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G8 high school reform results in higher grade repetition rates and lower graduate age, but does not affect graduation rates

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The G8 high school reform to reduce the total number of years spent at Gymnasium (Germany’s academic-track secondary school) has been more controversial than almost any other education reform in recent years. Although there are few reliable empirical findings on the effects of the G8 reform, several federal states are already considering a return to the old system, which required 13 years—rather than 12 under the G8 system—for graduation from Gymnasium. A new study by DIW Berlin examines the different effects of the G8 reform using administrative data on all students who graduated from Gymnasium between 2002 and 2013. The study shows, among other things, that the G8 reform has reduced the age of graduation from Gymnasium by an average of ten months—and not the twelve months Gymnasium schooling was reduced by. One reason for this is that the share of students who repeated a grade during their time at Gymnasium rose by three percentage points—approximately a fifth—as a result of the reform. The sharpest rise in grade repetitions was seen in the final years (Oberstufe), with boys being more strongly affected on average than girls. The share of students who graduated from Gymnasium (thereby earning their university entrance qualification or Abitur), however, was unaffected by the G8 high school reform.
The G8 high school reform has an impact on the percentage of students who graduate from Gymnasium, according to the study. Second, it examines whether the number of students repeating grades in Gymnasium has increased as a result of the G8 reform. Grade repetition is relevant not only because of its cost to the educational system, but also because it may act as an indicator of how well students are coping with the increased learning intensity.
G8 HIGH SCHOOL REFORM

Box 1

Description of Data

This study is based on data from the German Federal Statistical Office (Statistisches Bundesamt), taken from the records on “Allgemeinbildende Schulen, Fachserie 11, Reihe 1”, for the school years 1994/95 to 2012/13. These statistics contain data for every school year on the number of Gymnasium graduates, their year of birth, the number of students in every grade and school track, and the number of grade repetitions in every grade and school track. All data are also listed separately by gender.

The analysis conducted for the study uses data on 12 cohorts (2002 to 2013) for 14 federal states. The 168 data points contain data on more than 2.3 million Gymnasium graduates. It was not possible to include Hesse and Lower Saxony in the analysis. The data for Hesse, which introduced the G8 reform over a period of three years, do not allow a distinction to be made between students attending a G8 Gymnasium and those attending a G9 Gymnasium. Lower Saxony likewise could not be included in the study since for a large part of the period under observation there are no grade repetition data for the final years at Gymnasium. With regard to average age, however, very similar results are achieved if Lower Saxony is included in the analyses. There is therefore no reason to assume that the effects of the G8 reform in Lower Saxony are substantially different from those in other federal states.

A description of the way in which the three outcomes were calculated is given below:

- The average cohort graduation age is calculated from data on the number of Gymnasium graduates, broken down by year of birth.
- The grade repetition rates are calculated from data on the number of grade repetitions in every grade in Gymnasium. This number is counted at the beginning of every school year for the previous year. The grade repetitions are thus allocated to the previous cohort, to which the student who repeated the grade originally belonged. The grade repetitions for all the grades attended by the cohort, from seventh grade until graduation, are summed up. It should be noted that the total number of G9 grade repetitions is calculated from grades 7 through 13, while the total number of G8 grade repetitions is calculated from grades 7 through 12. The study counts grade repetitions beginning with the seventh grade, because Gymnasium begins in this grade in some federal states, and because, in some cases, the grade in which students start Gymnasium was changed during the period under observation. For the purpose of normalization, for a given cohort the total number of grade repetitions is divided by the number of students in seventh grade of the same cohort.
- For a given federal state, the Gymnasium graduation rate is calculated from the ratio of Gymnasium graduates to the average cohort size for the population of 18-to-20-year-olds in that state in the year of graduation.

1 Data for the school year 2002/2003 and onward are available in electronic form. Information on earlier periods is available in printed form only.
2 The number of data points in the grade-specific analyses rise from 168 to 1008 since, for each of the 12 cohorts in the 14 federal states, information on grade repetition rates for six different grades is considered separately in the calculations.
3 For more detailed information on the dataset and the variables used, see M. Huebener and J. Marcus, “Moving up a gear: The impact of compressing instructional time into fewer years of schooling,” DIW Discussion Papers, no. 1450 (2015).

This descriptive approach can provide a first impression of whether the G8 reform had any effect on the outcomes without using complex statistical methods. It also serves to test the plausibility of the multivariate analysis that will be used later in the study. This is important because the calculation of causal G8 reform effects is based on the assumption that the outcomes for the federal states that introduced the G8 reform would have shown the same changes over time had they not implemented the reform as the outcomes for those federal states that chose not to implement the reform. This assumption of parallel time trends cannot be tested directly, but it is lent some plausibility by the fact that trends over time in the G8 reform states paralleled those of the non-reform states in the period before the reform was introduced.

Developments in average graduation age in the non-reform states mirrored those in the first G8 reform states until 2007, when Saxony-Anhalt, the first of the federal states to switch to G8, saw its first G8 cohort graduate...
This indicates that the crucial assumption of parallel trends over time made in the following analyses can be justified. The first data point relevant to the reform is for the double graduation cohort in Saxony-Anhalt in 2007, which does not distinguish between G8 and G9 students. Gradually other federal states introduced the fast-track G8 system, significantly lowering the average graduation age.

The assumption of parallel trends over time also appears plausible with regard to the grade repetition rates in Gymnasium, i.e., from seventh grade to graduation. With the exception of 2002, grade repetition rates in the first G8 reform states paralleled those in the non-reform states prior to the introduction of the G8 reform in the first state of Saxony-Anhalt. As the first federal states had introduced the G8 reform, the two groups began to diverge. This fact indicates that the G8 reform led to an increase in grade repetitions.

A comparison of graduation rates in the two groups also shows parallel trends over time in the period preceding the introduction of the G8 reform. Graduation rates were not found to decrease compared to the control group for the period following the G8 reform. In addition, a simple comparison of graduation rates before and after a state has introduced the G8 reform can be misleading, since any effects the G8 reform may be obscured by the general rise in the number of high school graduates in recent years. For this reason, a control group comprising federal states that did not implement the reform is essential if the long-term trend of rising high school graduation shares—a phenomenon that is independent of the G8 reform—is to be accounted for.

**Figure 2**

**Trends in graduation age, grade repetitions and graduation rates in states with and without G8 high school reform**

[Diagram showing trends in graduation age, grade repetitions, and graduation rates with and without G8 reform.]

1 Saxony, Thuringia, Schleswig-Holstein, Rhineland-Palatinate.
2 Saxony-Anhalt, Mecklenburg-Western Pomerania, Saarland, Hamburg, Bavaria.

Source: The authors’ own calculations based on data from the German Federal Statistical Office, Fachserie 11, Reihe 1, Allgemeinbildende Schulen.

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With the introduction of the G8 high school reform, graduation age decreased considerably.

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**Increase in Grade Repetition Rates Due to G8 Reform**

The descriptive approach taken thus far merely shows the development of the three outcomes over time. To determine the causal effects of the G8 reform on the outcomes, the present study uses a regression-based difference-in-differences approach (see Box 2). This method focuses on the changes in graduation age, grade repetitions, and graduation rates that occurred in a given federal state following the introduction of the G8 reform, while at the same time taking into account general, non-G8-specific changes to these outcomes. This method also makes it possible to remove effects that other education reforms may have had on the outcomes. The reforms mentioned above include reforms that reduced
subject choice options in the final years of Gymnasium; the introduction of centralized school-leaving exams; reforms affecting the orientation stage (the period during which students are observed with an eye to tracking them into one of three secondary school types); and the merger of non-Gymnasium school tracks.

In view of many studies documenting differences between boys and girls with respect to a broad range of school success indicators, this study investigates the effects of the G8 reform both overall and by gender. The effects of the G8 reform can be expected to display gender differences. Since boys perform on average somewhat less well in school than girls, it is conceivable that the G8 reform caused a greater increase in grade repetition rates for boys.

An analysis of the data using the regression-based approach shows that the G8 reform lowered graduation age by an average of 0.86 years, or 10.3 months (see Figure 3). Consequently, the estimated average age of graduates fell to 18.74 years under the G8 system; had the...
The increase in grade repetitions was greater for boys than for girls.

G8 states retained the G9 system, it would have been 19.6 years of age. This effect is statistically significantly lower than the 12 months (corresponding to the intended reduction in school years in the G8 reform) by which graduation age could have been lowered.9 One explanation for this might be that a large share of students repeated a grade; the probability of a student repeating a grade in the course of their time at Gymnasium rose by 3.1 percentage points. Under the G9 system, an average of 14.5 percent of the students of a given cohort would have repeated a grade in the course of their time at Gymnasium. This percentage rose by 3.1 percentage points under G8, amounting to a 21-percent increase in the grade repetition rate.

Regression analyses confirm the hypothesis that the G8 reform resulted in a higher incidence of grade repetitions among boys than among girls. The probability of repeating a grade at Gymnasium rose by 3.8 percentage points for boys, while the probability for girls rose by 2.4 percentage points, resulting in a bigger gap between the repetition rates for boys and girls, which went from 6.8 to 8.2 percentage points as a result of the G8 reform.10 Gender differences can be taken as the first reference point for judging the size of the G8 effect. The rise in the grade repetition rate by a total of 3.1 percentage points is roughly equal to half the gender difference before the G8 reform, which was 6.8 percentage points.

The increase in the grade repetition rate, however, did not result in a lower share of high school graduates. The change in graduation rates following the G8 reform was not only statistically insignificant; it was also very low in terms of the effect size. The G8 reform led to no appreciable changes for girls or boys. It is also evident that G8 had no impact on the percentage of seventh-graders that attended Gymnasium.11

Increase in Grade Repetition Rates Highest in Final Years

To be able to appoint appropriate remedial programs and take more targeted countermeasures, it is important to know whether the increase in grade repetition rates is distributed evenly across all grades. The effect of the G8 reform on grade repetitions was therefore examined separately for each grade—this was done by comparing grades 7-10 under G8 and G9, as well as qualification

9 This effect is independent of any potential impact of the G8 reform on the age at which children start school because the G8 reform was passed between 2001 and 2007, and the students represented in the data sample started school before 2001.
10 Calculations of grade repetition rates for the hypothetical scenario in which the G8 reform had not been implemented yield figures of 18.1 percent on average for boys and 11.3 percent on average for girls. The grade repetition rate for the period following the G8 reform was 21.9 percent on average for boys and 13.7 percent on average for girls.
11 For this analysis and further calculations, see M. Huebener and J. Marcus, "Moving up a gear: The impact of compressing instructional time into fewer years of schooling," DIW Discussion Papers, no. 1450 (2015).
phase I (12th grade under G9, 11th grade under G8) and qualification phase II (11th grade under G9, 12th grade under G8). The academic grades earned in the last two years of school count toward the final grade point average, so that the performance incentive for students attending these grades is comparable.\textsuperscript{12}

A breakdown of the effect on grade repetitions into individual grades shows that the G8 reform had almost no impact on repetition rates in grades 7-9 (see Figure 4). The increase in grade repetitions is particularly high in 10th grade and in the last two years of Gymnasium. This effect was observed for both girls and boys in these grades, although it was greater for boys.

The study will now turn from examining the average effects of the G8 reform as a whole to investigating whether there were differences among individual federal states (see Table). Of particular interest is whether there were differences among the federal states regarding the effect of the G8 reform on grade repetitions. The reason for this interest is twofold. Due to the breakdown by grade levels, the greatest amount of data is available for this variable. Also, grade repetitions are a direct indicator for changes in graduation age.

In Saxony-Anhalt, the first of the federal states to switch to G8, grade repetitions have increased in all grades as a result of the reform. A similar picture can be seen in the data for Mecklenburg-Western Pomerania. Here, however, the statistically significant effects were observed in the 8th grade and in both qualification phases (i.e., in the last two grades). Hamburg is within the national average, while Bavaria only shows a significant increase in the second qualification phase (similar to Saarland). The results for Saxony-Anhalt and Mecklenburg-Western Pomerania are based on six or five G8 cohorts, respectively, while Bavaria has only two G8 cohorts. This may explain why the effects are not statistically significant for many grades. Caution is recommended in interpreting results for Baden-Wuerttemberg, Berlin, and Bremen, as the calculations for these federal states are based solely on the first cohort to graduate after the double graduation cohort. There is some indication, however, that for these federal states, too, the G8-related increase in grade repetition rates is particularly high in the final years of Gymnasium. Overall, the analysis shows that the G8-related increase in grade repetition rates is a widespread phenomenon affecting most federal states.

\textsuperscript{12} An alternative analysis comparing the 10th grade under G8 with the 11th grade under G9 shows very similar qualitative results. Another alternative would be to compare grades 11 under G8 and G9 and grades 12 under G8 and G9. However, there are structural differences between these grades, as in G9 schools the 11th grade functions as the transition to the qualification phases, while in G8 schools the 11th grade is already the first year of the qualification phase.

### Figure 4

**Effects of the G8 reform on grade repetition rates by grade**

Results based on multivariate regressions\textsuperscript{1}

<table>
<thead>
<tr>
<th>Grade</th>
<th>Overall</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>+0.01</td>
<td>+0.14</td>
<td>-0.04</td>
</tr>
<tr>
<td>8</td>
<td>+0.29</td>
<td>+0.34</td>
<td>-0.32</td>
</tr>
<tr>
<td>9</td>
<td>+0.14</td>
<td>+0.13</td>
<td>+0.19</td>
</tr>
<tr>
<td>10</td>
<td>+1.27***</td>
<td>+1.40***</td>
<td>+1.06***</td>
</tr>
<tr>
<td>Qualification phase 1\textsuperscript{2}</td>
<td>+2.48***</td>
<td>+3.28***</td>
<td>+1.91***</td>
</tr>
<tr>
<td>Qualification phase 2\textsuperscript{3}</td>
<td>+1.01***</td>
<td>+1.31***</td>
<td>+0.65**</td>
</tr>
</tbody>
</table>

\textsuperscript{1} Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

\textsuperscript{2} 12th grade under G9, 11th grade under G8.

\textsuperscript{3} 13th grade under G9, 12th grade under G8.

Source: The authors’ own calculations based on data from the German Federal Statistical Office, Fachserie 11, Reihe 1, Allgemeinbildende Schulen.

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The sharpest rise in grade repetitions was seen in the final years of high school.

Differences in the impact of the G8 reform among the federal states may be attributable to the different ways in which the reform was implemented, differing political circumstances in the federal states, or a lack of precision in the estimates.

### G8 Effects Also Felt Several Years after the Reform

Another relevant question regarding the G8 reform is whether the average effects calculated for graduation age, grade repetition, and graduation rates will change as schools become more experienced in dealing with
The results of this DIW Berlin study, which examines Gymnasium cohorts from 2002 to 2013, provides findings that both supporters and opponents of the reform will be able to use to substantiate their arguments. One of the first findings is that the G8 reform has not had any impact on the percentage of seventh-graders attending Gymnasium or on the number of Gymnasium graduates. Fears that the G8 reform would deter students from taking their school-leaving examinations Abitur cannot be substantiated; nor can hopes that decreasing the number of years required for graduation would encourage more young people to opt for Gymnasium.

Further, the study shows that graduates of the G8 system are clearly younger — approximately ten months on average. It can thus be concluded that most students were able to graduate and qualify for university entrance more quickly. This was not true of all students, however, because the number of students who had repeated a grade increased: of every 100 students in a given cohort, an additional three students repeated a grade at some point in their time at Gymnasium as a result of the changeover to the G8 system. Boys were affected by this to a greater extent than girls.

The increase in grade repetition rates affected most federal states.

The first result that the analysis provides is that a sustained reduction in graduation age was indeed seen with the introduction of the reform — and not before (see Figure 5). But even five years after the double graduation cohort, the reduction in graduation age had still not reached a full year. The changes seen in the effect of the G8 reform on grade repetitions over time do not suggest that it will quickly diminish with the passing of time. The increase in grade repetition rates therefore does not appear to be solely a result of the transition from G9 to G8, but seems more permanent in nature. The effects of the G8 reform on graduation rates fluctuated around zero for all cohorts both before and after the reform. Owing to considerable variation in the size of birth cohorts over time as a result of a drop in the birth rate in eastern Germany after reunification, the effects of G8 reform were also examined with a view to an alternative normalization of graduation rates. This analysis produced similar results, with the effect of the reform on graduation rates displaying no obvious trend.

**Conclusion**

The present study by DIW Berlin shows that the G8 high school reform cannot yet be considered a clear success nor failure. The results of this DIW Berlin study, which examines Gymnasium cohorts from 2002 to 2013, provides findings that both supporters and opponents of the reform will be able to use to substantiate their arguments. One of the first findings is that the G8 reform has not had any impact on the percentage of seventh-graders attending Gymnasium or on the number of Gymnasium graduates. Fears that the G8 reform would deter students from taking their school-leaving examinations Abitur cannot be substantiated; nor can hopes that decreasing the number of years required for graduation would encourage more young people to opt for Gymnasium.

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The increase in the number of repeaters was not distributed evenly across all grades, but was most common toward the end of Gymnasium. In most federal states, however, the additional instructional time was redistributed primarily across grades 7 to 10. Different conclusions can be drawn from the fact that the increase in grade repetitions did not occur in the grades with the greatest amount of additional instructional time. It is conceiva-

### Table

**Effects of the G8 reform on grade repetition rates by federal state**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Saxony-Anhalt</th>
<th>Mecklenburg-Western Pomerania</th>
<th>Saarland</th>
<th>Hamburg</th>
<th>Bavaria</th>
<th>Baden-Württemberg</th>
<th>Berlin</th>
<th>Brandenburg</th>
<th>Bremen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 7</td>
<td>1.23***</td>
<td>0.73</td>
<td>−0.95</td>
<td>0.11</td>
<td>−0.8</td>
<td>0.27</td>
<td>−0.23</td>
<td>−0.02</td>
<td>−0.29</td>
</tr>
<tr>
<td>Grade 8</td>
<td>1.52***</td>
<td>1.07***</td>
<td>−0.51</td>
<td>0.08</td>
<td>0.26</td>
<td>−0.31</td>
<td>0.50</td>
<td>0.02</td>
<td>−0.37</td>
</tr>
<tr>
<td>Grade 9</td>
<td>1.30***</td>
<td>0.54</td>
<td>−1.14</td>
<td>0.26</td>
<td>−0.28</td>
<td>0.69*</td>
<td>0.17</td>
<td>0.19</td>
<td>0.53</td>
</tr>
<tr>
<td>Grade 10</td>
<td>1.86***</td>
<td>0.25</td>
<td>−0.21</td>
<td>3.10***</td>
<td>0.05</td>
<td>0.31</td>
<td>1.00*</td>
<td>0.26</td>
<td>6.10***</td>
</tr>
<tr>
<td>Qualification phase 1</td>
<td>3.98***</td>
<td>4.95***</td>
<td>0.49</td>
<td>4.28***</td>
<td>0.78</td>
<td>1.83**</td>
<td>1.68</td>
<td>0.62</td>
<td>1.98**</td>
</tr>
<tr>
<td>Qualification phase 2</td>
<td>1.10**</td>
<td>1.07***</td>
<td>1.08**</td>
<td>1.38***</td>
<td>2.62***</td>
<td>0.23</td>
<td>0.03</td>
<td>−0.04</td>
<td>2.63*</td>
</tr>
</tbody>
</table>

N 1,008

1 Results based on multivariate regressions. Significance levels: *** p<0.01, ** p<0.05, * p<0.1
2 12th grade under G9, 11th grade under G8.
3 13th grade under G8, 12th grade under G9.

Source: The authors’ own calculations based on data from the German Federal Statistical Office, Fachserie 11, Reihe 1, Allgemeinbildende Schulen.

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ble that students were able to pass lower grades despite potential gaps in knowledge and that these gaps grew as they progressed from year to year, ultimately resulting in grade repetitions in the last three years. On the other hand, it is also possible that the increase in grade repetition rates does not automatically indicate that students are unable to cope with the new learning environment; it may reflect a considered decision to voluntarily repeat a grade in order to be able to take certain classes or to improve Abitur results. What is clear, however, is that no single conclusion can be drawn on the relative merits of either interpretation. Regardless of the cause, grade repetitions reduce the potential of the G8 reform to lower graduation age and, owing to the repeated use of school resources, create additional costs for the educational system.

This study is not intended to provide a definitive assessment of the G8 reform, but it does offer further insight into the impact of the G8 reform. It is hoped that the results provided here will help put the debate on the advantages and disadvantages of the G8 reform on a more evidence-based footing. Further research is needed, however, to gain a more comprehensive picture of the effects of the G8 reform. For example, it is important to find out how much younger G8 students actually are when they enter the job market and whether the G8 reform has brought about changes with respect to university attendance and professional careers, success in the labor market, and many other factors, including social and civic engagement, leisure activities, fertility, and health. Only by examining many different aspects will it be possible to make a comprehensive assessment and provide indications of whether, in the end, this reform is creating additional costs or yielding additional benefits. To improve the credibility of empirical findings and enable generalizations to be made, it is important to design studies that cover multiple federal states and multiple cohorts, using variations in the way that the G8 reform was implemented, both over time and across regions, to establish the causal effects of the G8 reform.