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Book

The value added of Internationella Engelska Skolan

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The Value Added of Internationella Engelska Skolan

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Table of contents

1. Introduction and summary

The Swedish education system lacks rigorous measures of school quality. This is problematic since a well-functioning education market requires that parents make informed school choices. Appropriate performance metrics are also needed for accountability purposes and for ensuring that authorities and operators can identify and rectify problems (Heller Sahlgren and Jordahl 2016).

This report presents the value added of Internationella Engelska Skolan (IES). The value-added scores are based on year 9 national test performance in English, mathematics, and Swedish in the 2018/19 school year, and are computed at the student level using data from Statistics Sweden. Value-added scores measure the extent to which schools' students perform better on national tests in year 9 than what is expected, given their test scores in year 6 as well as their background characteristics.

The value added of IES as a whole is compared with the value added of all municipal schools in Sweden, the value added of other independent schools, and the value added of municipal schools located in municipalities where IES operates.

We find that IES has higher value added in English, mathematics, and Swedish than the municipal-school sector as a whole. This holds true regardless of whether or not we adjust for student background. The difference is marginally smaller when we compare IES to municipal schools in municipalities where IES operates. While the difference between IES and other independent schools is somewhat smaller, it is statistically significant in English and mathematics. The IES advantage is if anything larger among students with low-educated parents, but broadly similar among students with an immigrant background, compared with the average effect.

When using the official grade-point scale, the value added of IES is the largest in mathematics and the smallest in Swedish. However, when focusing on the probability of achieving an A grade, the value added of IES is the highest in English. Notably, there is also a lower probability that IES students have no recorded test scores compared with municipal and other independent schools, again adjusting for prior test scores and background characteristics. If we assume that lower-performing students on average are less likely to take the national tests, this suggests that, if anything, the IES performance advantage we find may be underestimated.

2. Study population and method

The data are obtained from Statistics Sweden and contain information on all students who were registered to take national tests in year 9 in the 2018/19 school year. The value-added scores are calculated at the student level and are presented for IES as a whole.

The value-added scores are based on grade points on the national tests in English, mathematics, and Swedish, using the official scale:

- A 20 points
- B 17.5 points
- C 15 points
- D 12.5 points
- E 10 points
- F 0 points

In section 3.1.2, we also present calculations using an alternative scale, where we assume that the score increases by 2.5 points instead of 10 points when students move from F to E. To do so, we assign F grades 7.5 points instead of 0 points).

However, the unadjusted grade point is not a particularly good measure of school quality. Students with high performance prior to enrolment tend to perform well, regardless of the contribution of any given school. Accordingly, research has demonstrated the importance of adjusting for initial student achievement in order to properly identify schools' value added (Chetty et al. 2014; Deming 2014). We therefore control for students' performance on the national tests in year 6.

Value-added scores are relative, which means that the value added of two schools should be interpreted in relation to each other. As a result, a school where students perform worse in year 9 than they did in year 6 may still have high value added – if the performance of students in other schools have declined even more in the same period. By adjusting for test scores in year 6, we effectively iron out student-level differences in initial performance.

Prior research has demonstrated that initial test scores are sufficient to obtain unbiased estimates of the contributions of teachers and schools to student performance (Chetty et al. 2014; Deming 2014). However, to ensure that our measures capture school quality, we also control for the following background characteristics when calculating the value-added scores:

- Sex
- Age upon arrival to Sweden
- Country of birth (recoded by region)
- The father's country of birth (recoded by region)
- The mother's country of birth (recoded by region)
- Disposable income of the father
- Disposable income of the mother
- The father's level of education (7 categories)
- The mother's level of education (7 categories)

Overall, there are few missing values on the control variables. However, in order to include as much of the population as possible in our analysis, we assign a value of zero to missing observations and include indicators for missing values. Similar methods to deal with missing values in control variables are regularly used in education research (Falck and Woessmann 2013; Hanushek et al. 2013).

We calculate the value-added scores using regression analyses, following the method utilized by Holmlund et al. (2019). In essence, the scores are obtained by taking the difference between students' actual grade points on the tests in year 9 and the grade points that we predict using their test performance in year 6 and background variables. Further information on the background variables and the regression analyses are reported in Appendix A.

In section 3, we report the value-added scores of IES created using our main specification, followed by scores created using alternative model specifications in section 4.

3. Value-added scores

In section 3.1, we compare the value added of IES with that of other schools in Sweden and then compare value-added scores among students from less advantaged backgrounds in section 3.2.

3.1 How does IES perform compared with other schools?

In this section, we compare IES as a whole with (i) all municipal schools, (ii) other independent schools, and (iii) all municipal schools in the municipalities where IES operates. We present calculations based on both the official grade-point scale (in section 3.1.1) and calculations based on an alternative scale where the score increases by 2.5 points instead of 10 points between grades F and E (in section 3.1.2). We also present value-added measures based on the probability of achieving an A–C grade on the tests (in section 3.1.3) and on the probability of achieving an A grade (in section 3.1.4).

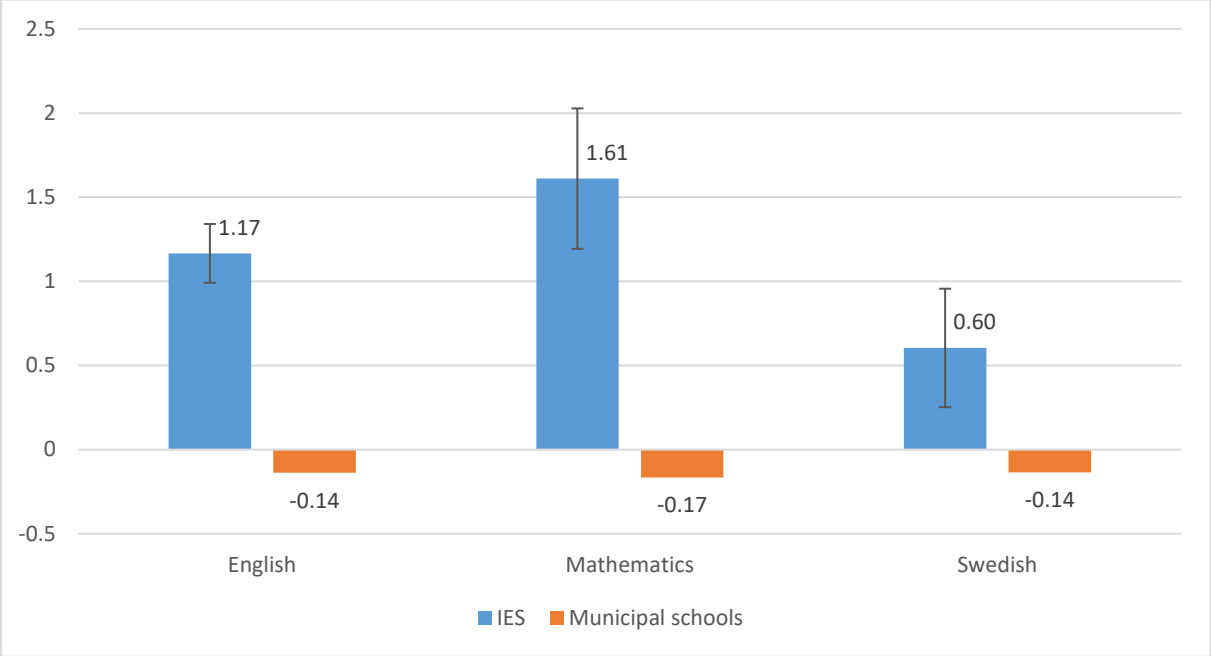
3.1.1 The value added of IES according to the official grade-point scale

Figure 1 demonstrates that IES has higher value added on national tests in grade 9 compared with municipal schools overall. The difference is the largest in mathematics and the smallest in Swedish, but it is statistically significant in all three subjects. IES raises its students' test scores by about 1.6 grade points in mathematics, 1.2 grade points in English, and 0.6 points in Swedish, whereas municipal schools have a small negative effect in all three subjects.[1] In terms of value added, IES thus has a sizable advantage over the municipal sector as a whole. In mathematics, the advantage corresponds to 64 percent of one grade, calculated from E and above, or 16 percent of the grade-point difference between F and E.[2] Compared with the total variation in IES and the municipal sector, the advantage of IES in mathematics corresponds to 39 percent of a standard deviation in value added at the student level.

[1] The calculations include students who follow the syllabus for Swedish as a second language. The results are very similar if we exclude those students from the calculations.

[2] The reason is that F grades translate into 0 points, E grades into 10 points, D grades into 12.5 points, C grades into 15 points, B grades into 17.5 points, and A grades into 20 points on the official scale.

Figure 1. The value added of IES compared with municipal schools

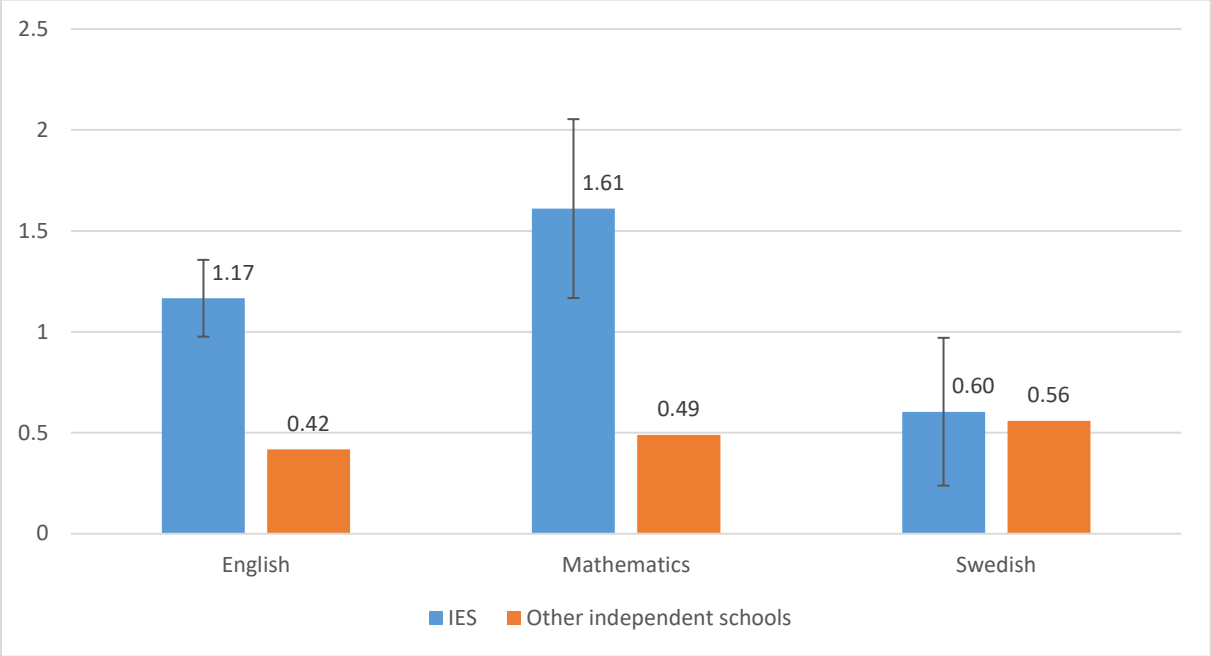


Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year. For each subject, the error bar displays the margin of error of the difference between IES and the other schools when statistical uncertainty is taken into account (at a 95% confidence level).

Figure 2 compares IES with other independent schools in Sweden (i.e. *friskolor* in Swedish). IES has higher value added on average than other independent schools in mathematics and English, but not in Swedish. Notably, other independent schools also have positive value-added scores, unlike the municipal schools in figure 1.

The IES advantage in mathematics corresponds to 45 percent of one grade from E and above, or 11 per cent of the grade-point difference between F and E. Compared with the total variation among students in independent schools, the mathematics advantage of IES corresponds to 29 percent of a standard deviation in value added at the student level.

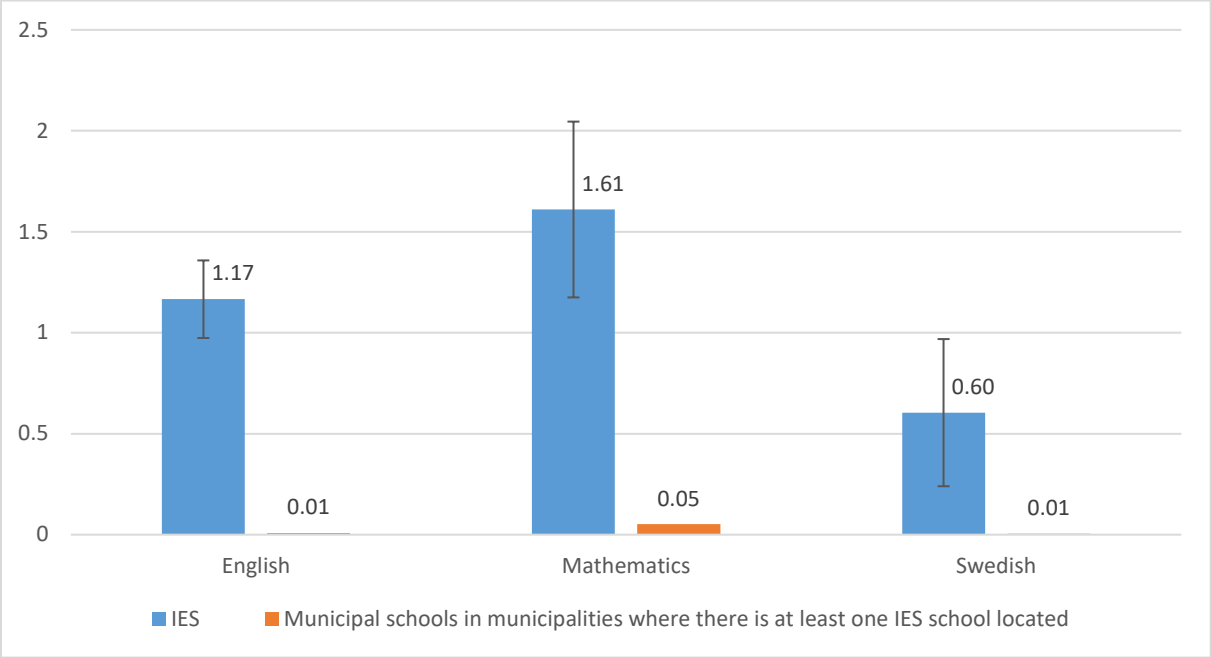
Figure 2. The value added of IES compared with other independent schools



Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year. For each subject, the error bar displays the margin of error of the difference between IES and the other schools when statistical uncertainty is taken into account (at a 95% confidence level).

Finally, figure 3 compares IES with municipal schools in municipalities where IES operates. The figure demonstrates that the municipal schools in these municipalities have slightly higher value added than the national average. Nevertheless, the advantage of IES remains statistically significant in all three subjects.

Figure 3. The value added of IES compared with municipal schools in municipalities where IES operates



Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year. For each subject, the error bar displays the margin of error of the difference between IES and the other schools when statistical uncertainty is taken into account (at a 95% confidence level).

3.1.2 The value added of IES with an alternative grade-point scale

In this section, we report the same comparisons as in section 3.1.1, but using an alternative grade-point scale where the step between an F grade and an E grade is considered equally large as the steps between the other grades. We construct such a scale by changing the grade point for an F from 0 to 7.5. Our alternative scale is therefore the following:

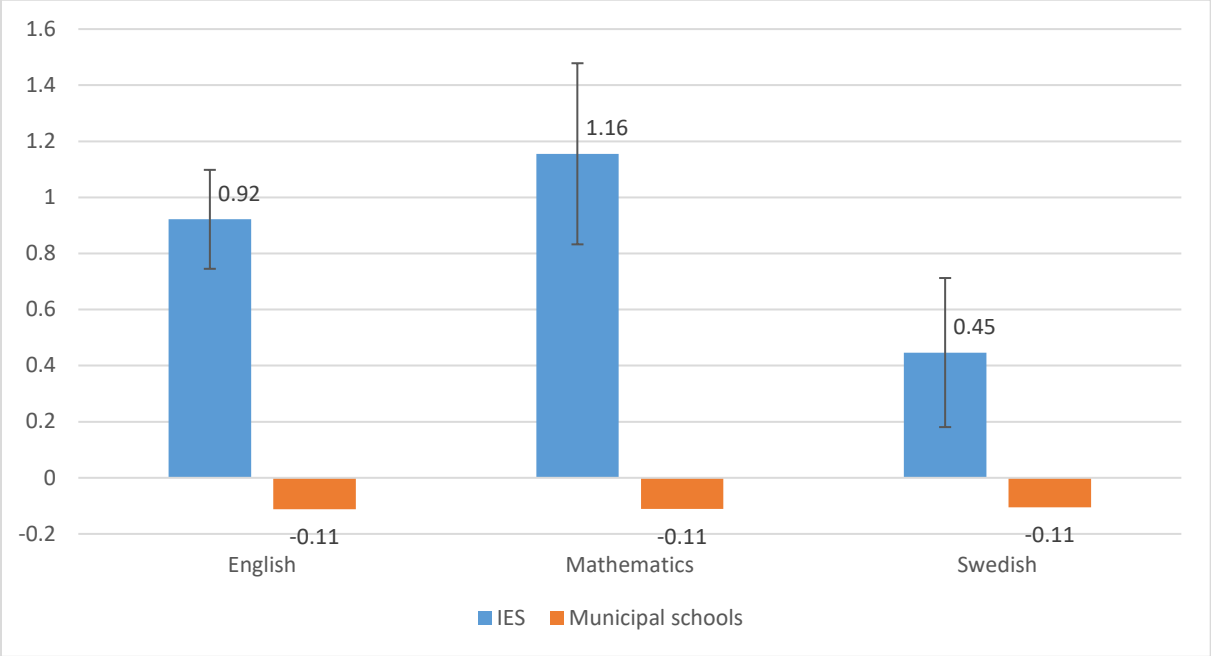
- A 20 points
- B 17.5 points
- C 15 points
- D 12.5 points
- E 10 points
- F 7.5 points

The reason for using the alternative grade-point scale is that there is a risk that students at the lower end of the grade distribution dominate value-added measures based on the official grade-point scale. This is due to the fact that moving from F to E converts into a grade-point increase as large as for students moving from E to A. Our alternative grade-point scale provides more information on schools' value added across the entire grade distribution. Comparing schools' value added using both scales also enables us to study in more detail where in the grade distribution schools have their largest effects.

Figures 4–6 show the value added of IES compared with municipals schools using the alternative grade-point scale. Qualitatively, the results are similar to those in section 3.1.1. IES still has higher quality than municipal schools, although the differences are somewhat smaller with the alternative grade point scale. However, this is expected since the alternative grade point-scale automatically reduces the variation in value added, as F now equals 7.5 points instead of 0 points. When expressed as the share of the total variation in value added at the student level, the IES advantage is of similar size when using both grade-point scales. The exception is in mathematics, where the effect size is slightly larger with the alternative grade-point scale.

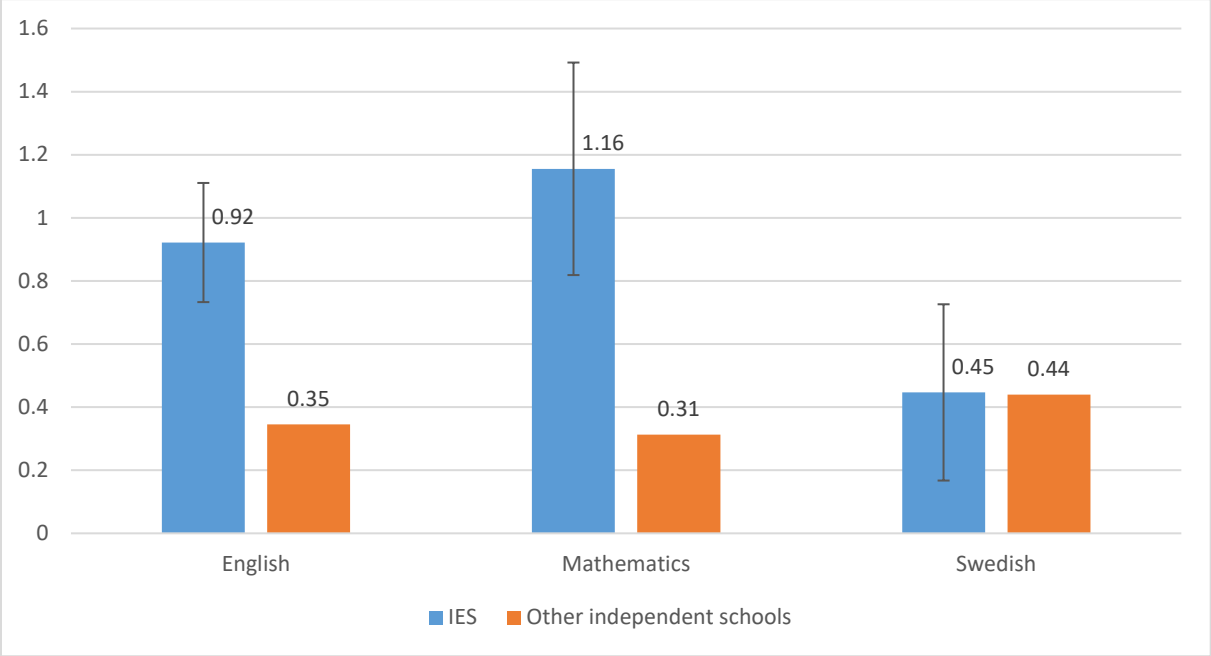
Taken together, the value-added measures presented in section 3.1.1 and 3.1.2 indicate that IES provides higher-quality education compared with other schools.

Figure 4. The value added of IES compared with municipal schools, using the alternative grade point scale



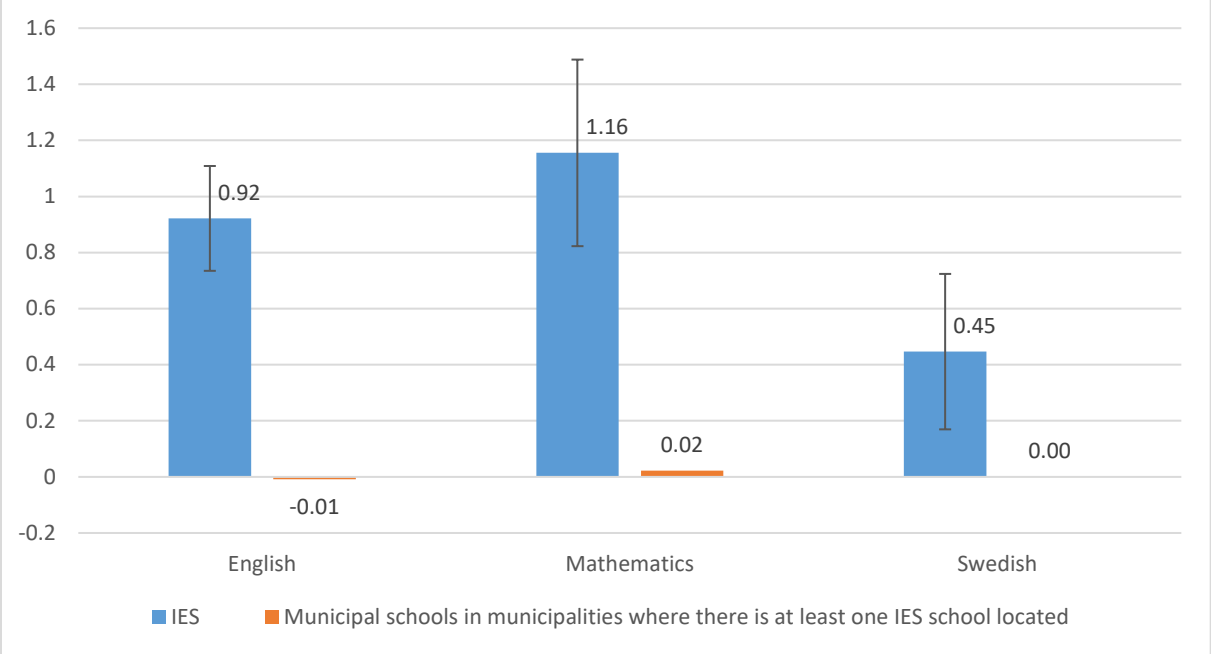
Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year. For each subject, the error bar displays the margin of error of the difference between IES and the other schools when statistical uncertainty is taken into account (at a 95% confidence level).

Figure 5. The value added of IES compared with other independent schools, using the alternative grade-point scale



Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 academic year. For each subject, the error bar displays the margin of error of the difference between IES and the other schools when statistical uncertainty is taken into account (at a 95% confidence level).

Figure 6. The value added of IES compared with municipal schools in municipalities where IES operates, using the alternative grade-point scale



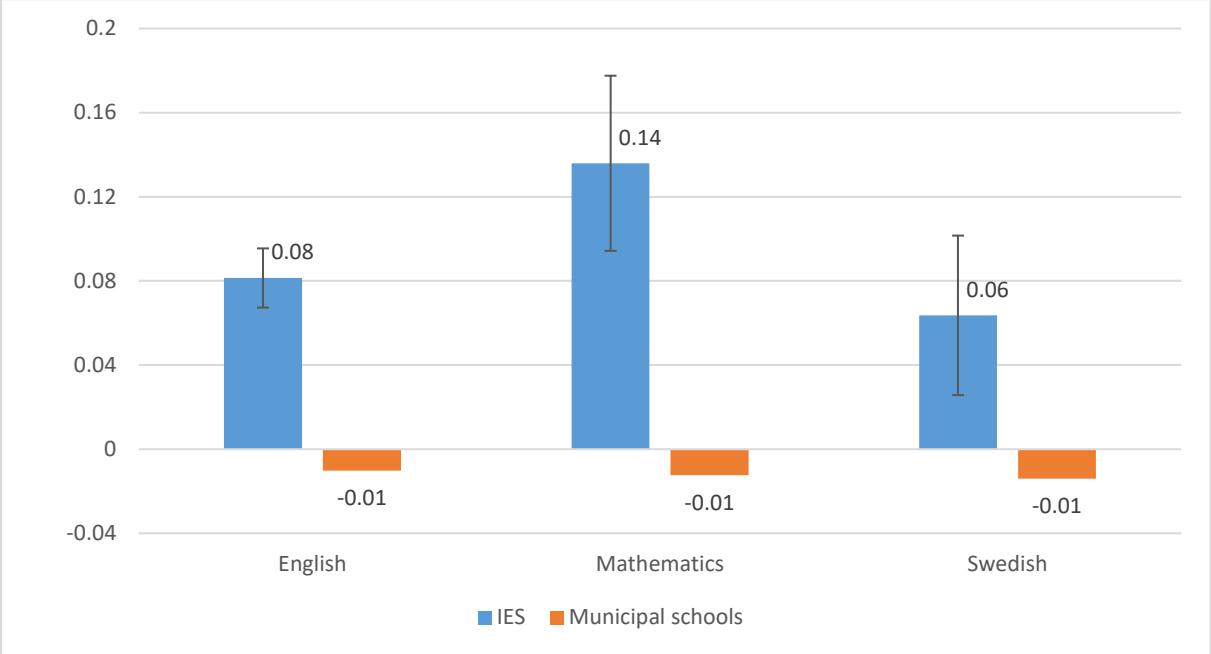
Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year. For each subject, the error bar displays the margin of error of the difference between IES and the other schools when statistical uncertainty is taken into account (at a 95% confidence level).

3.1.3 The value added of IES based on the probability of achieving an A–C grade

The results in the previous section suggests that the IES advantage is not merely due to the construction of the official grade-point scale, where the step from F to E translates into a grade-point increase of 10. This also suggests that the IES effect is not merely due to improvements among low-performing students. To study this further, we compute value-added scores based on an indicator for whether or not students achieve an A–C grade on the national tests in year 9. In other words, we study whether the probability of achieving an A–C grade differs between IES and other schools, once we adjust for background variables and prior achievement. In this case, the latter is estimated using an equivalent indicator for whether or not students achieved an A–C grade on the national tests in year 6.

Figure 7 shows that IES performs better than municipal schools also in this respect. Again, the IES effect is the largest in mathematics and the smallest in Swedish, with a statistically significant difference in all three subjects. An IES education raises the probability of achieving an A–C grade on the national tests in year 9 by between 6 and 14 percentage points. Relative to the overall variation in the value-added scores, the IES effect is very similar compared to the model specification using the official grade-point scale in section 3.1.1. The exception is the impact in English, which is somewhat smaller when analyzing the A–C indicator.

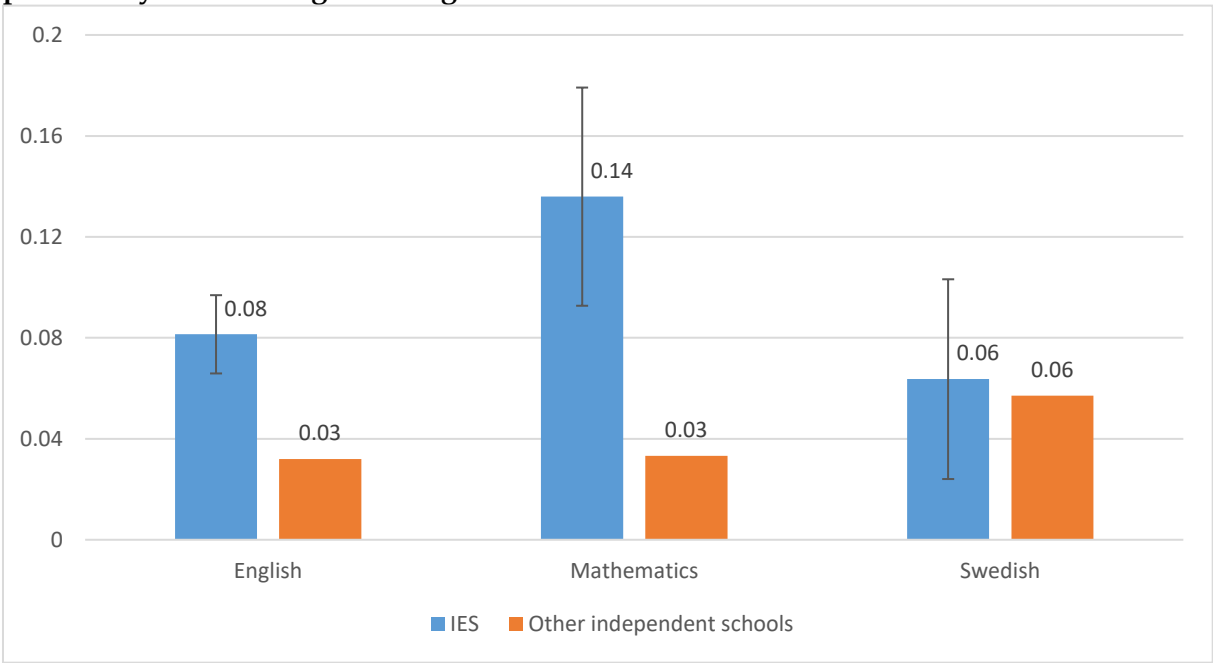
Figure 7. The value added of IES compared with municipal schools, based on the probability of achieving an A–C grade



Note: The bars show the student-weighted value added in terms of the probability of achieving an A–C grade on national tests in year 9 in the 2018/19 school year. For each subject, the error bar displays the margin of error of the difference between IES and the other schools when statistical uncertainty is taken into account (at a 95% confidence level).

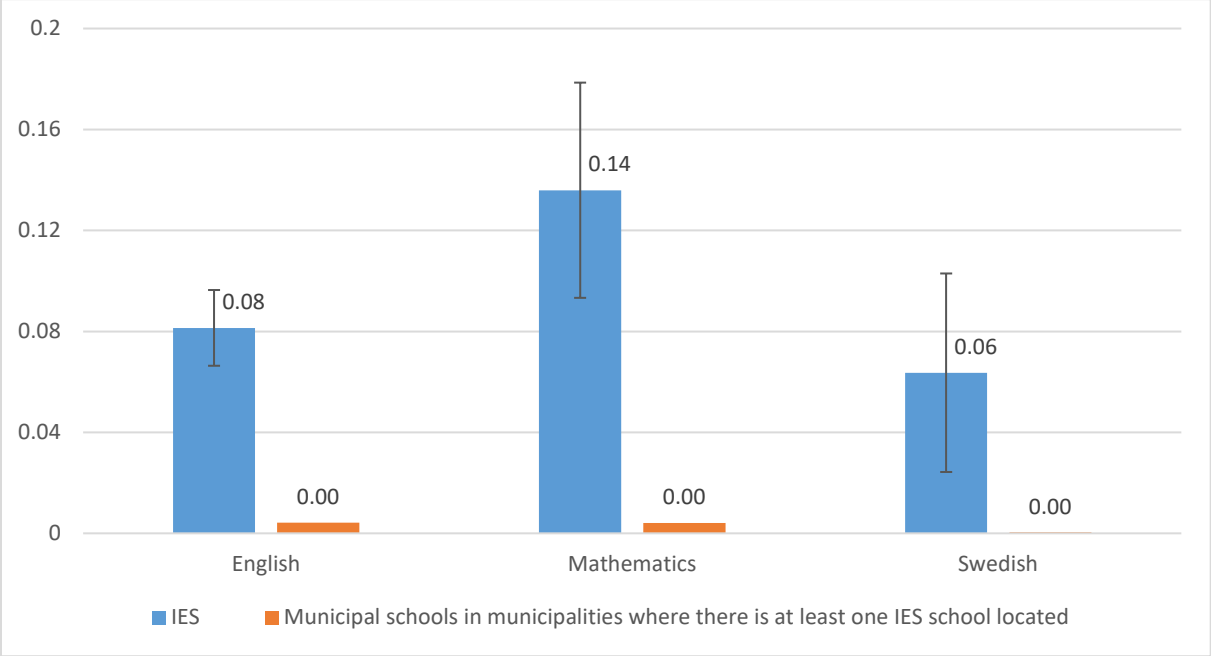
Figures 8 and 9 show that IES also has higher value added compared with other independent schools as well as municipal schools in municipalities where IES operates. As in previous model specifications, the exception is that the difference in Swedish compared with other independent schools is not statistically significant.

Figure 8. The value added of IES compared with other independent schools, based on the probability of achieving an A–C grade



Note: The bars show the student-weighted value added in terms of the probability of achieving an A-C grade on national tests in year 9 in the 2018/19 school year. For each subject, the error bar displays the margin of error of the difference between IES and the other schools when statistical uncertainty is taken into account (at a 95% confidence level).

Figure 9. The value added of IES compared with municipal schools in municipalities where IES operates, based on the probability of achieving an A–C grade



Note: The bars show the student-weighted value added in terms of the probability of achieving an A–C grade on national tests in year 9 in the 2018/19 school year. For each subject, the error bar displays the margin of error of the difference between IES and the other schools when statistical uncertainty is taken into account (at a 95% confidence level).

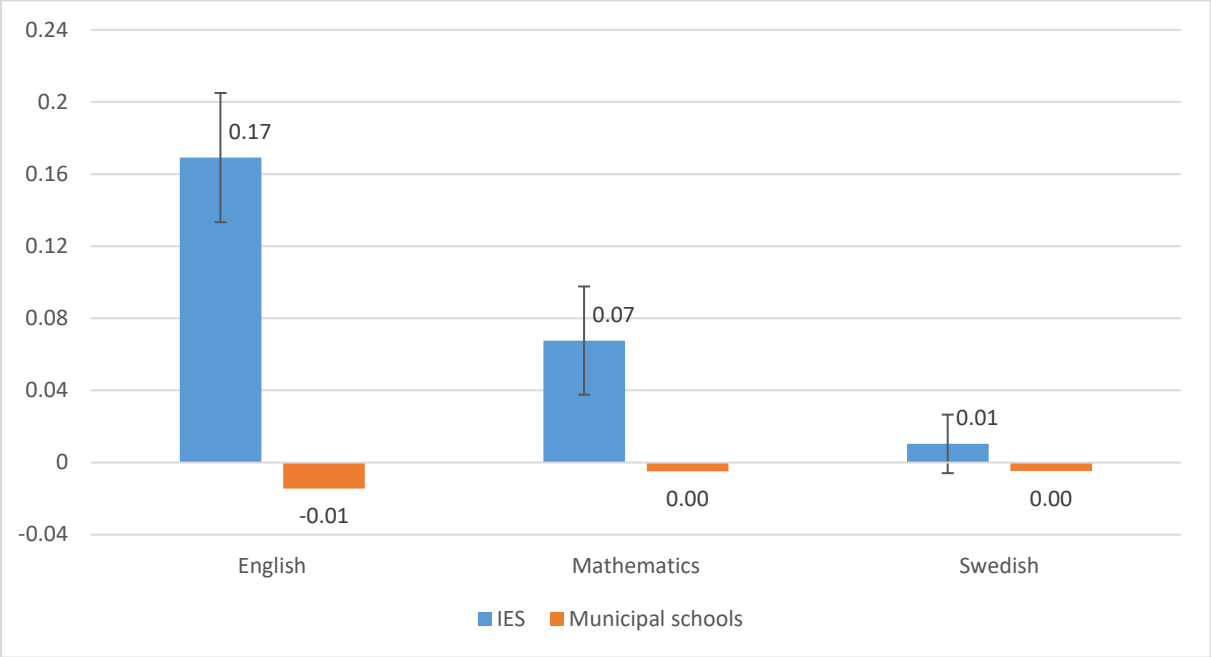
3.1.4 The value added of IES based on the probability of achieving an A grade

In order to analyze the contribution of IES at the very top end of the grade distribution, we also compute value-added scores based on an indicator for whether or not students achieve an A grade on the national tests in year 9. In other words, we study whether the probability of achieving an A grade differs between IES and other schools, once we adjust for background variables and prior achievement. In this case, prior achievement is captured by an equivalent indicator for whether or not students achieved an A grade on the national tests in year 6.

The results display a somewhat different picture compared with our previous findings. As displayed in figures 10–12, the IES impact is the largest in English, while there are no statistically significant differences in Swedish. Nevertheless, the differences in English and mathematics are statistically (and qualitatively) significant.

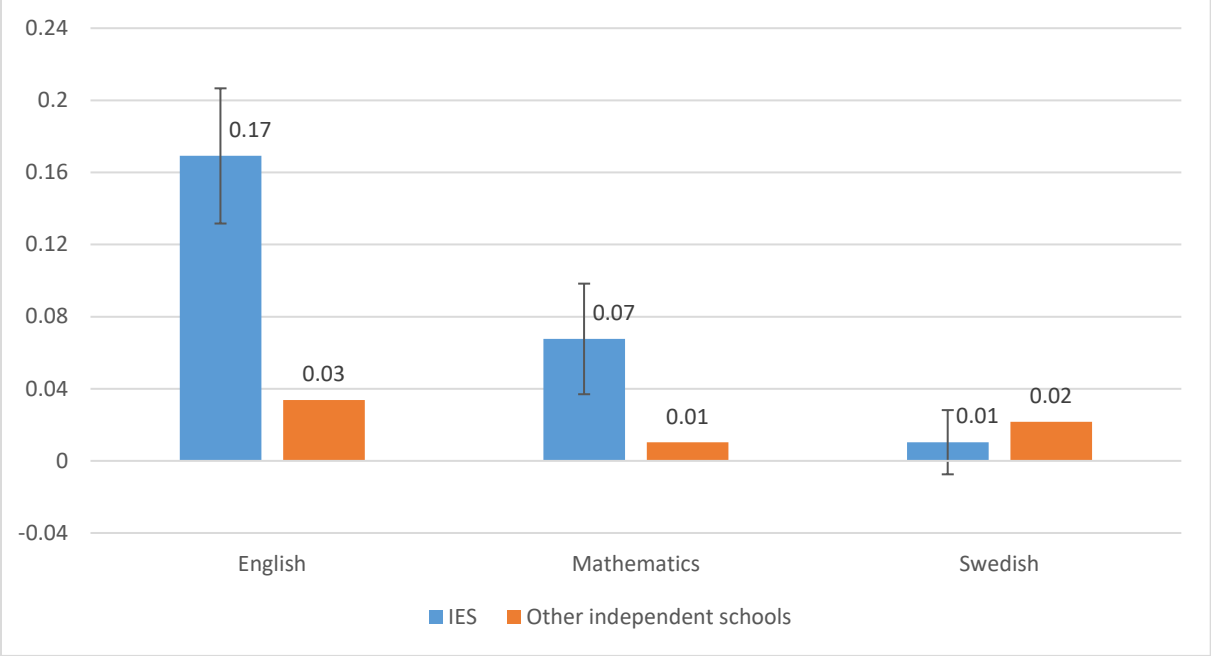
Although it may be expected that a bilingual IES education produces excellent results in English, this exercise illustrates the importance of studying differences at the top of the grade distribution, rather than focusing only on the official grade-point scale.

Figure 10. The value added of IES compared with municipal schools, based on the probability of achieving an A grade



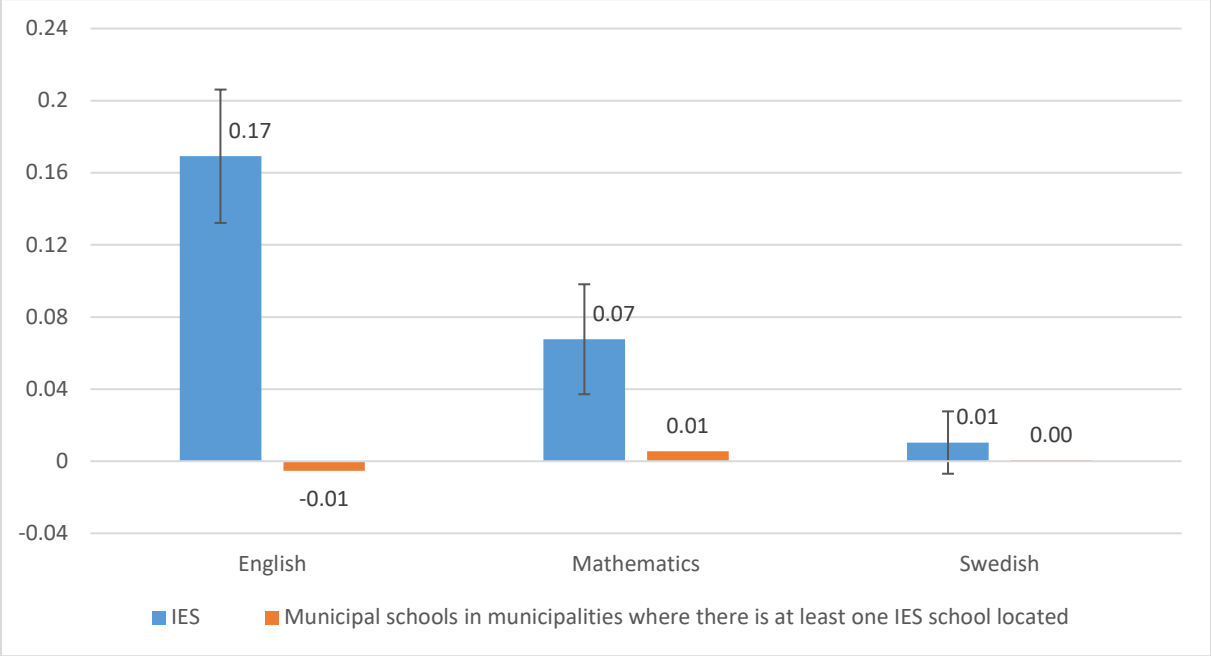
Note: The bars show the student-weighted value added in terms of the probability of achieving an A grade on national tests in year 9 in the 2018/19 school year. For each subject, the error bar displays the margin of error of the difference between IES and the other schools when statistical uncertainty is taken into account (at a 95% confidence level).

Figure 11. The value added of IES compared with other independent schools, based on the probability of achieving an A grade



Note: The bars show the student-weighted value added in terms of the probability of achieving an A grade on national tests in year 9 in the 2018/19 school year. For each subject, the error bar displays the margin of error of the difference between IES and the other schools when statistical uncertainty is taken into account (at a 95% confidence level).

Figure 12. The value added of IES compared with municipal schools in municipalities where IES operates, based on the probability of achieving an A grade



Note: The bars show the student-weighted value added in terms of the probability of achieving an A grade on national tests in year 9 in the 2018/19 school year. For each subject, the error bar displays the margin of error of the difference between IES and the other schools when statistical uncertainty is taken into account (at a 95% confidence level).

3.2. Value-added scores among students from less advantaged backgrounds

Does an IES education benefit students from more disadvantaged backgrounds more or less than the average student? To investigate this, we aggregate the value-added scores from our main model at the school level only among students with (1) low-educated parents, defined as those with less than a three-year upper-secondary education, corresponding to parents in the 10th percentile in 2019. We also aggregate the value-added scores from our main model at the school level only among students with (2) an immigrant background, defined as students who are either born abroad (or have no birth country registered), or have two parents born abroad (or have no birth country registered).

The results are displayed in Figures B1–B6 in Appendix B, which suggest that the effect of attending an IES school is somewhat larger among students with low-educated parents than on average, although the estimates naturally become less precise. Meanwhile, among students with an immigrant background, there is little difference compared with the average effect overall, although the advantage in mathematics and Swedish vis-à-vis municipal schools in municipalities where IES operates is slightly smaller in absolute terms. However, also these estimates are less precise.

Overall, the results thus suggest that IES, if anything, benefits students with low-educated parents more than other students, while broadly having the same impact among immigrant students as non-immigrant students.

4. Value-added scores from alternative model specifications

In addition to the main specification presented in section 3.1.1, we have also calculated value-added scores using alternative model specifications. The results from these models provide further information on the robustness of the main specifications. Here, we discuss the results from the alternative models briefly, and include figures with detailed results in Appendix B.

In section 4.1, we present the results from models that exclude background controls. Section 4.2 contains the results from models that adjust for whether or not a student attended the same school in years 6 and 9. In section 4.3, we present results from models that control for non-linear functional forms of the national test scores in year 6.

All alternative model specifications generate very similar results to the main specification presented in section 3.1.1.

4.1 Excluding background controls

In the first alternative model specification, we exclude student-background controls from the value-added calculations. One reason for excluding background controls is to ensure that the value-added scores capture the entire change in test performance, irrespective of background, compared with what would be predicted given students' prior achievement. On the other hand, an important reason for including background variables is that they indeed affect student progress between years 6 and 9, regardless of prior achievement. In addition, prior test scores are measured with error, as some students may have had an exceptionally bad or good day when taking the national tests in year 6, and this problem can be reduced by including background controls.

When excluding background controls, IES and other independent schools obtain slightly higher value added in all three subjects. As in section 3.1.1, the performance advantage of IES compared with other schools is statistically significant, except for the difference in Swedish between IES and other independent schools. These comparisons are presented in figures B7–B9 in Appendix B.

4.2 Adjusting for whether or not students attended the same school in year 6

Some students attended different schools in years 6 and 9, and it is possible that their performance is affected by the school change as such. It is also possible that schools with

year-group configurations that allow students to attend the school in both years 6 and 9 mark the national tests differently compared with other schools.

To examine if such issues affect the value-added comparisons, we adjust for a variable indicating whether or not students attend the same school in years 6 and 9. All IES schools have configurations covering both years 6 and 9, so no year 9 students had to attend another school in year 6 for structural reasons.

Figures B10–B12 in Appendix B present the same comparisons as in section 3.1.1, but adjusted for the above-mentioned indicator. The absolute value added of IES is reduced slightly, but the differences compared with all municipal schools and other independent schools are almost unaffected. The differences compared with municipal schools in municipalities where IES operates are reduced by up to 23 percent, but all differences that are statistically significant in section 3.1.1 remain statistically significant at the five percent level.

4.3 Models accounting for non-linear functional forms of prior test scores

We have also varied the functional form of the regression model by including different polynomials of prior test scores in year 6. A reason for doing so is that the grading scale creates "floor and ceiling effects," since it is impossible to get a lower grade than F or a higher grade than A.

We present comparisons between IES and other schools when adjusting for prior test scores using a quadratic functional form in figures B13–B15 in Appendix B. The results are almost identical to the linear model specification in section 3.1.1. We have also calculated the value-added scores using cubic and quartic functional forms. These model specifications also produce similar results compared with the linear model specification in section 3.1.1.

5. Missing observations

Because of absences, for example due to illness, all students do not sit the national tests in year 9. In addition, test results are not always reported to Statistics Sweden. Missing values in these respects may to some extent be seen as an alternative measure of school quality: for example, few missing observations may signal that a school is well structured, as it ensures that most students show up on the test day (and that all scores are reported to Statistics Sweden, in accordance with the regulations). However, most importantly for our purposes, missing values risk biasing the value-added scores. For example, if there are relatively more poorly performing students missing in IES schools, the value-added scores are likely to be biased in their favor. On the other hand, if there are relatively fewer poorly performing students missing in IES schools, the measures may be biased against IES.

We have analyzed whether the probability of having no recorded test scores in year 9 differs between IES and other schools, after adjusting for prior achievement and background

characteristics. It turns out that there is a lower probability that IES students have no reported test scores in English and mathematics compared with municipal and other independent schools. If anything, therefore, the value-added advantage we find in these subjects are more likely to be biased against IES than in its favor (given the widely held fear that results of poorly performing students are less likely to be reported). In Swedish, the differences between IES and other schools are small and statistically insignificant. Detailed results are presented in figures C1–C3 in Appendix C.

6. Concluding remarks

This report has demonstrated that IES provides higher school quality – measured as the value added on national tests in English, mathematics, and Swedish in year 9 – than other Swedish schools on average. IES outperforms municipal schools in all three core subjects by a statistically significant margin, and other independent schools in English and mathematics. While IES performs higher than other independent schools in Swedish as well, this difference is not statistically significant. The IES advantage is if anything larger among students with low-educated parents, but broadly similar among students with an immigrant background, compared with the average effect.

In addition, in English and mathematics, there is a lower probability that IES students have no recorded test scores, after adjusting for prior achievement and background characteristics, thus decreasing the risk that differential non-response biases our findings in favor of IES. The lower probability of having no test score reported may also be seen as measure of school quality in itself.

Certainly, a potential problem threatening the validity of the reported value-added scores is that the national tests are not marked externally – and there is no external moderation of the scores either. Hence, the results may be partly due to differences in marking standards.

Yet, while it is impossible to account for this entirely, such differences are likely to be relatively small in this report. First, value-added measures tend to reduce problems with lenient marking, as they effectively pick up conditional student progress across years. Furthermore, the findings are robust to including an indicator for whether or not students took the national tests in years 6 and 9 in the same school, which to a large extent adjusts for the possibility that schools with certain year-group configurations may have different incentives to mark the tests in year 6 leniently.

Second, the IES effect in mathematics does not deviate considerably from the IES effect in English and Swedish. Test scores in mathematics are generally more comparable between schools, since teachers have fewer degrees of freedom in their marking. It is therefore noteworthy that the average value-added difference in the favor of IES is in fact the largest in mathematics. Still, while the problems that arise with internal marking appears to be manageable in this case, it is impossible to rule them out entirely, and future value-added calculations would consequently benefit from being based on externally marked tests.

Another weakness of our analysis is that the value-added measures are only based on test scores in grade 9 from a single year. Including additional years would reduce the uncertainty of the calculations and would also enable researchers to analyze the development of school quality over time.

Finally, we would like to stress the importance of credible and comparable measures of school quality. Although not without their weaknesses, value-added scores are superior to most other measures of quality, especially average student grades or test scores, and could aid several actors in the education system for different purposes: (1) students and parents in their school choices, (2) schools and teachers in their quality work and professional development, and (3) authorities in their attempts to hold schools accountable for their performance.

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Appendix A. Study population and method

The study population consists of students who were registered to take national tests in year 9 in the 2018/19 school year. Our measures of school quality are based on student performance on national tests in English, mathematics, and Swedish in years 6 and 9, obtained from the National Agency for Education (*Elevregistret*). Table A1 contains a more detailed description of the background variables and their sources.

Table A1. Background variables

Variable	Description	Source
Sex	Legal sex according to the Population Register, where 1=man and 2=women.	Statistics Sweden, Total Population Register
Age upon arrival to Sweden	Most recent immigration year minus year of birth. Individuals without an immigration year are assigned the value −1.	Statistics Sweden, Total Population Register and own calculations
Country of birth	Grouped by region, 11 categories: Sweden, Nordic countries except Sweden, EU28 except the Nordic countries, Europe except EU28 and the Nordic countries, Africa, Asia, North America, Oceania, South America, Soviet Union, Stateless, Unknown.	Statistics Sweden, Total Population Register
Country of birth of the father	Grouped by region, 11 categories, same categories as Country of birth.	Statistics Sweden, Total Population Register
Country of birth of the mother	Part of the world, 11 categories, same categories as Country of birth.	Statistics Sweden, Total Population Register
Disposable income of the father	Disposable income, three-year average of the father.	Statistics Sweden, Income and Taxation Register
Disposable income of the mother	Disposable income, three-year average of the mother.	Statistics Sweden, Income and Taxation Register
Education of the father	The father's level of education, in 7 categories: Primary and lower secondary education, less than 9 years; Primary and lower secondary education, 9 years; Upper secondary education, less than 3 years; Upper secondary education, 3 years; Post-secondary education, less than 3 years; Post-secondary education, 3 years or longer; Postgraduate education.	Statistics Sweden, Register on Participation in Education
Education of the mother	The mother's level of education. Same categories as Education of the father.	Statistics Sweden, Register on Participation in Education

When calculating schools' value added, we follow Holmlund et al. (2019, p. 215–217) and estimate the following regression model:

$$P_{is}^{åk9} = \alpha P_{is}^{åk6} + \boldsymbol{\beta X_i} + \mu_s + \varepsilon_{is}$$

where $P_{is}^{åk9}$ is the grade point on the 2019 year 9 national test in English, mathematics or Swedish of student *i* in school *s*, while $P_{is}^{åk6}$ is the corresponding grade point for the same student on the national tests in the same subject in year 6. The background variables in Table A1 are included in the vector $\boldsymbol{X_i}$. The equation also contains a school effect, μ_s, and an error term, ε_{is}. We cluster the standard errors at the school level. The value added of school *j* according to this model is:

$$FV_j = \frac{1}{n_j} \sum_{i\ om\ s=j} \left(P_{is}^{åk9} - \left(aP_i^{åk6} + \boldsymbol{bX_i} \right) \right),$$

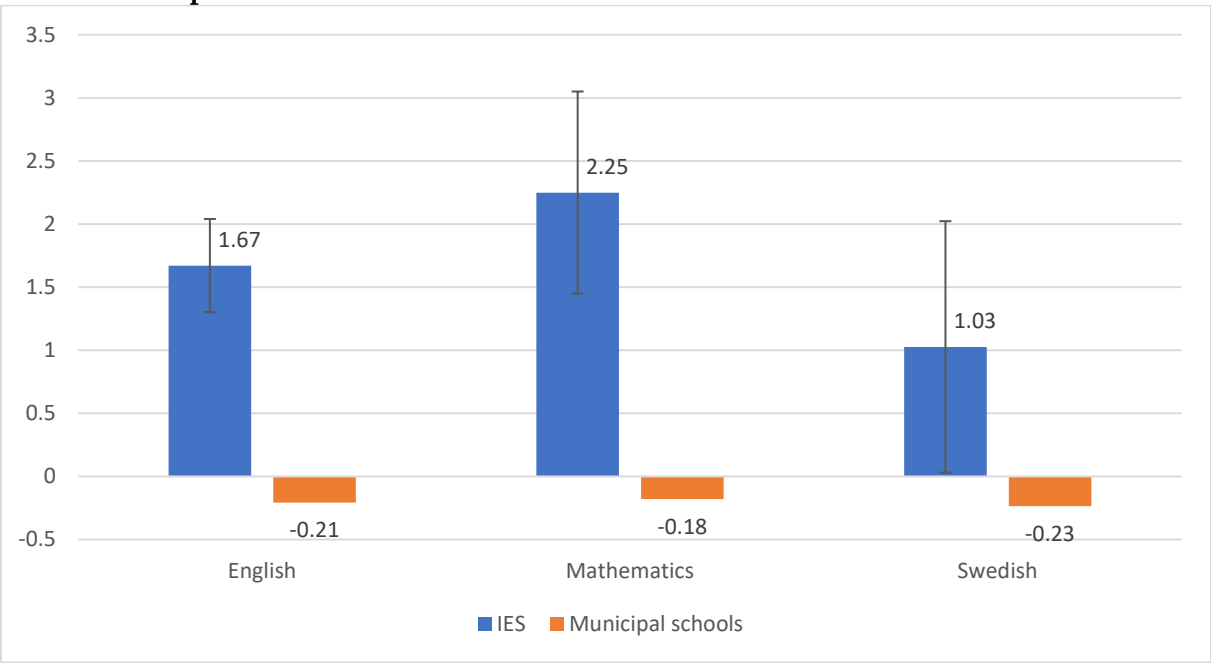
where n_j is the number of students in school *j*. In each subject, students with year 9 test scores are included in the calculations. We deal with missing values on the background variables and the test scores in year 6 by imputing such observations with 0 and including dummies for missing values.

Appendix B. Heterogeneous effects and alternative specifications

In this appendix, we present the results from the models analyzing heterogeneous effects discussed in section 3.2, and from the alternative model specifications discussed in section 4.

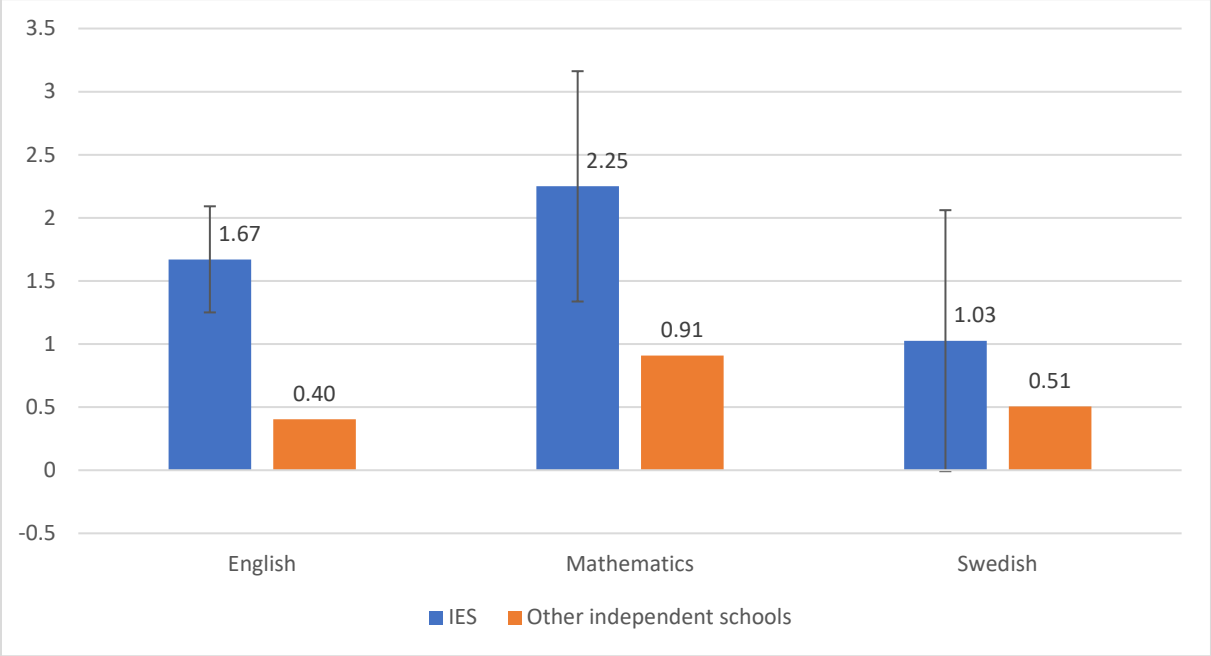
Heterogeneous effects

Figure B1. The value added of IES compared with municipal schools among students with low-educated parents



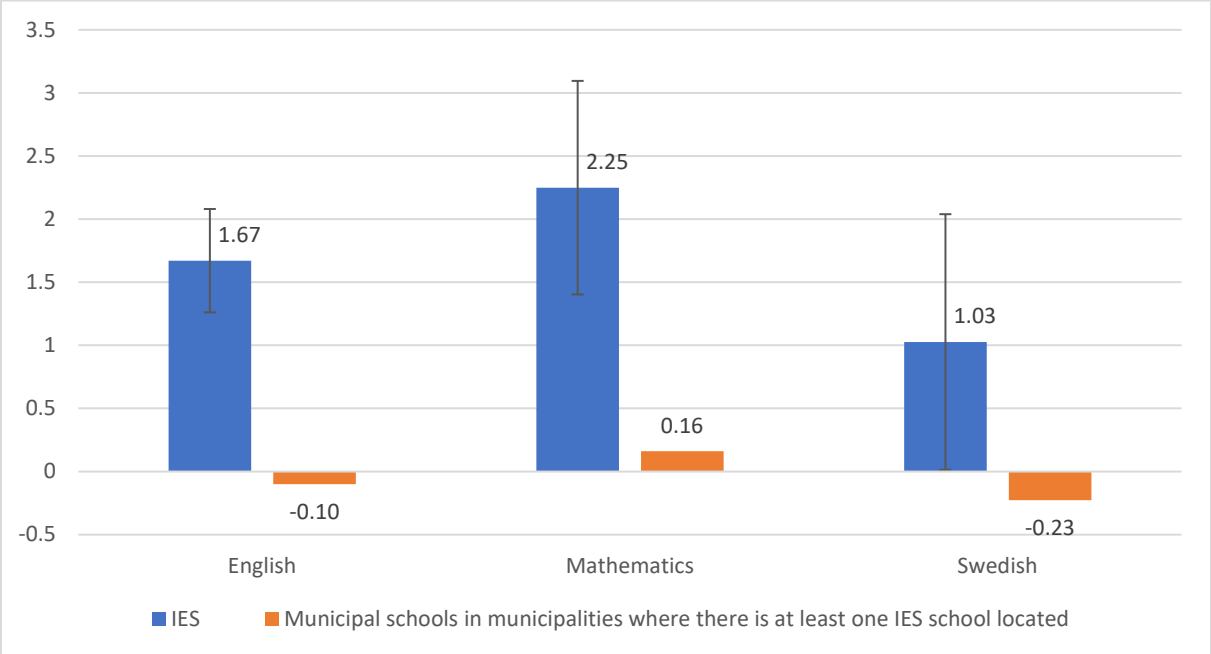
Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year, among students with low-educated parents. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

Figure B2. The value added of IES compared with other independent schools among students with low-educated parents



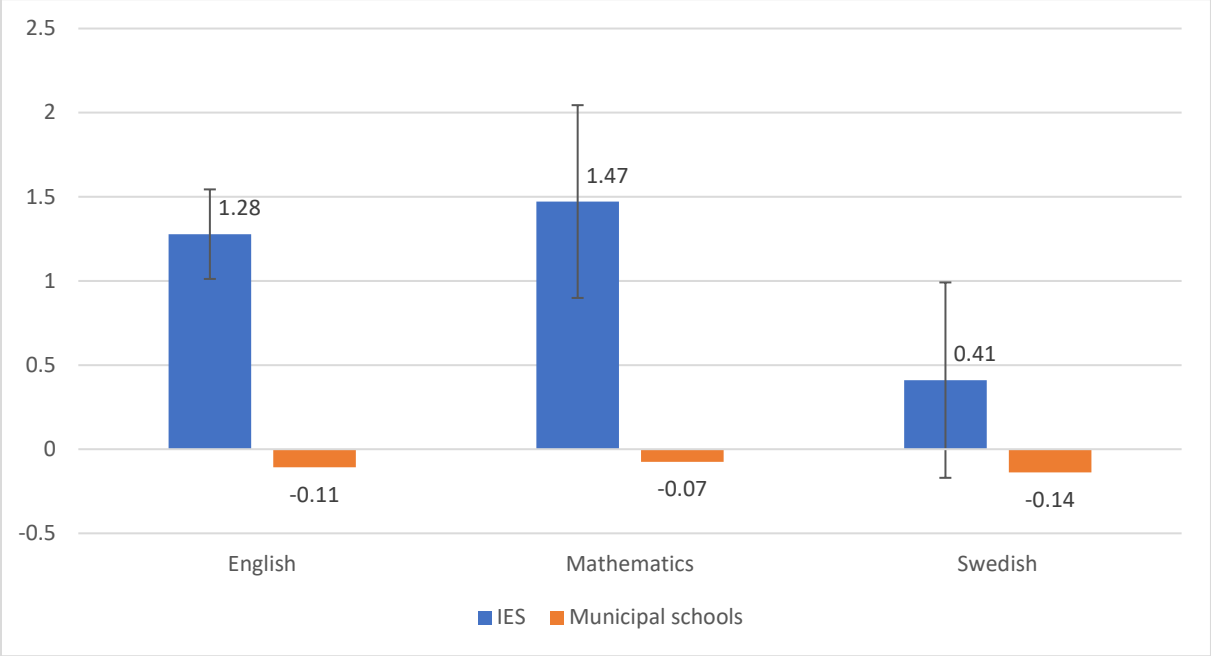
Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year, among students with low-educated parents. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

Figure B3. The value added of IES compared with municipal schools in municipalities where IES operates among students with low-educated parents



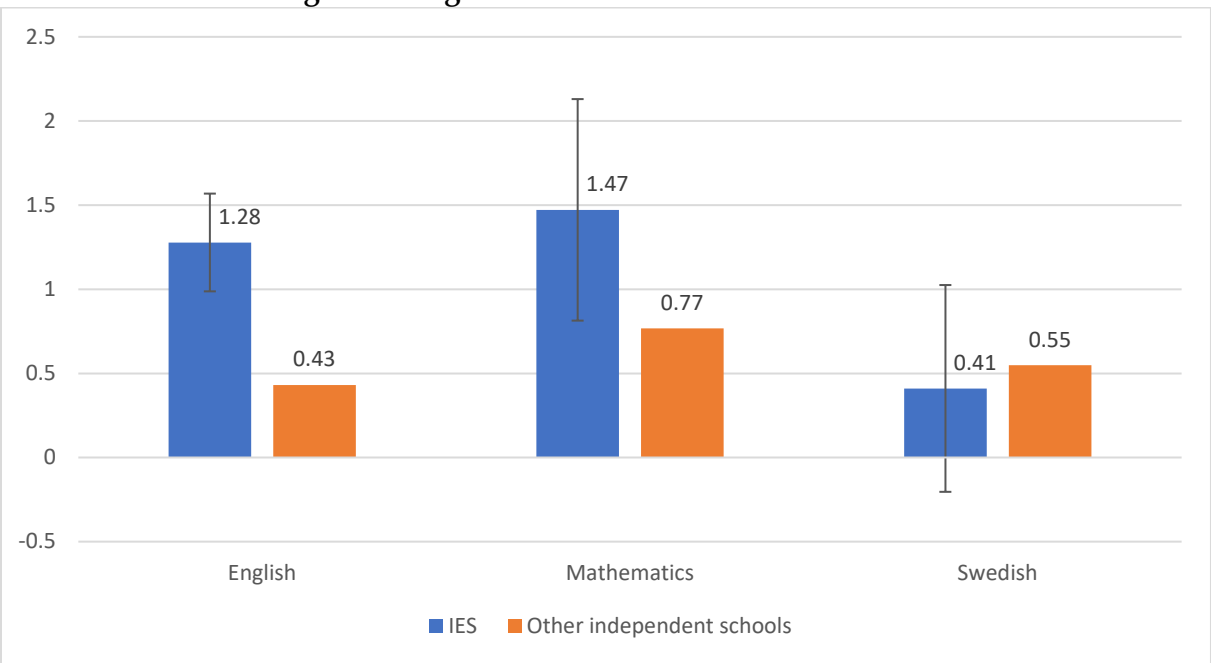
Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year, among students with low-educated parents. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

Figure B4. The value added of IES compared with municipal schools among students with an immigrant background



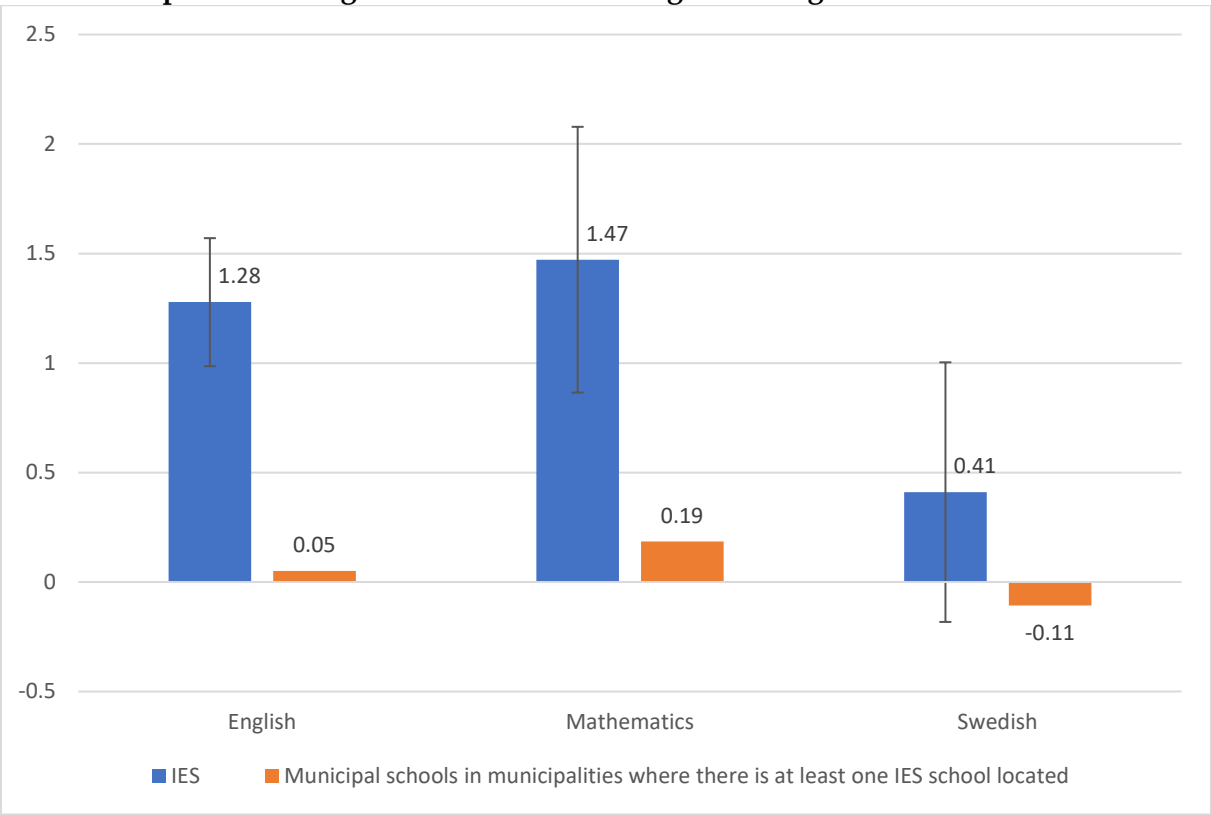
Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year, among students with an immigrant background. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

Figure B5. The value added of IES compared with other independent schools among students with an immigrant background



Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year, among students with an immigrant background. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

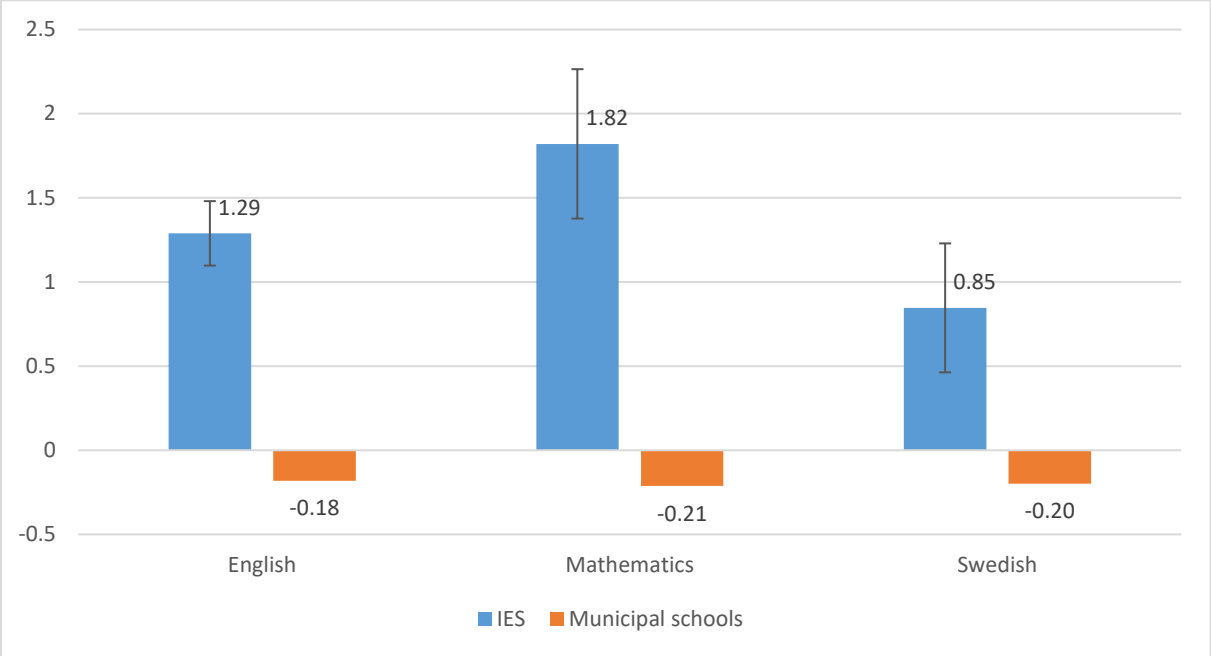
Figure B6. The value added of IES compared with municipal schools in municipalities where IES operates among students with an immigrant background



Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year, among students with an immigrant background. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

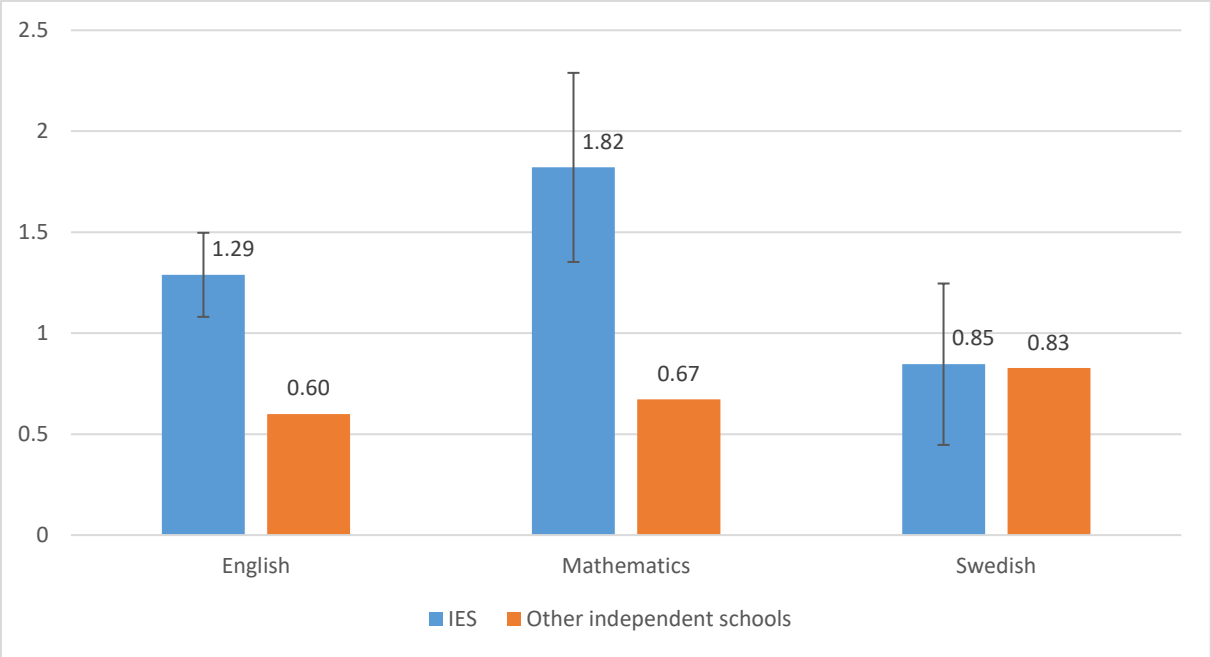
Alternative model specifications in section 4.1

Figure B7. The value added of IES compared with municipal schools, excluding background controls



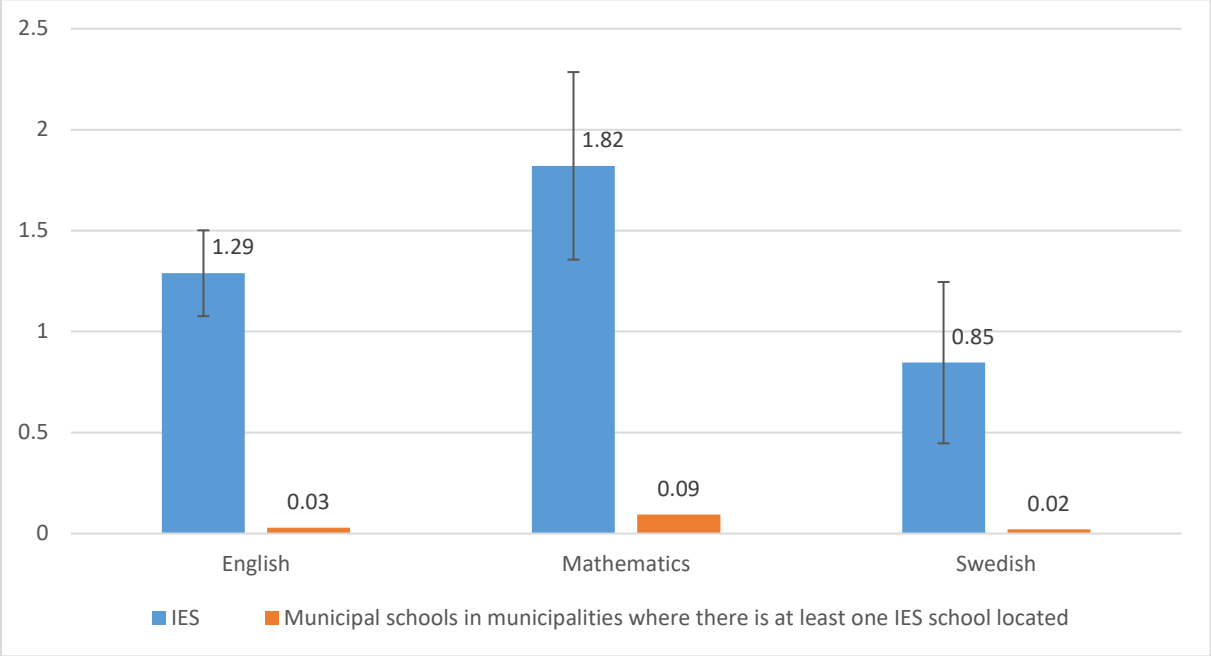
Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

Figure B8. The value added of IES compared with other independent schools, excluding background controls



Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

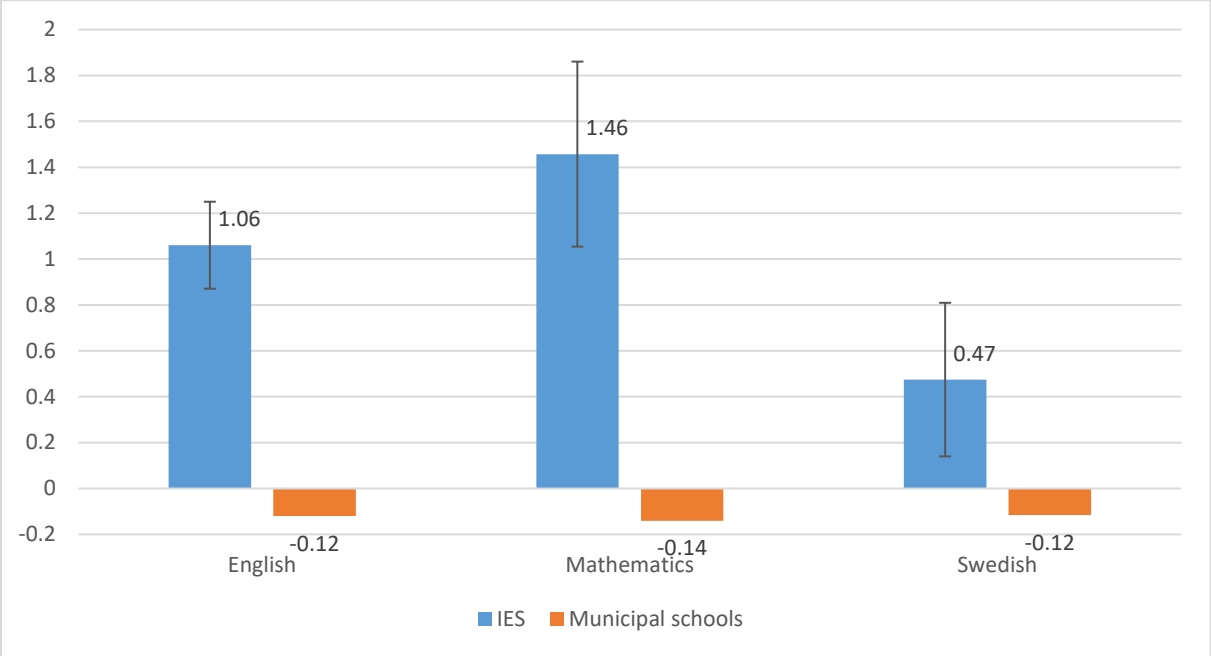
Figure B9. The value added of IES compared with municipal schools in municipalities where IES operates, excluding background controls



Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

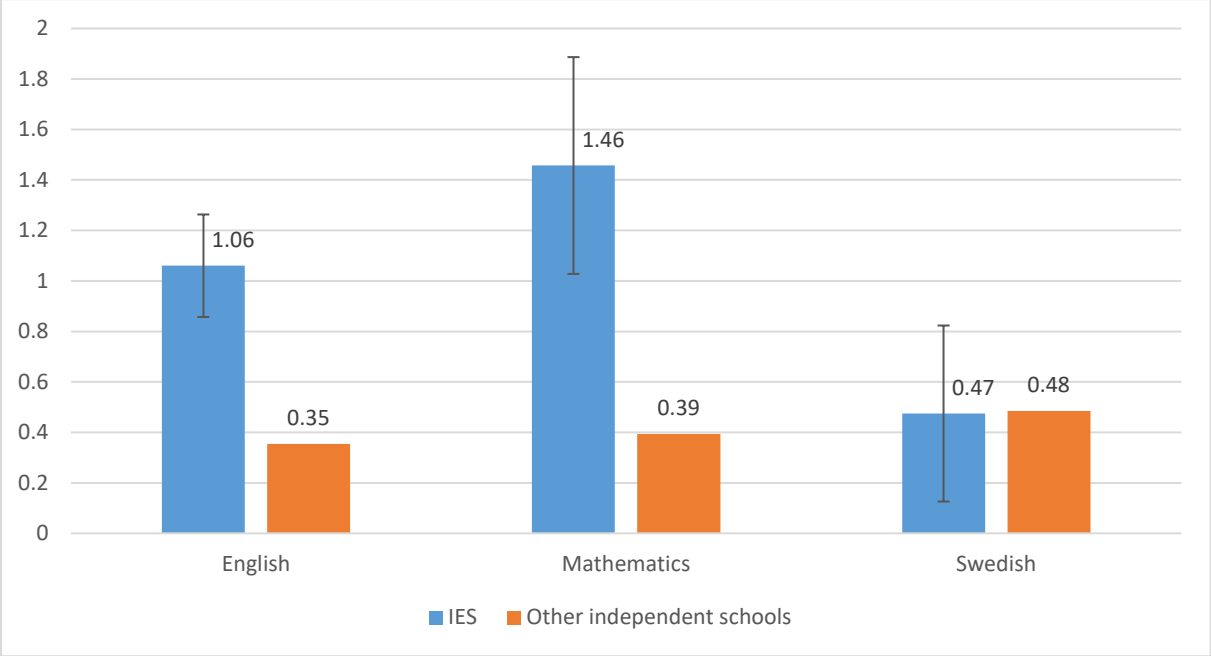
Alternative model specifications in section 4.2

Figure B10. The value added of IES compared with municipal schools, adjusting for whether students attended the same school in year 6



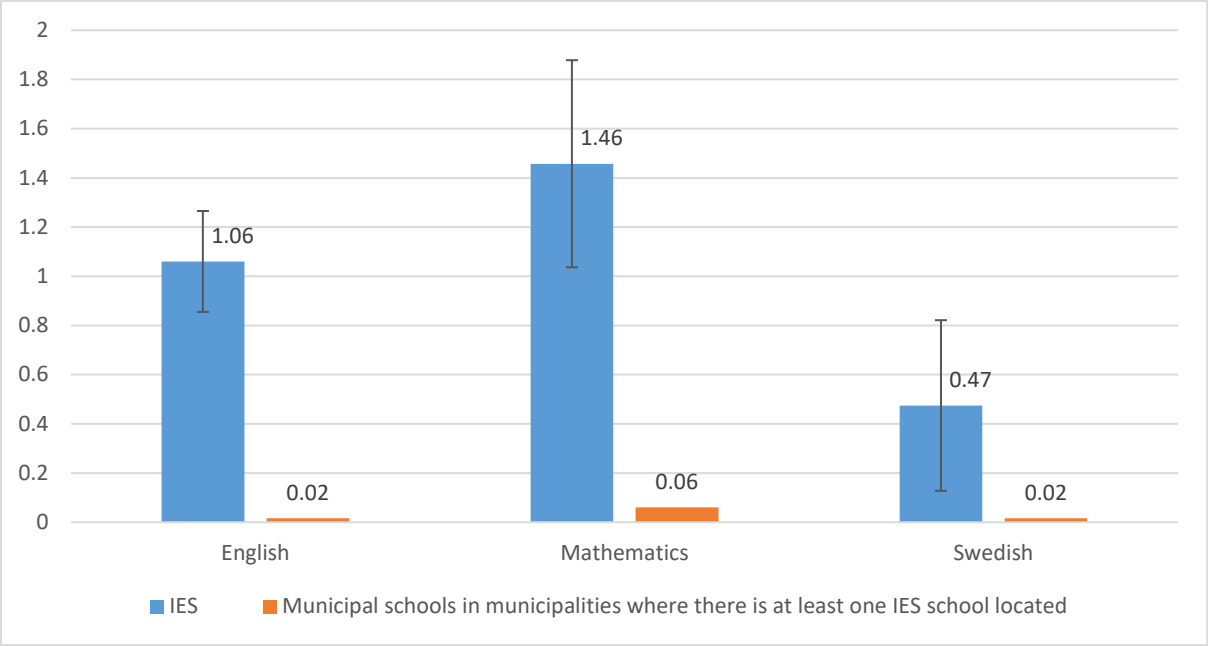
Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year, adjusting for an indicator for whether or not the student took the national tests in year 6 and 9 in the same school. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

Figure B11. The value added of IES compared with other independent schools, adjusting for whether students attended the same school in year 6



Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year, adjusting for an indicator for whether or not the student took the national tests in year 6 and 9 in the same school. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

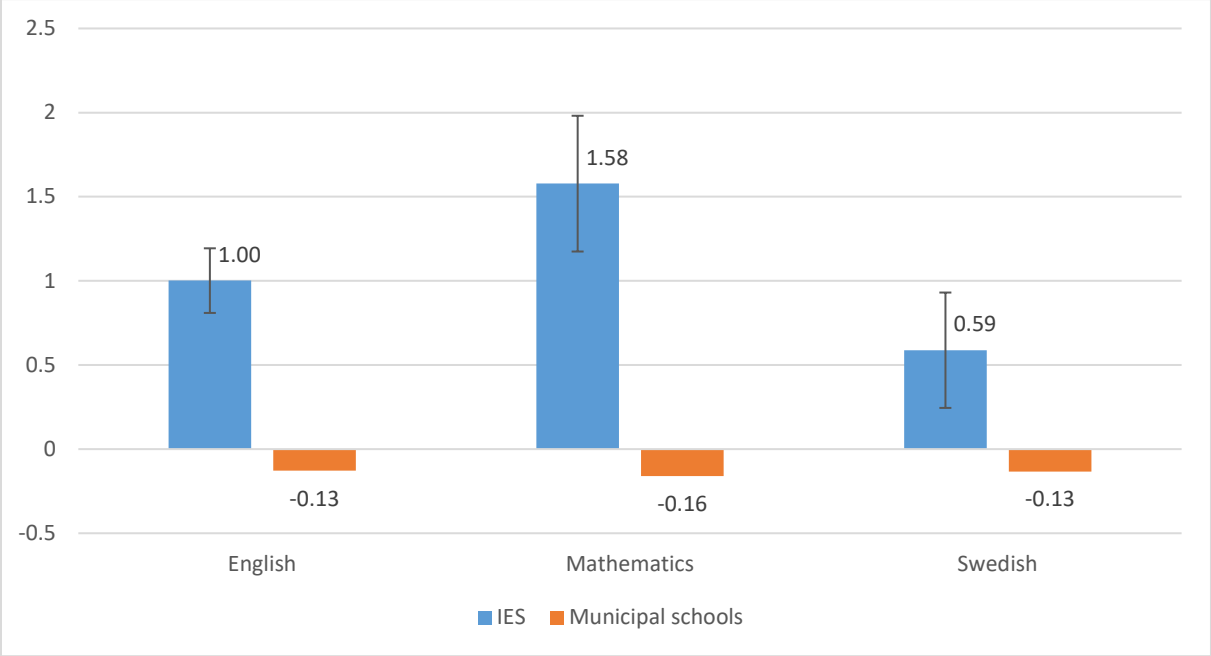
Figure B12. The value added of IES compared with municipal schools in municipalities where IES operates, adjusting for whether students attended the same school in year 6



Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year, adjusting for an indicator for whether or not the student took the national tests in year 6 and 9 in the same school. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

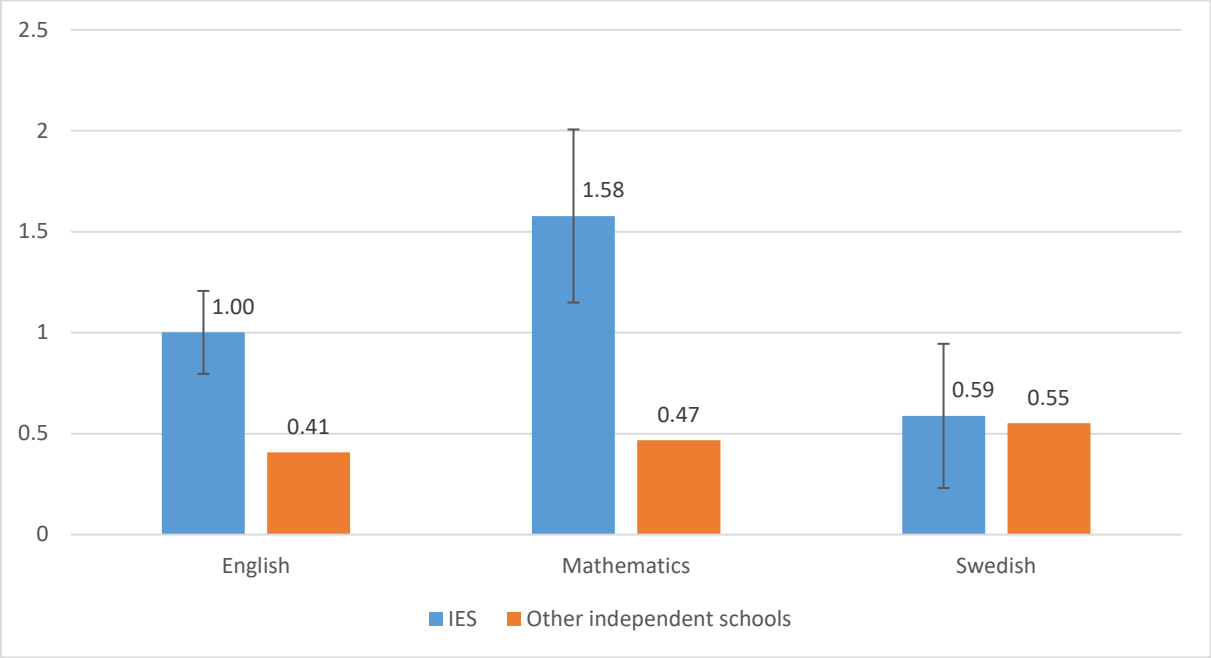
Alternative model specifications in section 4.3

Figure B13. The value added of IES compared with municipal schools, quadratic model



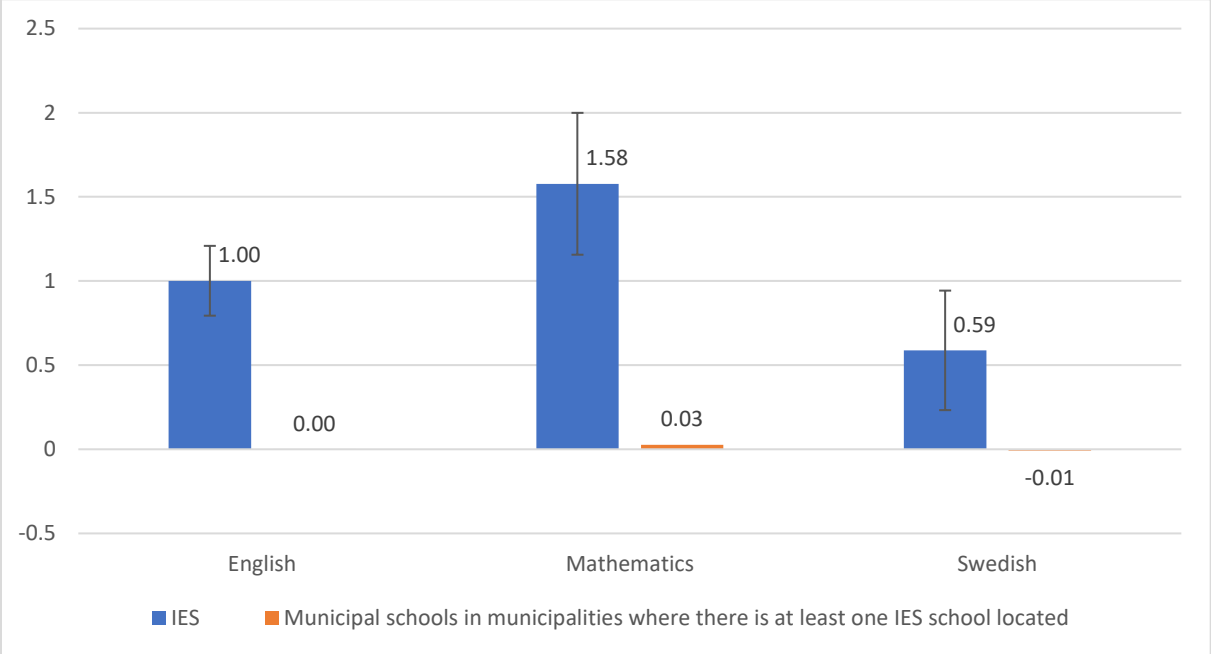
Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year, when adjusting for prior test scores using a quadratic functional form. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

Figure B14. The value added of IES compared with other independent schools, quadratic model



Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year, when adjusting for prior test scores using a quadratic functional form. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

Figure B15. The value added of IES compared with municipal schools in municipalities where IES operates, quadratic model

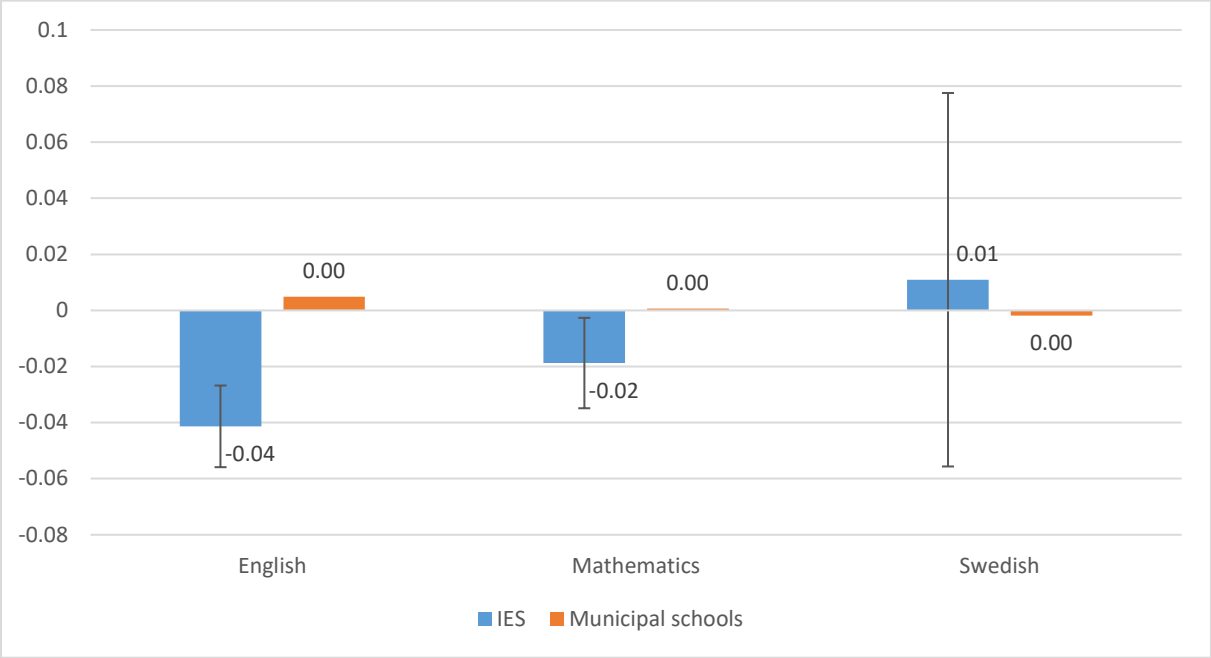


Note: The bars show the student-weighted value added expressed as average grade points on national tests in year 9 in the 2018/19 school year, when adjusting for prior test scores using a quadratic functional form. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

Appendix C. Missing observations

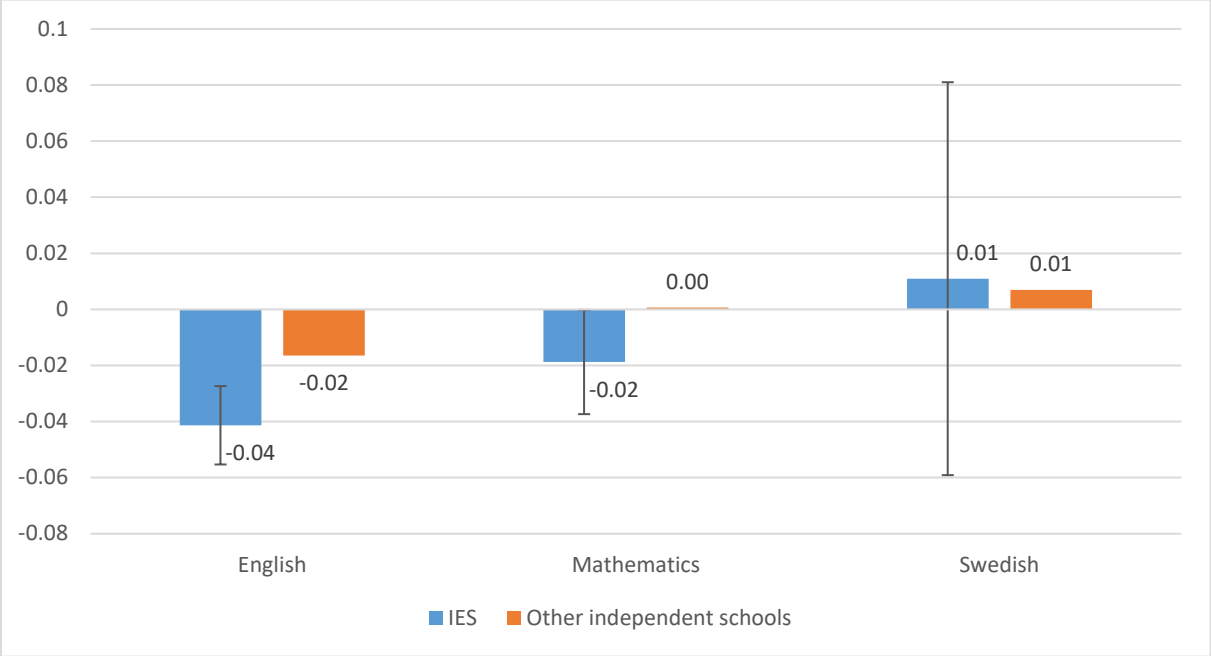
In this appendix, we present figures with the analysis of missing observations described in section 5. We use the same model specification as in section 3.1.1, but with an indicator for missing observations as the outcome variable. In other word, schools' value added is based on the probability to have no test score at all instead of the actual test scores.

Figure C1. Missing observations of IES compared with municipal schools



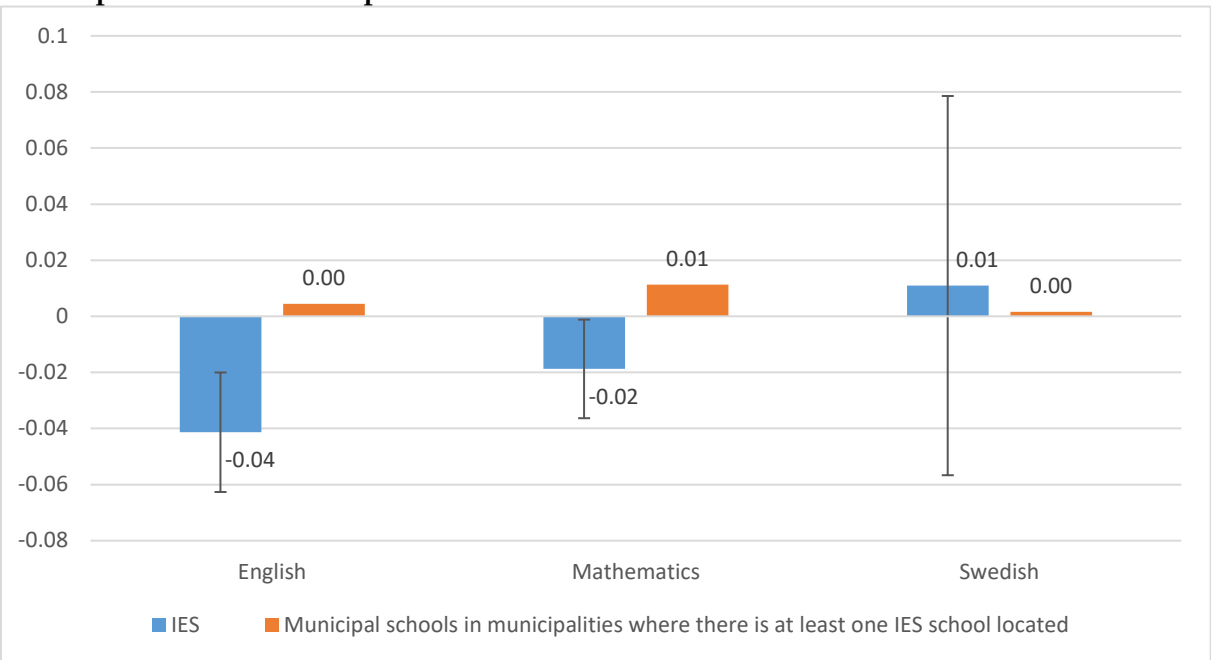
Note: The bars show the student-weighted value added expressed as average missing values on national tests in year 9 in the 2018/19 school year. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

Figure C2. Missing observations of IES compared with other independent schools



Note: The bars show the student-weighted value added expressed as average missing values on national tests in year 9 in the 2018/19 school year. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).

Figure C3. Missing observations of IES compared with municipal schools in municipalities where IES operates



Note: The bars show the student-weighted value added expressed as average missing values on national tests in year 9 in the 2018/19 school year. The error bars display the margin of error when statistical uncertainty is taken into account (at a 95% confidence level).