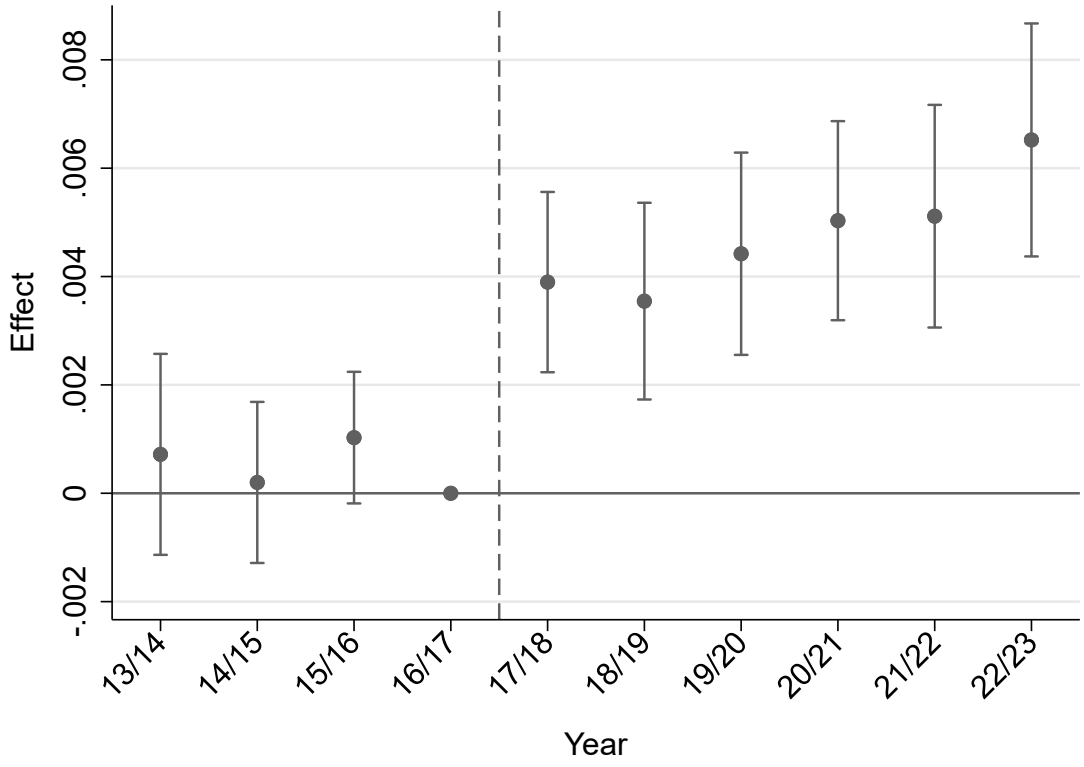
To study how education providers used the additional resources from the Equity grant and whether and how this translated into smaller differences in student attainment, we provide several pieces of evidence. First, we use our estimation model to test if the introduction of the Equity grant led to an increased teacher-to-student ratio among providers with a high index relative to providers with a low index, and whether teacher composition changed with its introduction (subsection 5.1). We then turn to estimating the effects of the Equity grant on student learning outcomes (subsection 5.2).

5.1 Effects of the Equity grant on teacher quantity and quality

5.1.1 Teacher quantity

In Figure 1, we present an event-study graph showing how the relationship between provider socioeconomic index and teacher-to-student ratio developed in the years before and after the introduction of the Equity grant. The teacher-to-student ratio is defined as the number of full-time equivalent teachers employed by the provider divided by the number of students enrolled. The figure shows that after the introduction of the Equity grant, the estimated β_t-coefficients from Equation (2) are significantly positive and gradually increase in size. This suggests that the added funding was used to strengthen the teacher resources. The gradual pattern of this effect fits the expansion of the Equity grant which increased from SEK 0.5 billion in 2017 to SEK 6.55 billion in 2022. To put the size of the point estimates into perspective, note that, in 2016/17, moving 100 points up along the index was associated with having 0.011 more teachers per student (see Table 1). In 2022/23, this positive association had increased by 0.006, i.e. by almost 50 %. Figure 1 also shows that the estimates before the introduction are small and insignificant which supports the identifying assumption of parallel trends in the post-reform period.

Figure 1 Effects on the relationship between provider index and teacher-to-student ratio

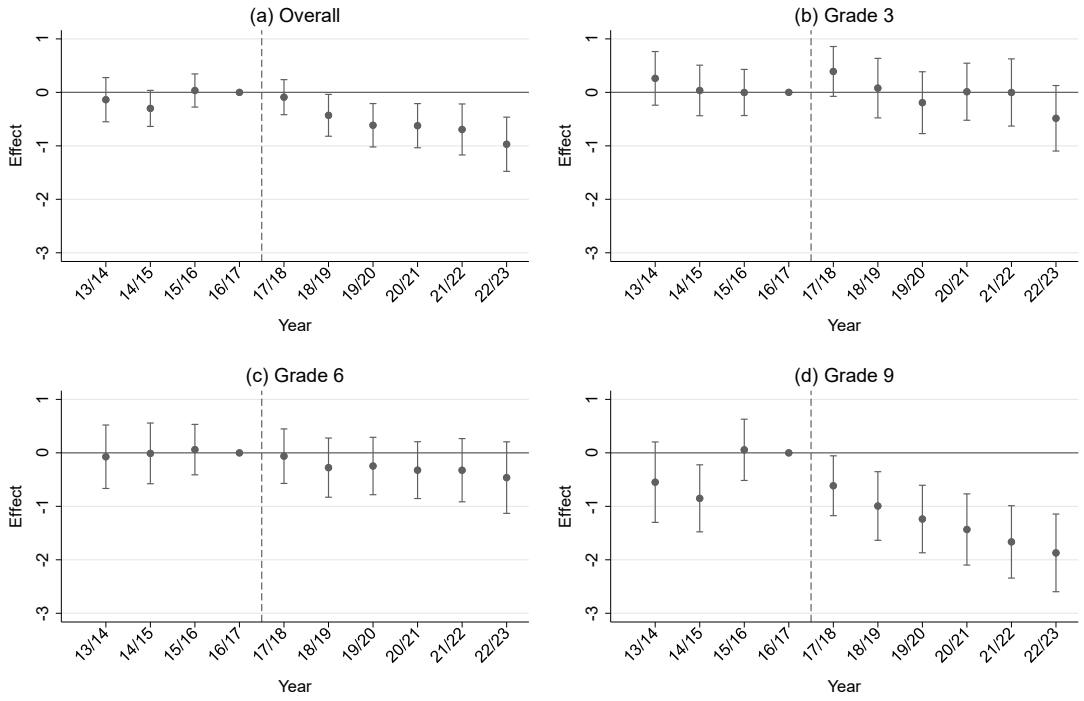


Note: The figure shows estimates of β_t from Equation (2). Estimation is performed at the student level but the teacher-to-student ratio only varies at the provider level. The figure includes 95% confidence intervals based on standard errors clustered at the provider level.

A limitation with the teacher-to-student ratio is that we can't observe it for specific grades. While we know the grade level of the students, the information in the *Teacher register* is not precise enough to construct grade-specific teacher-to-student ratios. Thus, it is not possible to examine if the effects depicted in Figure 1 vary by grade level. However, the *Student register* contains information about which class the student is in. Typically, a school has two or three classes per grade level and the class variable specifies which one of these classes that the student belongs to. Using this information, we can construct a class size variable which enables us to do grade-specific analyses. We focus on grades 3, 6 and 9 since test results are available for students in these grades. Figure 2 shows overall effects on class size (panel a) and grade-specific effects (panels b–d). In line with the positive effects on the teacher-to-student ratio, we observe *negative* effects on class size overall (panel a). The effects become more negative over time consistent with the gradual expansion of the grant. In 2016/17, moving 100 points up along the index was associated with having 2.5 fewer students in a class (see Table 1). In 2022/23, this negative association had decreased further by 1 student. Turning to the grade-specific results, it is interesting to note that we only observe significantly negative estimates for grade 9. Of course,

this doesn't necessarily mean that education providers with a high index only increased teacher resources in grade 9. The teacher-to-student ratio can also be increased by having multiple teachers in a class, instead of splitting the class, in which case we would observe no effects on class size. Still, the results in Figure 2 show that the results for class size are in line with those for teacher-student ratios, and also show that education providers seem to invest in smaller classes in higher grades.

Figure 2 Effects on the relationship between provider index and class size



Note: The figure shows estimates of β_t from Equation (2). Estimation is performed at the student level but the teacher-to-student ratio only varies at the provider level. The figure includes 95% confidence intervals based on standard errors clustered at the provider level. The outcome variable is defined as class size in the respective grade.

5.1.2 Teacher quality

The Equity grant clearly increased the teacher-to-student ratio among providers with a high index relative to providers with a low index. But what happened to the composition of the teachers? In Figure 3, we study actual and predicted monthly full time equivalent teacher wages (in log) to capture this dimension.[13] As mentioned above, we obtained predicted wages by regressing the log of the actual wage on indicators of the teachers' competence (years of teaching experience, educational background and whether they have a teacher certification for the subjects that they are currently teaching). We argue that the predicted wage can be viewed as a composite measure

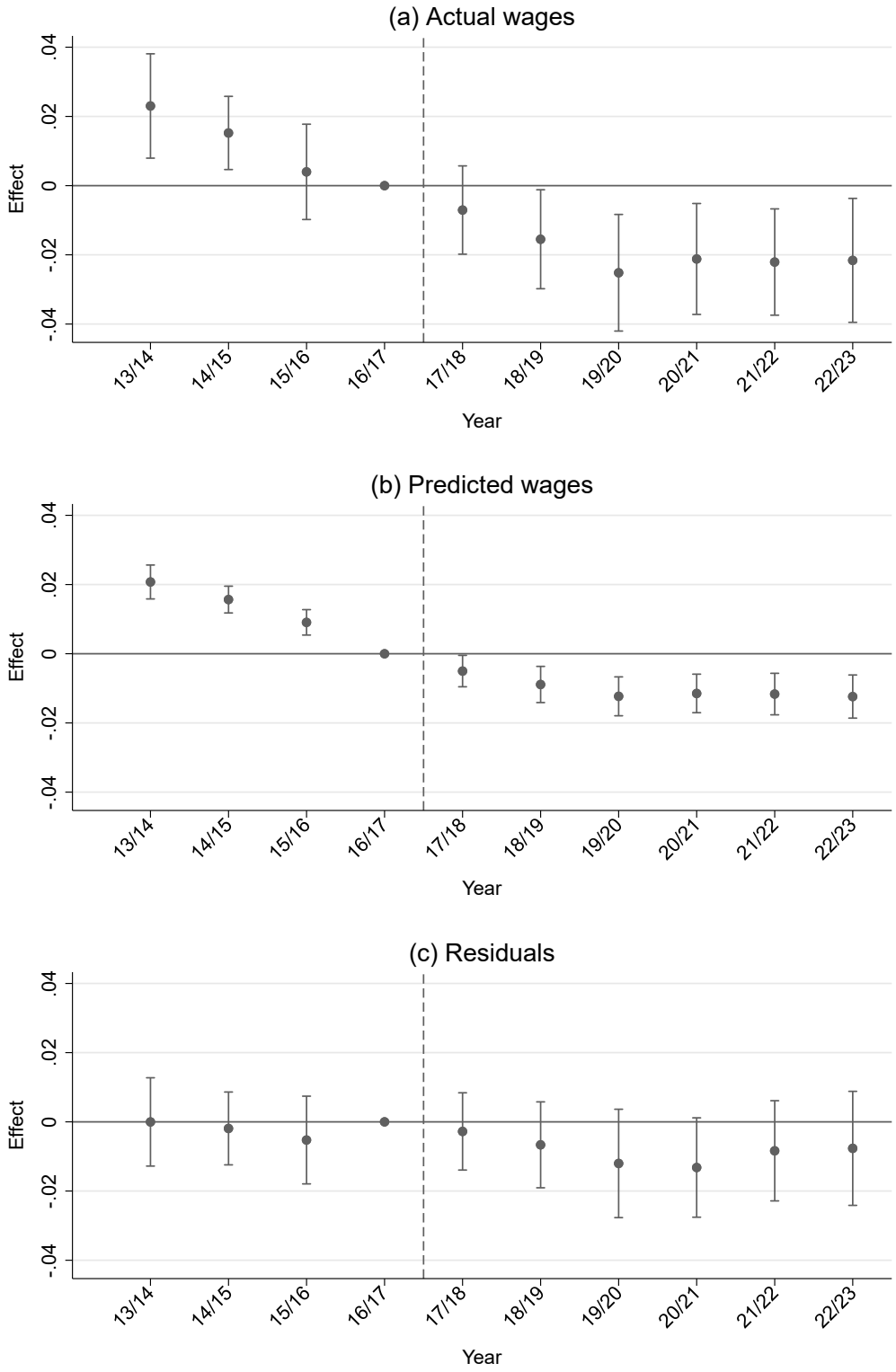
[13] Since this analysis relies on the *Teacher register*, in which we can't link teachers to specific grade levels, we can't perform grade-specific estimations.

of teacher quality since it shows whether the teacher has qualifications that are highly valued on the teacher labor market.

Figure 3b shows that providers with high and low index values had different trends in teacher quality in the years before the reform. Providers with a high index experienced decreasing teacher quality relative to providers with a low index, indicating that it became increasingly difficult to recruit high-quality teachers to schools predominantly serving children from weaker socioeconomic backgrounds. This development continued, at a slower pace, in the first three years after the reform, after which a stabilization occurred. Estimates for the actual wage give a similar picture (Figure 3a).[14] Given the significant estimates in the pre-reform period, it is difficult to know what would have happened after 2016/17 in the absence of the reform. While acknowledging this uncertainty, we interpret the results as suggesting that the Equity grant helped stop a further deterioration of the teacher quality among providers serving children from weaker socioeconomic backgrounds. Still, it is important to recognize that, relative to providers with a lower index, providers with a higher index had poorer average teacher quality in 2022/23 compared to the pre-reform reference year of 2016/17. Thus, while high-index providers exhibited a positive development with respect to teacher *quantity* after the reform, the opposite pattern is true for teacher *quality*. These contrasting results suggest that there are two opposing forces shaping potential effects on student test results.

[14] Consequently, we don't find any significant effects on the residualized wage (Figure 3c), which we view as a measure of wage setting practices by the providers.

Figure 3 Effects on the relationship between provider index and actual and predicted teacher wages



Note: The figure shows estimates of β_t from Equation (2). Estimation is performed at the student level, but the outcomes only vary at the provider level. The figure includes 95% confidence intervals based on standard errors clustered at the provider level.

5.2 Effects of the Equity grant on student learning outcomes

5.2.1 Standardized national tests in Swedish and mathematics

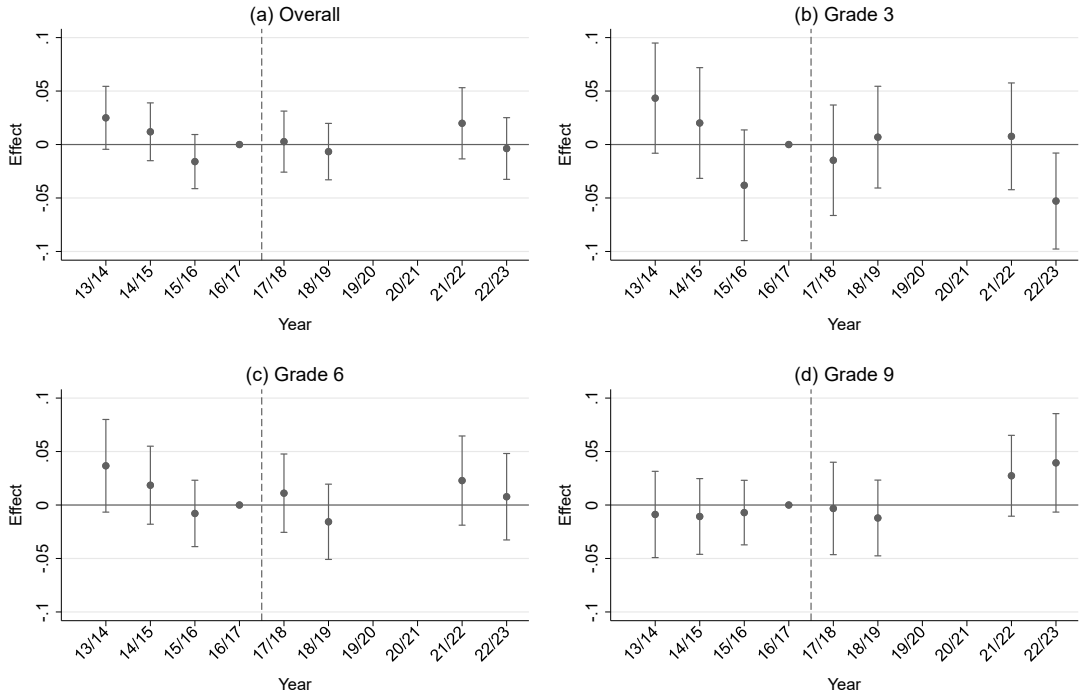
Students in grades 3, 6 and 9 take standardized national tests in Swedish and mathematics.[15] The test results in grades 6 and 9 are very important for the subject grade, whereas the main purpose of grade 3 tests is to gauge if students meet the minimum requirements.[16] We focus on an outcome that captures the average performance of the student across Swedish and mathematics. The model is estimated for all grades combined, as well as separately for the different grade levels.

Figure 4 presents the results. In panel (a), we focus on the results for all grades combined. We can first note that all pre-reform estimates are insignificant which supports the validity of the empirical approach. During the first two years after the introduction of the grant, the effects are small and insignificant. It should be noted, however, that the grant was relatively small in the first years, and it is also not clear if increased teacher resources should be expected to have an immediate effect on test results. Then, there are two years for which we lack data on test results due to the pandemic. After the pandemic, there are still no significant effects on student test results. While the point estimate is positive and relatively large in 2021/22, there is no indication of a lasting effect in 2022/23. Thus, despite the effects on the teacher-to-student ratio that we saw in Figure 1, the results for all grades combined suggest that the relationship between provider index and student test results was unaffected by the Equity grant.

We also estimated the model separately by grade level. In grades 3 (panel b) and 6 (panel c), there are no indications of positive effects. In fact, the 2022/23-estimate for grade 3 is even negative, although the confidence interval is very wide. The estimates in grades 3 and 6 might, however, be driven by small pre-existing negative trends before the introduction of the Equity grant. In grade 9, however, the estimates show that the Equity grant might have pushed the baseline negative relationship between provider index and test scores in a positive direction (i.e. reduced the test score gap between providers with a strong and weak student composition respectively). While the positive estimates in the two latest years are insignificant, they stand out compared to the pre-reform estimates and the early post-reform estimates which are all close to zero. One explanation to why we find indications of positive effects in grade 9, and not in the other grades, could be the class size results from Figure 2, where the clear negative estimates for grade 9 stood out. Thus, providers serving many disadvantaged students might be able to improve test scores if they use the grant money to reduce class size.

[15] In grades 6 and 9, they also take national tests in some additional subjects: English (both grade 6 and 9), Natural Science (only grade 9) and Social Science (only grade 9). We focus on Swedish and mathematics since these tests are consistently available across grades 3, 6 and 9.
[16] Students don't receive subject grades until grade 6.

Figure 4 Effects on the relationship between provider index and student national test results



Note: The figure shows estimates of β_t from Equation (2). Estimation is performed at the student level. The figure includes 95% confidence intervals based on standard errors clustered at the provider level. The outcome variable is defined as the average of Swedish and math test scores. Test scores are standardized by cohort and grade level.

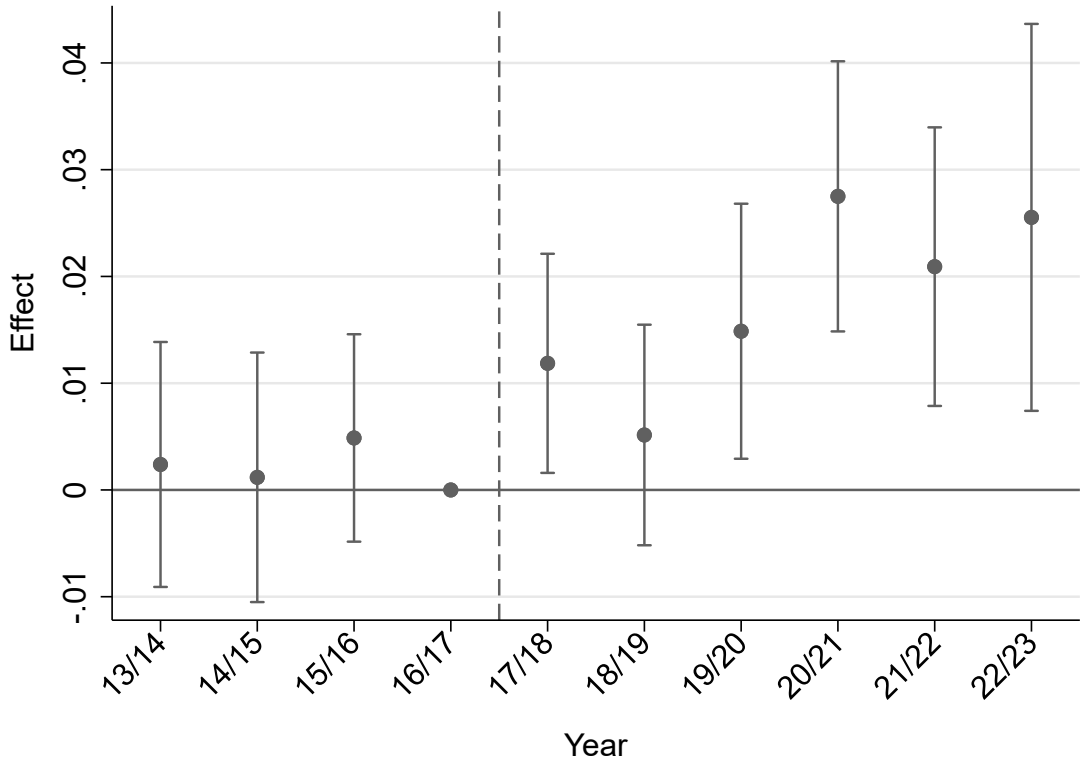
5.2.2 High school eligibility and enrollment

A key outcome at the conclusion of compulsory school is whether the student has sufficient grades to be eligible for high school.[17] Naturally, this outcome is only relevant for grade 9 students. If the student does not satisfy the Pass requirement in Swedish, English, mathematics and at least five other subjects, the student is not eligible to start a high school program.[18] The share of grade 9 graduates eligible for high school has hovered around 85 % during our study period. Hence, it is a margin that is primarily relevant for students in the lower part of the ability distribution. In Figure 5, we study if the difference in this outcome between providers with high and low 2016-index was affected by the Equity grant. The pre-reform estimates are small and insignificant which supports the identifying assumption that the post-reform estimates would have been close to zero in the absence of the reform. Focusing on the post-reform estimates, the results indicate that providers serving students with a weaker socioeconomic background have gained on providers serving more advantaged students as a consequence of the reform. The estimates for the years 2019/20–2022/23 are all highly significant and quite substantial. Note that in 2016/17,

[17] Remember that the construction of the socioeconomic index builds on the high school eligibility variable (see section 2.2).
[18] Students are taught in 17 different subjects.

a 100-step increase in the index was associated with a 17.2 percentage points lower average likelihood of having high school eligibility (see Table 1). In 2022/23, this negative relationship had become about 2.6 percentage points less negative, i.e. a gain of more than 15 %.

Figure 5 Effects on the relationship between provider index and high school eligibility



Note: The figure shows estimates of β_t from Equation (2). Estimation is performed at the student level. The figure includes 95% confidence intervals based on standard errors clustered at the provider level. The outcome variable is defined as a dummy for the student being eligible for high school.

Using data from the *High school student register*, we can further examine if the effects on high school eligibility translates into effects on actual high school enrollment in "real" high school programs, i.e. the so-called academic programs or the vocational programs. Students who are ineligible for high school programs can still be enrolled in so-called introductory high school programs where they get a chance of improving their compulsory school credentials so that they can start a formal high school program at a later stage. For this analysis, we create a dummy that takes the value 1 if the student is enrolled in an academic or vocational program in the fall of the year in which the student graduated from compulsory school. The dummy is defined as 0 if the student was only enrolled in an introductory program or not enrolled at all.

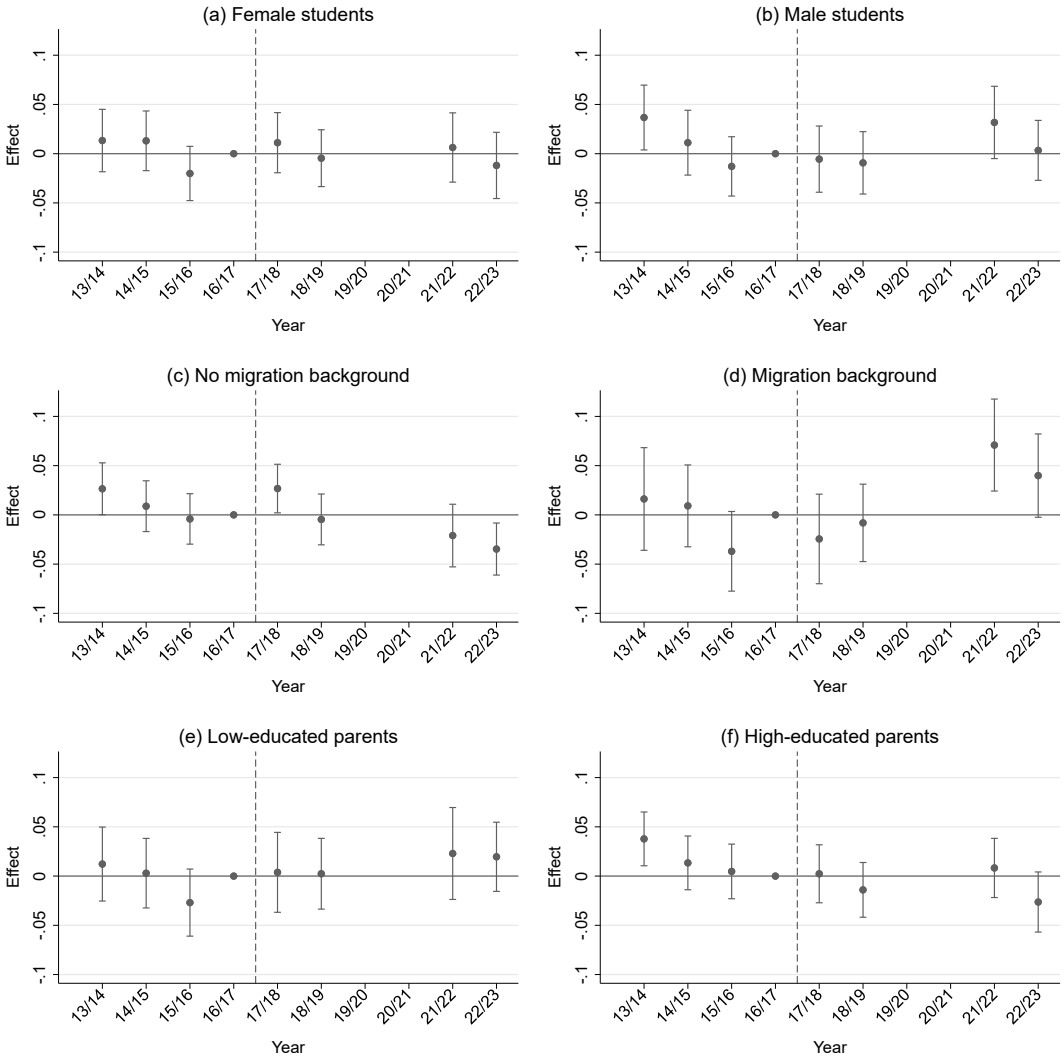
Figure A2 shows the results. As expected, the results are very similar to the eligibility results in Figure 5 which further confirms the finding that, relative to low-index providers, more students from high-index providers participate in high school education following the Equity grant reform.

5.3 Heterogeneous effects

The grant targets education providers with a socioeconomically weaker student composition, and provides additional resources for them. However, even if these providers on average have a weaker student composition, there is still within-provider variation in student characteristics. An important question is therefore whether specific types of students benefit more from additional (teacher) resources. This also relates back to the study of Leuven et al. (2007) who argue that the marginal return to additional compensatory resources can be zero even for disadvantaged students. To gain precision for these heterogeneity analyses, we focus on the national tests in Swedish and mathematics where we can pool results from grades 3, 6 and 9.

Panels (a) to (f) of Figure 6 show results for the effect of the grant on test scores by gender, parents' migration background and parents' educational achievement. While there is clearly no differential effect for male and female students, the results show interesting patterns for migration background and parental education. Panel (d), which restricts the estimation sample to students with at least one foreign-born parent, shows significant effects towards the end of the observation period, suggesting that students with migration background enrolled with high-index providers have gained on students with migration background enrolled with low-index providers. Despite not being significantly different from zero, a similar picture emerges in Panel (e), which shows the effects on test scores for students with low-educated parents. Similarly to students with migration background, the positive point estimates suggest that students of low-educated parents benefit more from the additional resources distributed by the Equity grant. However, we acknowledge that these results are uncertain.

Figure 6 Heterogeneous effects on the relationship between provider index and test scores



Note: The figure shows estimates of β_t from Equation (2). Estimation is performed at the student level. The figure includes 95% confidence intervals based on standard errors clustered at the provider level. The outcome variable is the mean of Swedish and math test scores and we study students in grades 3, 6 and 9.

6 Conclusions

In this paper, we have evaluated the effects of a large compensatory central government grant, the so-called Equity grant, in the Swedish compulsory school system. The grant, which allocates additional funding to education providers (i.e. municipalities and independent providers) according to the socioeconomic composition of students in their schools, was introduced in 2017/2018 and then gradually expanded over the following years. Between 2017 and 2024, the grant increased from SEK 0.5 billion to SEK 7.5 billion per year (the total yearly cost of the Swedish compulsory school system is currently around SEK 150 billion). The grant is scheduled to continue at the current level in the coming years. Using nationwide administrative education

data from the academic years of 2013/14–2022/23, we can follow differences in teacher resources and learning outcomes between providers with weaker and stronger student composition (defined in the last pre-reform year of 2016/17) both before and after the introduction of the Equity grant.

Our results show that the teacher-to-student ratio, which was markedly higher for providers with many disadvantaged students compared to other providers already before the Equity grant, became even more compensatory across providers in the years following the reform. Since the size of the grant was gradually increased, the clearest impact on the teacher-to-student ratio can be seen in the later years. While the data do not allow us to define grade-specific teacher-to-student ratios, we can use the class indicator in the *Student register* to define class size per grade level. Overall, the class size analysis confirms the results from the teacher-to-student ratio analysis, but when we specifically study grades 3, 6 and 9 (for which we have results on national tests) we only find clear and significant effects in grade 9. This result might indicate that providers with a weaker student composition primarily used the additional grant money to strengthen teacher resources in the higher grade levels.

We also studied whether the Equity grant affected the distribution of teacher quality across providers. This analysis is less straightforward, not least because it is hard to define teacher quality. In this paper, we use predicted teacher wages based on teacher qualifications as a quality measure. A teacher with a high predicted wage has qualifications that are highly valued on the teacher labor market and we take this as an indication of quality. Teacher quality among providers with a weaker student composition was on a declining trend relative to providers with a stronger student composition already before the Equity grant and this development continued in the first years after the reform. The diverging pre-trends makes causal interpretations of the post-reform estimates very uncertain, but we do observe a stabilization in the teacher quality differences between providers with high and low socioeconomic index in the later years potentially indicating that the Equity grant helped stop a further deterioration of the teacher quality among providers serving children from weaker socioeconomic backgrounds. Still, relative teacher quality among providers with a weaker student composition was lower in the 2022/23 than in the last pre-reform year of 2016/17, i.e. teacher quantity and teacher quality moved in opposite directions.

Our analysis of learning outcomes is primarily based on results on standardized national tests in Swedish and mathematics in grades 3, 6 (primary school) and 9 (lower-secondary school). Our difference-in-differences model, which controls for detailed current student characteristics, generates insignificant pre-reform estimates supporting the identifying assumption that the estimates after 2016/17 would have been insignificant in the absence of the Equity grant. On average, when we study the three different grade levels combined, we find small and insignificant reform effects on test scores. This finding, which might appear somewhat surprising given the

substantial relative increase in the teacher-to-student ratio among providers serving students with a weaker socioeconomic background, could have at least two potential explanations. First, note that teacher resources were markedly compensatorily allocated across providers already before the Equity grant. The findings might therefore indicate that Sweden had reached a point where marginal effects on test score gaps of making the resource allocation *even* more compensatory were limited. Second, it could be that the relative decrease in teacher quality among providers with a weak student composition, depicted in Figure 3, counteracts any positive impacts of the higher teacher-to-student ratio. In any case, the Equity grant has been unsuccessful in terms of reducing *average* test score differences between providers serving mainly advantaged and disadvantaged students respectively.

However, estimates from grade-specific test score analyses provide a bit more nuance. While we find no indications of reform effects on test score gaps in grades 3 and 6, estimates from grade 9 suggest that providers with a weaker student composition may have had a relative improvement in test scores in the later years (2021/22–2022/23). It is interesting that these effects appear in grade 9, since this is also where we found the clearest effects with respect to class size. A possible interpretation of this link between the teacher resources analyses and the test score analyses is that compensatory resource policies potentially can affect test score gaps if the use of the compensatory funding is concentrated to class size reductions. We also find other indications of that the Equity grant improved the situation for grade 9 students enrolled with providers with a weaker student composition: relative to students enrolled with other providers, we see improvements in the probability of graduating from compulsory school with sufficient grades to be eligible for high school. These results are further corroborated by corresponding estimates for *actual* high school enrollment.

What can we learn from the results? Even though we see some possible reform effects for grade 9 students, our main conclusion is that it is hard and costly, but not impossible, to reduce differences in learning outcomes between education providers serving students from very different socioeconomic backgrounds through compensatory resource allocation policies. We studied a large compensatory grant within the Swedish compulsory school system and found, on average, small and insignificant effects on test scores. This finding is in line with some previous studies (Borgen et al. 2025; Leuven et al. 2007; van der Klaauw 2008), although there are also studies that have found that compensatory resource allocation policies can have an impact on differences in test results between schools (Machin, McNally, and Meghir 2004, 2010). It is not straightforward to explain these differences across studies, but exactly how additional compensatory funding is used could matter. If anything, our results point to the importance of class size reductions in this context.

Importantly, it is worth emphasizing that there is solid evidence that more resources generally improve learning outcomes (e.g. Jackson, Johnson and Persico 2016; Jackson 2020; Jackson and Mackevicius 2024; Krueger 1999; Angrist and Lavy 1999; Fredriksson et al. 2013; Holmlund, McNally and Viarengo 2010; Gibbons, McNally and Viarengo 2018). Thus, if a resource allocation becomes more and more compensatory it is reasonable to assume that gaps in learning outcomes between schools/providers with different socioeconomic student composition at some point will start to decrease. However, our results indicate that such an equalization might come at a substantial cost.

Finally, the fact that we on average find insignificant effects on test scores doesn't necessarily mean that students were unaffected by the reform. The Equity grant undeniably led to a higher teacher-to-student ratio in schools with many disadvantaged students and it is possible that this had a positive influence on outcomes that we cannot capture with our data, e.g. mental health and anti-social behavior.

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Appendix A Additional information

Table A1 Overview of the size of the Equity grant

Grant	2017	2018	2019	2020	2021	2022	2023	2024
Equity grant	0	1	3.5	4.9	6.2	6.55	6.66	7.48
Equality grant	0.5	0.5	0	0	0	0	0	0
Total	0.5	1.5	3.5	4.9	6.2	6.55	6.66	7.48

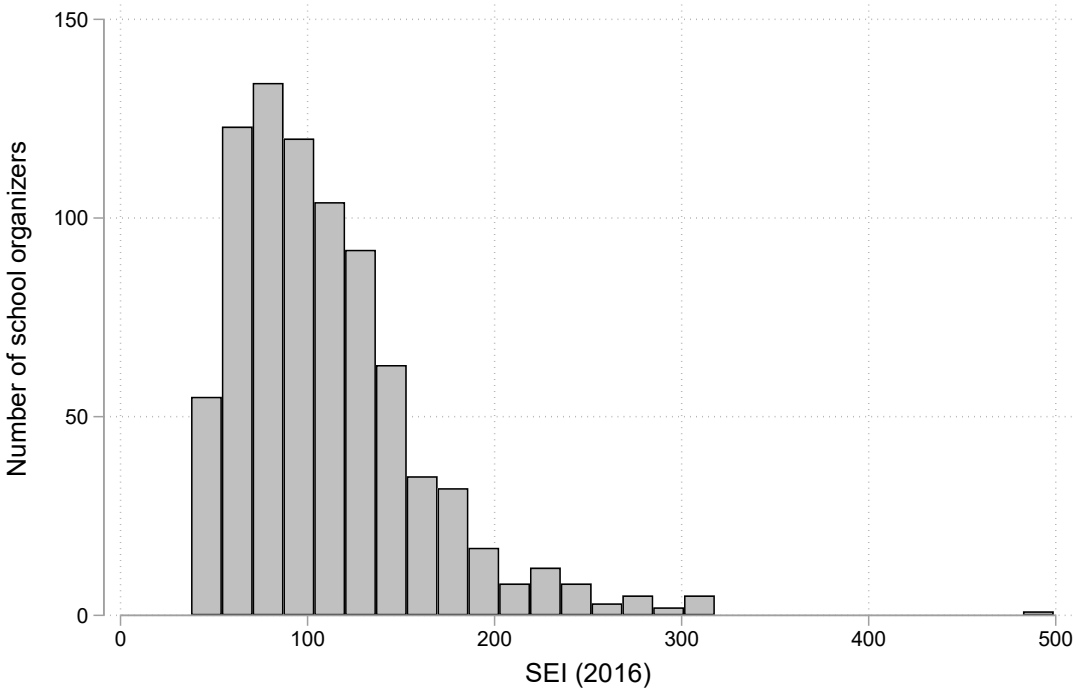
Note: All numbers are in billions of SEK (current prices). The Equality grant was only distributed among the 50 % of the providers with the weakest student composition. All providers are allocated at least some funding from the Equity grant, although the amount is very small for providers serving the most advantaged students.

Table A2 Associations between high school ineligibility and student background variables

	Outcome: High school ineligibility
Female student	-0.0184***
	(0.000965)
Student born abroad	0.105***
	(0.00183)
Parental education 1	0.206***
	(0.00241)
Parental education 2	0.0703***
	(0.00107)
Parental education 4	0.188***
	(0.00476)
Parental income 1	0.131***
	(0.00187)
Parental income 2	0.0723***
	(0.00424)
Parental income 3	0.0662***
	(0.00393)
Parental income 4	0.0691***
	(0.00341)
Parental income 5	0.0481***
	(0.00220)
Parents not living together	0.0431***
	(0.00104)
Number of siblings: 0	0.0108***
	(0.00119)
Number of siblings: 2	0.0101***
	(0.00138)
Number of siblings: 3	0.0335***
	(0.00237)
Number of siblings: 4	0.0686***
	(0.00379)
Number of siblings: 5+	0.111***
	(0.00488)
Constant	0.0343***
	(0.000974)
Observations	381,476
R-squared	0.192
Adj. R-squared	0.188

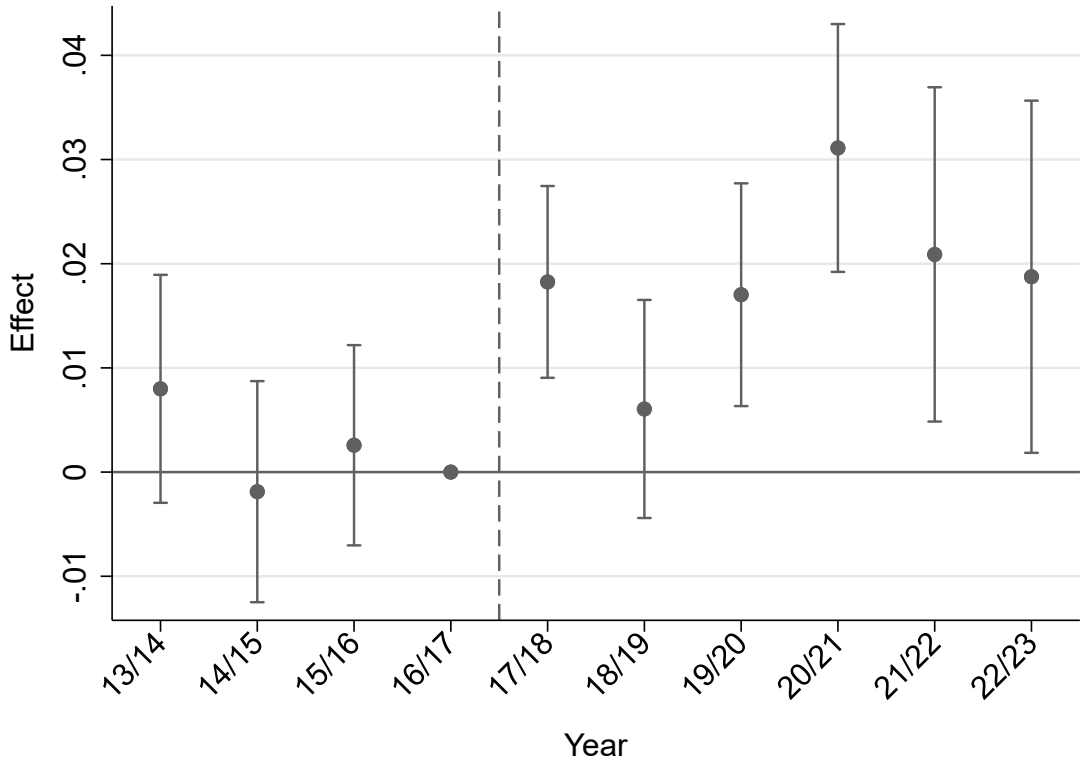
Note: This table shows the coefficient estimates of the prediction model that forms the basis for the socioeconomic index as described in section 3.2. The estimation is based on all students in grade 9 and includes the pre-reform years 2013/14 to 2016/17. The dependent variable is a dummy that takes the value 1 if the student is *not* eligible to continue with upper secondary school directly after grade 9. Parental income groups are defined as the maximum of either parents' income with 1 being defined as income lower than 60 % of the median, 2 between 60 and 80 %, 3 as between 80 and 100%, 4 between 100 and 120 %, and 5 between 120 and 150 %. Incomes higher than 150% of the median serve as the reference group. Parental education is defined as the maximum of either parent's education with 1 being defined as education up to completed compulsory school (9 years), 2 as parents with up to completed upper secondary education, and 4 as missing information about education. Parents with any post-secondary education (more than 12 years in total) serve as the reference group. */**/*** refers to statistical significance at the 10/5/1 percent level. Standard errors are in parentheses.

Figure A1 Distribution of the 2016 education provider socioeconomic index (SEI)



Note: The figure shows the distribution of the 2016-index at the education provider level. One education provider is one observation.

Figure A2 Effects on the relationship between provider index and enrollment in academic or vocational high school programs



Note: The figure shows estimates of β_t from Equation (2). Estimation is performed at the student level. The figure includes 95% confidence intervals based on standard errors clustered at the provider level. The outcome variable is defined as a dummy which is 1 if the student enrolled in an academic or vocational high school program, and 0 if the student is enrolled in an introductory program or no program at all in the year following the last year of compulsory school.