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The Divergence of School Track Choices After Covid-19

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Philipp Breidenbach, Lukas Hörnig, and Sandra Schaffner[1]

The Divergence of School Track Choices After Covid-19

Abstract

During the pandemic, many measures were taken to prevent the spread of Covid-19. Some of these measures, such as school closures, directly affected students. Children from different backgrounds are likely to have different abilities to cope with the challenges of the pandemic and associated countermeasures. We analyse whether pre-existing differences in transition rates from primary schools in low-income and high-income neighborhoods to secondary schools have widened. Our results show that the transition rate from primary schools to Gymnasium, the academic track, increased by 1.5 percentage points in primary schools in high-income neighborhoods compared to primary schools in low-income neighborhoods, suggesting that the pandemic increased educational differences in Germany. We provide suggestive evidence that children's technological equipment and parents' capabilities to help their children differ across neighborhood types.

JEL-Codes: I24, I21, J15, D30

Keywords: Covid-19; school closures; educational inequality; school tracking; neighborhood effects

August 2023

1 Philipp Breidenbach, RWI; Lukas Hörnig RWI and RUB; Sandra Schaffner, RWI. *– We thank Thomas K. Bauer and Albrecht Glitz for comments and suggestions as well as Inga Heinze for research assistance. We are grateful to the North-Rhine-Westphalian statistical office for providing us data. We gratefully acknowledge financial support by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - 492351283.* *– All correspondence to: Lukas Hörnig, RWI, Hohenzollernstr. 1-3, 45128 Essen, Germany, e-mail: lukas.hoernig@rwi-essen.de*

1 Introduction

The COVID-19 pandemic has had a profound and lasting impact on the world. In many countries measures were taken to combat the spread of the virus. Interventions in education were among the most hotly debated measures. Unexpectedly, the German government decided to close schools in March 2020. Depending on infection rates, schools were closed several times during the pandemic. Teachers had to switch to distance teaching, although most were neither pedagogically nor technically prepared.

Students faced not only the challenge of studying at home, but also other side effects of the pandemic, such as social distancing (or more directly, the health threat). Teachers, researchers, and policymakers expected negative effects on educational outcomes. However, not only may there be an overall decline in learning outcomes, but students from different backgrounds are likely to have different abilities and resources to cope with these challenges.

In this paper, we analyze whether there are differential effects of the pandemic on school transition rates in Germany's most populous state, North-Rhine-Westphalia (NRW). We analyze the transition rate of children in the 4^{th} grade to a *Gymnasium*, the highest/academic track of the secondary school system. While most studies look at (standardized) test scores, this is not possible in our case. Standardized tests in NRW (VERA-3) were not conducted in 2020, and the data are not available at the school level anyway. However, we believe that the transition rate to secondary education

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is an interesting outcome because it is a strong proxy for educational outcomes later in life. We distinguish primary schools in neighborhoods with above and below the median income *per capita*. Our synthetic difference-in-differences (Arkhangelsky et al., 2021) results indicate that the change in the transition rate to *Gymnasium* is significantly higher (1.5 pp) in schools in high-income neighborhoods compared to schools in low-income neighborhoods. However, our results also suggest that this is mainly compensated by a reversed pattern in the change of transition rates to the *Gesamtschule*, which combines all tracks. The medium and long-term effects are unclear, as a high school degree is still possible at this type of school, although it may be less likely than in the *Gymnasium*.

We use a survey of parents of primary school children in North Rhine-Westphalia about their experiences during the pandemic conducted by Breidenbach et al. (2021) to gain some indication of the mechanisms behind this development. Survey results indicate that families from schools in low-income neighborhoods with a high proportion of foreigners have worse technical equipment, have been hit harder by the crisis in terms of financial burden, and see more problems in helping their children with homework. These differences are potential drivers of the increased disparities during the pandemic.

There is evidence from several countries that school closures have a negative impact on learning outcomes. Test scores are significantly lower in Belgium (Maldonado and De Witte, 2022; Gambi and Witte, 2021), the Netherlands (Engzell et al., 2021; Haelermans et al., 2022a,b; Bol, 2020), Italy (Contini et al., 2021), one German federal state (Schult et al., 2022, Baden-Württemberg), and the U.S. (Jack et al., 2023). In their meta-analysis of 42 studies from 15 countries, Betthäuser et al. (2023) find an overall decline in learning outcomes that is particularly large for students from low socioeconomic backgrounds. Heterogeneous effects on test scores

are found specifically for parental education (Haelermans et al., 2022a,b; Engzell et al., 2021), parental income (Haelermans et al., 2022a,b), non-western background (Haelermans et al., 2022a), and single parenthood (Haelermans et al., 2022a).[1] Our results, however, point in a different direction, as transition rates to the academic track are increasing. This could be due to teachers and parents (over)compensating for the negative learning effects.

The evidence in the existing literature suggests that there are heterogeneous effects that can potentially increase educational inequality. This heterogeneity may arise from several sources, such as differences in time spent learning, equipment, and the ability of parents to help their children. Grewenig et al. (2021) finds that school closures during the pandemic lead to reduced time spent learning, especially for low achievers. Chetty et al. (2020) find that access to digital devices, which are necessary for home schooling, is unequally distributed across socioeconomic groups. There is also evidence of differences in parental support, with higher income parents feeling more able to help their children and devoting more resources to home learning (Andrew et al., 2020; Bol, 2020). Heterogeneity in transition rates may be due to these differences in learning outcomes, but also to differences in compensation for learning deterioration.

The paper is structured as follows. In Section 2, we explain the education system and the course of the pandemic in Germany, describe our data sources, and outline our empirical strategy. Section 3 presents our main results for the impact of the pandemic on transition rates to the *Gymnasium* in low-income neighborhoods compared to high-income neighborhoods and illustrates an important heterogeneity as well as potential mechanisms. Section 4 concludes the paper.

[1] See Blanden et al. (2022) for a more detailed description of the literature.

2 Institutional Setting, Data, and Empirical Strategy

2.1 Institutional Setting

Covid-19 Pandemic in Germany

On January 27, the first case of the new coronavirus was detected in Germany. The German government quickly implemented measures to prevent the uncontrolled spread of the virus. All state governments decided on March 13 to close schools from March 16 to April 19, 2020. After several extensions of the corona protection measures and only under strict hygiene and distance regulations, the primary schools in NRW were finally reopened on May 4, 2020. Depending on the grade level, students gradually returned to normal schooling through alternating models before the summer vacation. Face-to-face education took place under strict security measures, such as wearing masks, social distancing, and increased hygiene measures.

With the number of infections on the rise again, the government introduced a "lockdown light" in November 2020. This included closing restaurants, bars, and gyms, and limiting private gatherings to 10 people. Soon, the federal and state governments decided to tighten the lockdown. Primary schools were closed again in NRW between mid-December and the end of February 2021. In March 2021, the federal and state governments decided to gradually relax the lockdown, depending on local infection patterns. From April 23 to June 30, 2021, the *Bundesnotbremse* was in effect. This set uniform federal measures for certain local incidences (number of cases per population times 100,000). The states had to implement them and were only allowed to deviate from them by taking even stricter measures. Schools were affected in that if the incidence exceeded 100 for three days, classes were held on alternate days. Schools were closed altogether if the

incidence exceeded 165 for three days. The measures could only be relaxed if the number of cases was below the threshold for five days.

School System of North Rhine-Westphalia

Education in Germany is the responsibility of the state governments. In all states, schools are divided into two parts: primary education and secondary education. Primary education (*Grundschule*) is compulsory and lasts for four years in the state North Rhine-Westphalia. Secondary education is divided mainly into *Hauptschule*, *Realschule*, *Gesamtschule*, and *Gymnasium*, lasting up to nine years. With the mid-term report in the fourth grade, parents receive a recommendation from their primary school for their child's further education. The recommendation is intended to help parents make a decision, but is not binding in NRW. Parents can enrol their child in a secondary school of their choice. The school will then decide whether the child can be admitted within the limits of the school's capacity.

Hauptschule provides the most basic education and its graduates qualify for some vocational training programs. *Realschule* prepares students for vocational education, and it is possible to continue in school to qualify for university education. *Gymnasiums* prepare students for university education. There is a strong parental income gradient in the probability of children attending *Gymnasium*: Wößmann et al. (2023) shows the probability of attending *Gymnasium* by income group for different household characteristics. Students from disadvantaged backgrounds are less likely to obtain the *Gymnasium* diploma and as a result are less likely to get an university degree. This contributes to educational inequality in Germany (Dustmann, 2004). There is a fourth track, the *Gesamtschule*, which is a mixture of the different types of schools. This type of secondary school offers all three types of diplomas and, depending on the student's performance, can qualify them to enter university.

Although it is possible to change tracks, once assigned to a track, upward mobility is rare (Matthewes, 2021).[2] Only *Gymnasium* and *Gesamtschule* directly lead to the high school degree, *Abitur*. Evidence for Germany suggests that assignment to *Gymnasium* is highly correlated with university enrollment and higher earnings later in life (*e.g.*, Dustmann, 2004).

2.2 Data

We obtain transition rates from primary to secondary schools at the school level (*Grundschule*) from the State Statistical Office of NRW (IT.NRW). This data set covers the transition rates to the different types of secondary schools and the demographic composition of all primary schools in NRW between the school years 2005/2006 and 2021/2022. We also obtain information on the number of students in the fourth grade, their composition by sex and by German citizenship.

We define neighborhoods as low- or high-income neighborhoods using information from the RWI-GEO-GRID data (RWI and microm, 2020). The RWI-GEO-GRID covers Germany's populated areas at a 1km x 1km grid level, approximately 225,000 grid cells, for the period 2005, and 2009-2017. Data are available from FDZ Ruhr. Information on the socio-economic and demographic composition of the grid cells was originally collected by microm, a commercial micro- and geomarketing provider. See Breidenbach and Eilers (2018) for a more detailed description.

We merge the school level data with the the socio-demographic information through a spatial join, *i.e.* we use the grid cells in which the schools are located. Thus, our indicator for low- and high-income schools does not directly imply the income of the parents, but whether the schools are located in a relatively low- or high-income neighborhood. This indicator equals one if the neighborhood income *per capita* is higher than the state

[2] In NRW 3.3% of students in grades 7-9 change track, and 6.4% change track after the 10th grade.

median income *p.c.* and zero otherwise.[3] Furthermore, we use information on population and the share of primary school aged kids (kids aged 6 to 10) from the RWI-GEO-GRID to control for neighborhood characteristics in our regressions.

Table A1 shows summary statistics of our variables by assignment to schools in low-income and high-income neighborhoods. The summary statistics reveal an educational disparity where, on average, schools in low-income neighborhoods have a transition rate to *Gymnasium* that is 13.6 percentage points lower than schools in high-income neighborhoods. The opposite is true, by smaller margins, for the transition rates to the other three types of schools. Since the number of places for students in secondary schools does not vary much from year to year, one might doubt that transition rates can vary much. Therefore, we take a closer look at the variation in transition rates. The between-school variation in the transition rate is 14.4 and the within-school variation is 7.5. Although the within variation is much smaller, it is far from negligible. Moreover, the within variation is stable for the subgroups by neighborhood type, i.e., it is 7.6 for schools in high-income and 7.5 for schools in low-income neighborhoods.

Finally, we use data from a survey of parents whose children are enrolled in primary schools in NRW. The survey was conducted in June and July 2021 and focused on the challenges faced by parents. See Breidenbach et al. (2021) for a detailed description of the survey. We merge our income group assignment with the survey data by the primary school in which the child is enrolled[4] to analyse how parents' perceptions of schools in high-income and low-income neighborhoods differ.

[3] We repeat our analysis using the county median instead of the state median. Table A2 shows the cross frequency of the classifications. About 80% of the schools are ranked the same in both variants. Overall, the two methods produce similar results. In addition, we repeat our analysis restricting the sample to the lowest and highest quartile of income *p.c.* which leads to larger estimates in magnitude as one would expect.

[4] If there are several children in family: parents' oldest child in primary school.

2.3 Empirical Strategy

Our research design estimates the differential impact of the pandemic by comparing schools in relatively low-income neighborhoods to schools in high-income neighborhoods. Thus, although we do not have a classical Diff-in-Diff setting with a treated and a control group, we run a standard Diff-in-Diff specification. Specifically, we estimate variants of the equation:

$$Y_{st} = \alpha_s + \gamma_t + \theta D_{st} + \beta X_{st} + \epsilon_{st} \tag{1}$$

where Y_{st} is the transition rate of school s in year t to a specific type of secondary school. Our main focus is on the share going to *Gymnasium*, but we also analyse the transition rates to other school types. α_s and γ_t are school and year fixed effects, respectively. These fixed effects capture time-invariant observable and unobservable characteristics specific to each school, as well as shocks common to all schools over time. When we add more flexible time controls, such as county-specific trends, our results are virtually unchanged. Our coefficient of interest is θ, which represents the differential effect of the pandemic on track shares in low-income neighborhood schools compared to relatively high-income neighborhood schools. The variable D_{st} takes on a value of 1 if a school is located in a neighborhood with less than the state median income *p.c.* and the year is 2020 or later. X_{st} is a vector of time-varying covariates of school s. These include the *log* of the shares of male and foreign students and the total number of students in the fourth grade on school level, as well as the population, population squared, income *p.c.* and income *p.c.* squared, and the share of primary school-age children in the neighborhood.

Equation (1) implies a number of important assumptions that we will examine in more detail. The static Diff-in-Diff specification implies that the pandemic and the accompanying measures have a constant effect on

the transition rate. However, there are reasons to expect this effect to be heterogeneous. First, the measures taken to contain the spread of the virus varied over time. In addition, there is no reason to believe that the stress of living through a pandemic remains constant. To account for time-varying effects, we modify Equation (1) to include the interaction of low-income neighborhood school with each year, rather than just the interaction with being after 2020. This allows us also to test, at least descriptively, the critical *common trends* assumption.

$$Y_{st} = \alpha_s + \gamma_t + \sum_{t=2013}^{2021} \theta_t Low\ Income_s + \beta X_{st} + \epsilon_{st} \tag{2}$$

Our setting leads to a slightly different interpretation of the coefficient θ than the standard Diff-in-Diff. We are not trying to identify the effect of the pandemic on the proportion of students in each track, but rather the differential effect of schools in relatively low-income neighborhoods compared to schools in high-income neighborhoods. Of course, students in both school types are affected by the pandemic and the countermeasures. However, students at schools in high-income neighborhoods may have more resources to deal with these challenges. We investigate whether these differences lead to an increase in differences between schools in low-income and high-income neighborhoods. The usual identification relies on the assumption that changes in track shares in schools in high-income neighborhoods are a valid counterfactual for changes in track shares in schools in relatively low-income neighborhoods if the pandemic had not occurred. Thus, differences in changes in track shares are due solely to how students responded differently to the pandemic. As this is not the case here, we can only identify a relative effect of the pandemic on the transition rate.

Nonetheless, we have to assume that the transition rates in schools in both types of neighborhoods followed the same trend before the pandemic.

We provide suggestive evidence of its validity in two ways. First, we show the raw data in Panel (a) of Figure A1. The red and green lines show the average transition rates to the *Gymnasium* over time for schools in high-income and low-income neighborhoods, respectively. While levels are considerably different, the changes before 2020 are qualitatively the same, with the exception of 2014 and 2017. Our regression following Equation 2 also yields two significant pre-reform deviations, as shown in in Panel (a) of Figure 1.

To compensate for these violations, we repeat our analysis using a more data-driven approach. We use the synthetic difference-in-differences design recently developed by Arkhangelsky et al. (2021). This method combines the standard Diff-in-Diff and Synthetic Control methods, *i.e.* Synthetic Diff-in-Diff controls for unit and time fixed effects as in the standard Diff-in-Diff and weighs units to match pre-treatment outcome trends similar to Synthetic Control methods. A new feature of Synthetic Diff-in-Diff is that it assigns not only *unit* weights, but also *time* weights, which are calculated to balance the pre-treatment and post-treatment periods for untreated units. These weights are typically larger closer to the start of the treatment period, so that long past shocks become less important. When we repeat the exercise of reporting the pre-pandemic interaction terms weighted with the unit and time weights from the Synthetic Diff-in-Diff, the pre-trends are close to zero and statistically insignificant.

Returning to the raw data reported in Figure A1, it is noticeable that transition rates increase in both groups after the outbreak of the pandemic. This suggests that transition rates are not a proxy for educational attainment and knowledge, as these should have declined during the pandemic. Rather, the increased transition rates may be due to school behavior, as schools may have tried to compensate for the worse school environment after the pandemic by being more generous with their recommendations.

The generally more generous behavior is difficult to test empirically, but it is consistent with the trend in grade repetition, which fell by 24 percent from 2019 to 2020. However, the increase in transition rates to the academic track appears to be significantly higher for schools in high-income neighborhoods.

3 Results

We start with an overview of the results from a static Diff-in-Diff model with the share of transitions to the *Gymnasium* as dependent variable. Table 1 displays the estimated Diff-in-Diff coefficients. They vary only slightly between the specifications (including and excluding trends, covariates, and fixed effects). The estimated coefficients indicate that students from schools in low-income neighborhoods show a statistically significant decrease in the transition to the academic track relative to schools in high-income neighborhoods. Our preferred specification is presented in column 4, including two-way fixed effects (year and school), time-varying covariates on school and neighborhood level, and county specific trends. While the transition rate to the *Gymnasium* was already about 13 percentage points lower on average in low-income neighborhood schools than in high-income neighborhood schools, this difference increased by 1.6 percentage points with the onset of the pandemic.

One explanation for the changes in the transition to different school types could be a different behavior regarding grade repetition. Parents may decide to let their child repeat the fourth grade instead of sending the child to a lower secondary school. Alternatively, overcompensating the higher burden of students during the pandemic, even children with bad grades may enroll in secondary schools – but potentially in a lower track. Repeaters should not affect our results. As the aggregated data show, only about 750 students repeated fourth grade in North Rhine-Westphalia

	Dependent Variable: Transition Rate *Gymnasium* (in %)			
	(1)	(2)	(3)	(4)
Low Income	-13.250^{***}			
	(0.283)			
After	1.514^{***}			
	(0.441)			
Low Income x After	-1.135^{***}	-1.615^{***}	-1.643^{***}	-1.569^{***}
	(0.426)	(0.202)	(0.202)	(0.216)
TWFE	*No*	*Yes*	*Yes*	*Yes*
Covariates	*No*	*No*	*Yes*	*Yes*
County x Trend	*No*	*No*	*No*	*Yes*
Observations	26910	26910	26910	26910

Notes: Dependent variable is the academic track share in percent. Unit of analysis: schools. Estimation methods: OLS regressions with TWFE, covariates, and county specific trends as indicated in the table. Sample period: 2013–2021 (excluding 2019, treatment from 2020). Standard errors: Conley (1999, 2008) spatial standard errors with 5km distance cutoff. *p<0.1; **p<0.05; ***p<0.01

Table 1: DiD Regression Estimates of Pandemic Effect on Academic Track Share

in 2019 (0.45% of all fourth graders). In 2020, the number of repeaters decreased to 570.[5]

These static results assume an immediate and static effect. In practice, however, cumulative adjustments may occur, as the first fourth graders were only affected in their last semester, while the following grades were affected by each grade for one year longer. We therefore expect an increasing effect size. To explore this further, we interact our treatment assignments with each year. The coefficients shown in Panel (a) of Figure 1 for the years 2013 to 2016 are positive and some of them are significantly different from zero, suggesting that the transition rate in low-income relative to high-income neighborhood schools was higher compared to the reference year. Furthermore, the graph shows that the difference in transition rates remained fairly constant from 2017 to 2019. After the onset of the pandemic

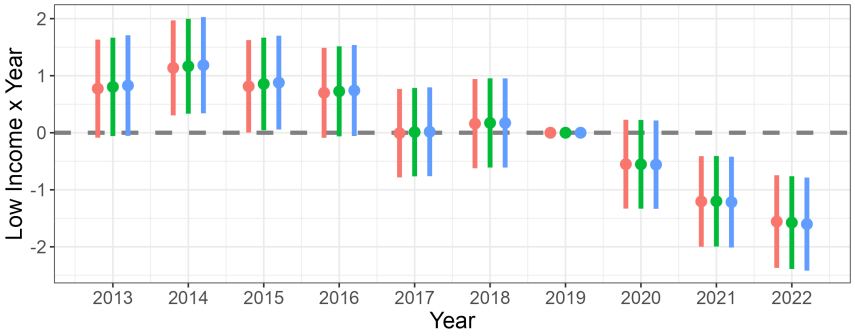
[5]Aggregated figures are available from the Statistical Office of North Rhine-Westphalia. https://www.landesdatenbank.nrw.de/ldbnrw/online/

in 2020, 2021, and 2022, the estimated coefficients of low-income schools become negative and significant for 2021 and 2022. While the effect of the pandemic remains below 1 percentage point and is not statistically significant in the first year (2020), the effect is about 1.2 pp in 2021 and 1.6 pp in 2022. This pattern is consistent with an increasing effect the longer students are exposed to the pandemic: In 2020, most transition decisions[6] were made before the pandemic started, so we do not expect large effects. In contrast, students transitioning in 2021 or 2022 had more than one or two years of schooling under pandemic conditions.

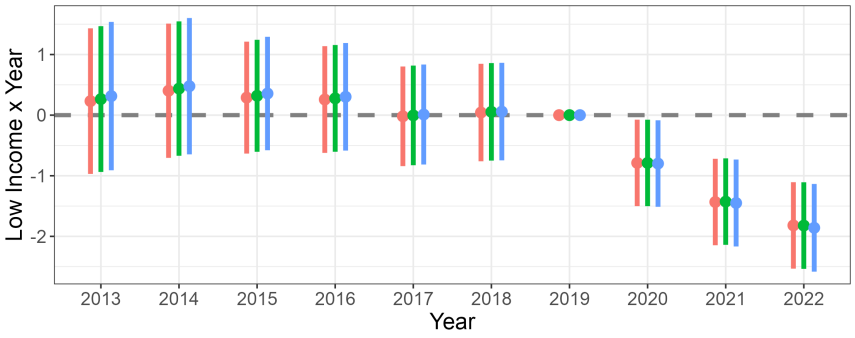
The pre-trends shown in Panel (a) of Figure 1 may indicate an overall trend. To increase confidence that our estimates are not biased, Panel (b) contrasts these results with estimates using synthetic Diff-in-Diff as described in Arkhangelsky et al. (2021). The reported results are based on the same regression specifications and the same balanced sample. The difference is due to different weights, where classical Diff-in-Diff assigns the same weight to each time period and unit of observation, while Synthetic Diff-in-Diff assigns different time and unit weights (unit weights are shown in Figure A3). One risk of using Synthetic Controls is that the matching process depends on very few observations. This risk is less pronounced in Synthetic Diff-in-Diff because the matching is done only for trends – not for levels. In our setting, each unit (school) is given a positive weight ranging from 0.0006 to 0.0011. The time weights are calculated to match the pre- and post-treatment periods of schools in high-income neighborhoods so that more similar time periods are compared. These weights are shown in Panel (c) of Figure A2. Applying these weights to the regressions leads to even larger effects in magnitude, with point estimates of about -1.5 pp for 2021 and -1.8 for 2022.

[6]While actual transitions happen in the summer, the decision where to enroll the child is made after parents receive the mid-term report.

Panel (a): Unweighted Regression



Panel (b): Synthetic Diff-in-Diff weighted Regression



Notes: Dependent variable is the transition rate to the *Gymnasium* in percent. Unit of analysis: schools. Estimation methods: TWFE regressions. Sample period: 2013–2022. Reference year: 2019. Standard errors: Conley (1999, 2008) spatial standard errors with 5km distance cutoff in Panel (a). The regression illustrated in Panel (b) is weighted with unit and time weights originating from a Synthetic Diff-in-Diff estimation following Arkhangelsky et al. (2021), see Panel (c) of Figure A2.

Figure 1: Effect on Low-Income Schools compared to High-Income Schools (State Median)

3.1 Foreigner Share at School

While low-income neighborhoods are also characterised by higher proportions of immigrants, we cannot separate ethnic composition and average income. However, we do know the proportion of foreign students in each school. We further divide the groups into schools with an above-median share of foreigners and schools with an below-median share of foreigners. To do this, we compare schools in low-income neighborhoods to the median share of foreign students in all schools in low-income neighborhoods.

Table 2 shows that not all schools in low-income neighborhoods are affected in the same way using the static Diff-in-Diff approach for transitions to *Gymnasium* weighted with the synthetic Diff-in-Diff weights, where we again implement the same specifications, including combinations of TWFE, covariates, and county-specific trends. All of the regression specifications paint a similar picture: The increased difference between schools in relatively high-income and low-income neighborhoods is more pronounced (-1.9 pp) in schools with a high proportion of foreign students. This difference persists across specifications. However, the effect is still negative (-1.1 pp) for schools with a low proportion of foreigners in low-income neighborhoods. In addition, we report the t-statistics of the difference between the coefficients of the interaction terms of $After\ x\ Low\ Income$ with the share of foreign students. All differences, except for the first specification, are statistically significant at the 1 percent confidence level.

3.2 Other Track Choices

So far, the results outlined have only shown that students from schools in low-income neighborhoods are less likely to choose the academic track during the pandemic. We also analyse the effects for the remaining secondary school types. Figure 2 shows the results for transitions to the three other most common tracks, *i.e. Hauptschule*, the lowest level, *Realschule*, an intermediate level, and *Gesamtschule*, which subsumes all types of school degrees (see the institutional description in Section 2.1).

Figure 2 shows the Synthetic Diff-in-Diff weighted estimate of the relative change in transition rates from relatively low-income neighborhood schools to high-income neighborhood schools after the onset of the pandemic. Panel (a) to (c) correspond to the relative change for *Gesamtschule*, *Realschule*, and *Hauptschule*, respectively. All panels show no statistically significant pre-trends. With the onset of the pandemic, we observe an

	Dependent Variable: Transition Rate *Gymnasium* (in %)			
	(1)	(2)	(3)	(4)
High Foreigner Share	−4.386***			
	(0.215)			
Low Income	−9.017***			
x Low Foreigner Share	(0.264)			
Low Income	−15.702***			
x High Foreigner Share	(0.293)			
After	1.867***			
	(0.262)			
After x Low Income	−1.103**	−1.103***	−1.136***	−1.090***
x Low Foreigner Share	(0.454)	(0.243)	(0.244)	(0.257)
After x Low Income	−1.938***	−1.938***	−1.922***	−1.875***
x High Foreigner Share	(0.455)	(0.243)	(0.245)	(0.257)
t-Stat.	−1.59	−2.97***	−2.76***	−2.71***
Covariates	*No*	*No*	*Yes*	*Yes*
TWFE	*No*	*Yes*	*Yes*	*Yes*
County x Trend	*No*	*No*	*No*	*Yes*
Observations	26,910	26,910	26,910	26,910
Adjusted R^2	0.239	0.782	0.782	0.783

Notes: Dependent variable is the academic track share in percent. Unit of analysis: schools. Estimation methods: OLS regressions weighted with unit times time weights obtained from the Synthetic Diff-in-Diff reported in Figure A2. Sample period: 2013–2022. High foreigner share is computed as a higher share of non-German pupils than the median share of all schools in the relative poor neighborhoods. t-statistics report the test statistic of the difference between the interaction terms of low and high foreigner shares with after and low income. *p<0.1; **p<0.05; ***p<0.01

Table 2: Synthetic Weighted DiD Regression Estimates of Pandemic Effect on Academic Track Share by Foreigner Shares

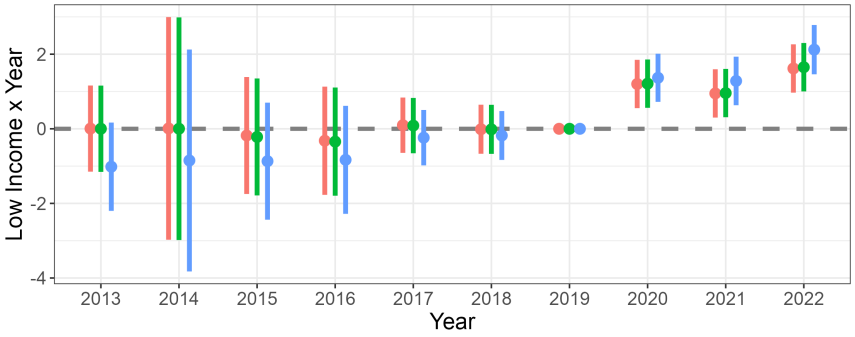
increase in the transition rates to *Gesamtschule* and *Realschule* in low-income neighborhood schools relative to high-income neighborhood schools since 2020, which remain fairly constant over the period 2020 to 2022. Only the *Gesamtschule* shows a significantly higher estimate in 2022. Comparing the static estimates from the Synthetic Diff-in-Diff algorithm for the three school types (see Figure A4), the relative increase in transition rates to the *Gesamtschule* is 1.3 percentage points, for *Realschule* 0.5 percentage points, and for the lowest qualification level *Hauptschule* a slight relative decrease in the transition rate of 0.3 percentage points.[7]

Since the change in this lowest level of education is in the same direction as for the *Gymnasium*, the *Hauptschule* cannot be a substitute for the *Gymnasium*. The largest relative increase in the transition rate is to the *Gesamtschule*. Here, comparable to the academic track, the effect size increases in 2022. This finding makes the interpretation difficult regarding the long-term consequences. Students of the *Gesamtschule* can also obtain the *Abitur*. However, based on the aggregate statistics of the last school year before the pandemic, the share of students leaving the *Gesamtschule* with *Abitur* is 49.1 percentage points lower than in the *Gymnasium*.However, it is difficult to disentangle how much of the difference is due to composition effects and how much to the causal effect of school type. The long-term effects therefore remain to be seen.

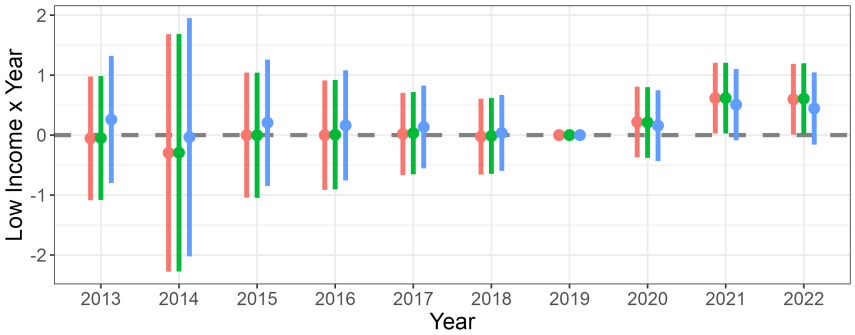
All track choices could be influenced if the composition of schools substantially changed during our observation period. To provide suggestive evidence that this is not the case, we calculated the Euclidean distances from the primary schools in our sample to the nearest *Gesamtschule* and *Gymnasium* in the 2017/18 and 2020/21 school years. The average distance from primary schools in high-income neighborhoods to the nearest

[7]Repeating this exercise with the absolute numbers of transitions reveals a similar picture: The decrease in the transition to *Gymnasium* is essentially compensated by an increase in the transition to *Gesamtschule*.

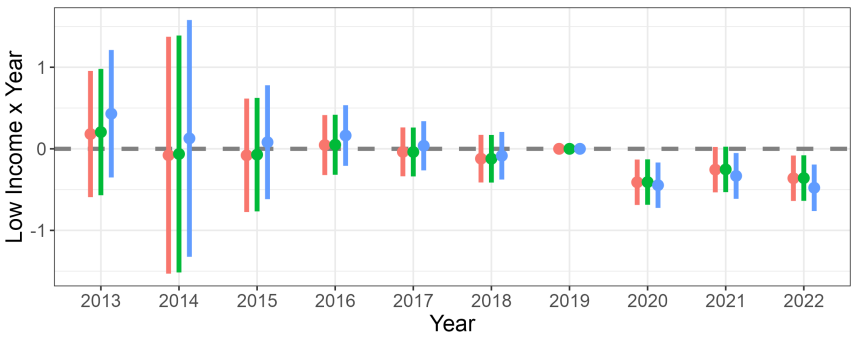
Panel A: *Gesamtschule*



Panel B: *Realschule*



Panel C: *Hauptschule*



Notes: Dependent variable is the transition rate in percent to the secondary school type as indicated in the panel captions. Unit of analysis: schools. Estimation methods: TWFE regressions. Sample period: 2013–2022. Reference year: 2019. The regressions are weighted with unit and time weights originating from a synthetic Diff-in-Diff estimation following Arkhangelsky et al. (2021). The synthetic Diff-in-Diff estimation output as in Arkhangelsky et al. (2021) is shown in Figure A4.

Figure 2: Effect on Low-Income Schools compared to High-Income Schools (State Median)

Gesamtschule is about 3700 meters, which is only slightly lower (by 44 meters) than in relatively low-income neighborhoods. The distances to the

nearest *Gymnasium* remain virtually unchanged, it changes by 0.2 meters (high-income) and -0.3 meters (low-income). The average distance to the nearest *Gesamtschule* decreased by about 90 meters in high-income neighborhoods and about 60 meters in low-income neighborhoods. Since we observe only small changes, the supply of secondary schools should not affect our results.

3.3 Transmission Channels

Using a survey of parents of primary school children conducted in June and July 2021, we focus on potential channels which may explain why the transition rates diverge. We are able to link respondents to their primary school in our main data set, which allows us to distinguish precisely between the previously defined low-income and high-income neighborhood schools in the survey data. The survey was conducted online and covered various aspects of the role of the pandemic in the school process, different forms of teaching, the impact of the pandemic on the household and other pandemic-related issues. It was sent to all 2712 primary schools in NRW with a request to distribute it to parents. Finally, there are about 5000 respondents from 484 schools in NRW.

We use different questions from the survey on three aspects: (i) interaction with school/teacher, (ii) role of parents, and (iii) technical equipment of the household. Two questions relate directly to parents' interactions with the school, encompassing all aspects they needed to consider during the pandemic. We show results for whether parents feel well informed and well supported. Parents from more affluent neighborhoods felt largely well informed by the school (74%). This remains fairly constant for schools in low-income neighborhoods with a low proportion of foreign students (73%). Only in the low-income group with a high proportion of foreign students do parents feel significantly less well informed by the school. Their positive

ratings are about 5 percentage points lower than those of parents from high-income neighborhoods. School support is rated much less positively by all groups. Less than 60 percent rate the support positively without significant differences between the three groups. The fact that the flow of information was worse may also have influenced the choice of the optimal secondary school, but the differences are small and limited to the group of schools with a high proportion of foreigners. These findings do not suggest that communication between school and parents is the driving factor of the increased differences.

With regard to the role of parents, the group means indicate larger differences. The results suggest worse conditions for students in schools in low-income neighborhoods, especially when there is also a high proportion of foreign students. Parents in both low-income neighborhood groups report having jobs that are less compatible with working from home. This is consistent with findings from Baumann and Kohlrausch (2021) that poorer parents have fewer opportunities to work from home, which can be a major disadvantage when looking after children during school hours. In addition, these parents are more likely to report having suffered financially from the pandemic. For 27% of parents from schools in low-income neighborhoods with a low proportion of foreigners, the pandemic causes a financial burden, which is 3.6 percentage points higher than for parents from higher-income neighborhoods. For parents from low-income neighborhoods with a high proportion of foreigners, the difference is large, at 15 percentage points. Furthermore, around 20% of parents in this group say that they have had problems helping their children with homework. This figure is about 6 percentage points higher than in the group of high-income schools. In contrast, parents in low-income neighborhoods with a low proportion of foreigners do not show significant differences compared to those in high-income neighborhoods. The higher shift to work from home in high-income

neighborhoods could make these parents more involved in the decision-making process or more likely to influence teachers' decisions. This could explain the increased share of transitions to *Gymnasium*.

In contrast, parents from low-income neighborhoods with a high proportion of foreigners at school are slightly less likely to report feeling stressed - although the small difference of 3.2 percentage points is only statistically significant at the 10% level. In addition, these parents report spending slightly more time to support their children in school work, on average about 10 minutes more per day. However, the longer time spent may reflect not only parental involvement but also different educational needs. In addition, the longer time commitment may discourage the decision to enroll their child in *Gymnasium* if the expectation is that the time commitment will only increase, while parents from schools in high-income neighborhoods may feel more confident. However, these findings cannot explain that transition rates to *Gymnasium* even increased during the pandemic. They can only explain the increased differences.

The final set of questions on parental conditions focuses on technical equipment. We observe that children in both groups of low-income neighborhoods are less likely to use a desktop PC or laptop for home schooling – by 4 and 11 percentage points in the low-income group with low and high proportions of foreigners, respectively. The pattern is similar for the use of tablets. In contrast, both groups in low-income neighborhoods, but especially those with a high proportion of foreign students, are more likely to use a mobile phone instead. While the proportion of mobile phone users for the purpose of home schooling among parents from schools in high-income neighborhoods is 19%, it is 32% among the low-income group with a high proportion of foreigners. When analyzing students who solely use mobile phones for online schooling and homework, the share in the high-income group is 2%, while it is more than three times higher in the

low-income group with a high foreigner share. The ability to follow lessons, but especially to do schoolwork, seems to be much less convenient on a mobile phone than on a PC, laptop or tablet. Again, the more favorable conditions, here in equipment, could mean that parents in high-income neighborhoods are more inclined to enroll their children in *Gymnasium*. If parents fear that homeschooling may return, this could explain the results. However, the federal government implemented in 2021 a subsidy program for schools in deprived neighborhoods to buy tablets for all students[8]. If this program is well targeted, it should reduce such effects from 2021/2022, which we cannot observe in the data.

[8]See https://bass.schul-welt.de/19555.htm.

	High Income (N=2720)		Low Income; Low Share (N=948)			Low Income; High Share (N=926)		
	Mean	Std. Dev.	Mean	Std. Dev.	Δ Mean (S.E.)	Mean	Std. Dev.	Δ Mean (S.E.)
Well informed by school	0.74	0.44	0.73	0.44	-0.0092 (0.018)	0.69	0.46	-0.048* (0.024)
Supported by school	0.56	0.5	0.59	0.49	0.028 (0.02)	0.57	0.5	0.011 (0.026)
Work-from-home ability	0.57	0.5	0.45	0.5	-0.12*** (0.023)	0.43	0.5	-0.14*** (0.03)
Pandemic as financial burden	0.24	0.42	0.27	0.45	0.036+ (0.018)	0.38	0.49	0.15*** (0.025)
Problems to help with assignm.	0.13	0.34	0.15	0.35	0.011 (0.015)	0.2	0.4	0.063** (0.02)
Parents felt stressed	0.86	0.34	0.85	0.35	-0.01 (0.015)	0.83	0.38	-0.032+ (0.019)
Hours of support	2.51	1.57	2.48	1.58	-0.032 (0.065)	2.67	1.64	0.16+ (0.085)
Using PC/laptop	0.53	0.5	0.49	0.5	-0.039* (0.019)	0.42	0.49	-0.11*** (0.023)
Using tablet	0.64	0.48	0.62	0.49	-0.024 (0.018)	0.57	0.5	-0.069** (0.023)
Using mobile phone	0.19	0.4	0.22	0.41	0.024 (0.015)	0.32	0.46	0.12*** (0.022)
Using only mobile phone	0.019	0.14	0.04	0.2	0.021** (0.0069)	0.066	0.25	0.047*** (0.011)

Notes: Income Groups are divided by neighborhood income p.c. compared to state level median income p.c. Relative poor neighborhoods are further divided by whether their share of foreign pupils are below/ above the median share of foreign pupils within the group of schools in relative poor neighborhoods. Differences are computed between the poor neighborhood subgroups and the relative rich group. +=.1, *=.05, **=.01, ***=0.001

Table 3: t-Tests of Survey Respones by Treatment (Sub-) Group

4 Conclusion

The transition from primary to secondary school after the fourth grade in Germany is likely to be decisive for the future development of children. While the *Hauptschule*, the lowest form of secondary school, allows for some vocational training, the *Gymnasium*, the highest form, is the basis for further academic education. Due to the separation into physically different schools, the transition to secondary school also places children in very different peer groups.

We analyze the differential evolution of the transition rate to *Gymnasium* in schools in low-income compared to high-income neighborhoods. The raw data show that transition rates increase in both groups after the onset of the pandemic. However, the increase appears to be significantly higher for schools in high-income neighborhoods. This underscores that our outcome variable is not a proxy for educational attainment. While we cannot use standardized tests, the transition rate is an interesting outcome, as it is a strong proxy for long-term educational attainment.

Our results confirm the impression from the raw data: After the onset of the pandemic, the transition rate of children from high-income neighborhoods increase by 1.5 percentage points relative to children attending primary schools in low-income neighborhoods. The effect is robust to a wide range of different empirical methods and variations in the definition of low-income neighborhoods. More detailed analyses show that the effect is even larger compared to schools that also have a high proportion of foreign students. Here the effect size increases to around 1.9 percentage points.

Additional findings from a survey conducted during the pandemic among parents of primary school children reveal significant differences between groups. In particular, households from schools in low-income

neighborhoods with a high proportion of foreigners have worse technical equipment, are more severely affected by the crisis in terms of financial burden and face more problems in helping their children with homework. These differences may explain, why parents from schools in high-income neighborhoods are more inclined to enroll their children in a *Gymnasium*. Another channel may be a more generous behavior of teachers regarding secondary school recommendations. However, we lack the data to analyze whether this varies between schools.

In terms of alternative track choices, schools in low-income neighborhoods show the largest relative increase – by about 1.3 percentage points – in transitions to *Gesamtschulen*. This may reflect the behavior of students in high-income neighborhoods who are substituting away from *Gesamtschule* toward *Gymnasiums*. However, the interpretation of these compositional changes is not entirely clear *a priori*. In general, the *Gymnasium* as a secondary school is the baseline path to access the *Abitur* and it shows the highest share of *Abitur* among the total of all graduates. Nevertheless, the *Gesamtschule* offers basically the same access to the *Abitur*. As more students enter the *Gymnasium*, it will be important to monitor whether more (high-income) students drop out. Otherwise, it may also be interesting to see whether long-term differences in educational attainment and income inequality are exacerbated by this uneven change in the rate of transition to secondary school.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT and deepl.com/write in order to ensure accurate English formulations and spell-check the written text. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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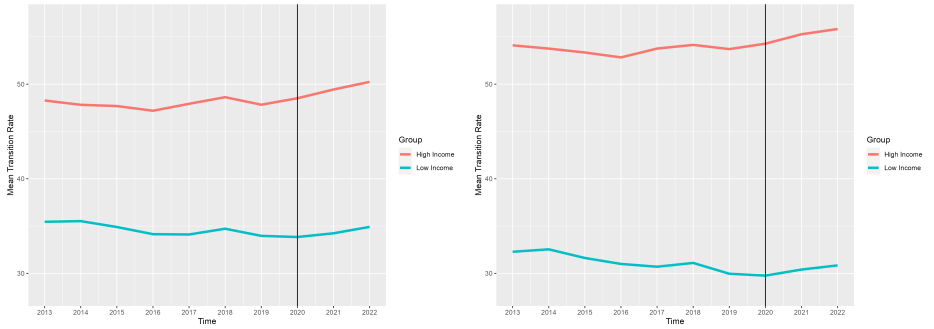
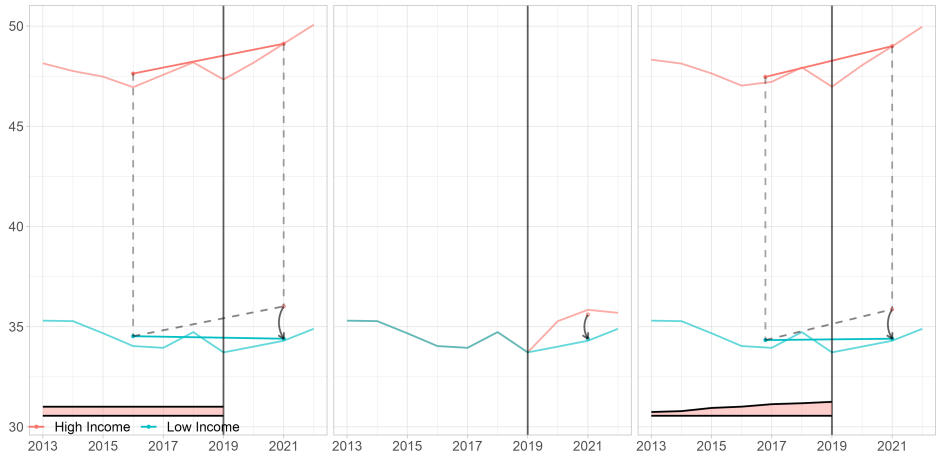
A Appendix



(a) Above/Below Median Income *p.c.* (b) Highest/Lowest Quartile Income *p.c.*

Figure A1: Descriptive Evidence for Common Trends

Notes: The average transition rates of schools weighted by their number of fourth graders is plotted by year and income group assignment. Income corresponds to the residential income of the 1x1km grid cell where the school is located.



(a) Diff-in-Diff (b) Synth. Control (c) Synth. Diff-in-Diff

θ (se) = -1.615*** (0.233) θ (se) = -1.203 (2.474) θ (se) = -1.468*** (0.236)

Notes: The figure plots the results of applying the standard diff-in-diff, synthetic control, and synthetic diff-in-diff estimator in Panels (a), (b), and (c), respectively. The vertical line indicates the last pre-pandemic year 2019. All panels show the trend of the transition rate from primary schools to the *Gymnasium* in percent - Panel (a) and (c) by schools in high and low-income neighborhoods. The arrows indicate the estimated effects θ, which are the differences between the transition rates in schools in low-income neighborhoods and the (projected) counterfactuals. In the standard Diff-in-Diff setting, all schools and time periods receive the same weight: the flat bottom graph in Panel (a) for the time weights and the straight lines for development between pre- and post-treatment in both groups. In the synthetic control method, schools in high-income neighborhoods receive a weight to match the pre-treatment period of schools in low-income neighborhoods. The treatment effect is given by the observed transition rates of low-income schools and the weighted mean of high-income schools. The synthetic diff-in-diff estimator compares the change in the transition rate in low-income schools with the unit- and time-weighted change in the transition rate in high-income schools. The time weights are shown in the lower part of Panel (c), with more weight given to later years in the pre-treatment period. The unit weights are shown in figure A3, which shows that the weights are not concentrated in a few schools. Dependent variable is the transition rate to the *Gymnasium* in percent. Unit of analysis: schools. Sample period: 2013–2021 (treatment from 2020). Standard errors: Bootstrapped standard errors for Diff-in-Diff and Synthetic Control and jackknife standard errors for Synthetic Diff-in-Diff. *p<0.1; **p<0.05; ***p<0.01

Figure A2: Effect on Low-Income Schools compared to High-Income Schools (State Median) by Method (in percentage points)

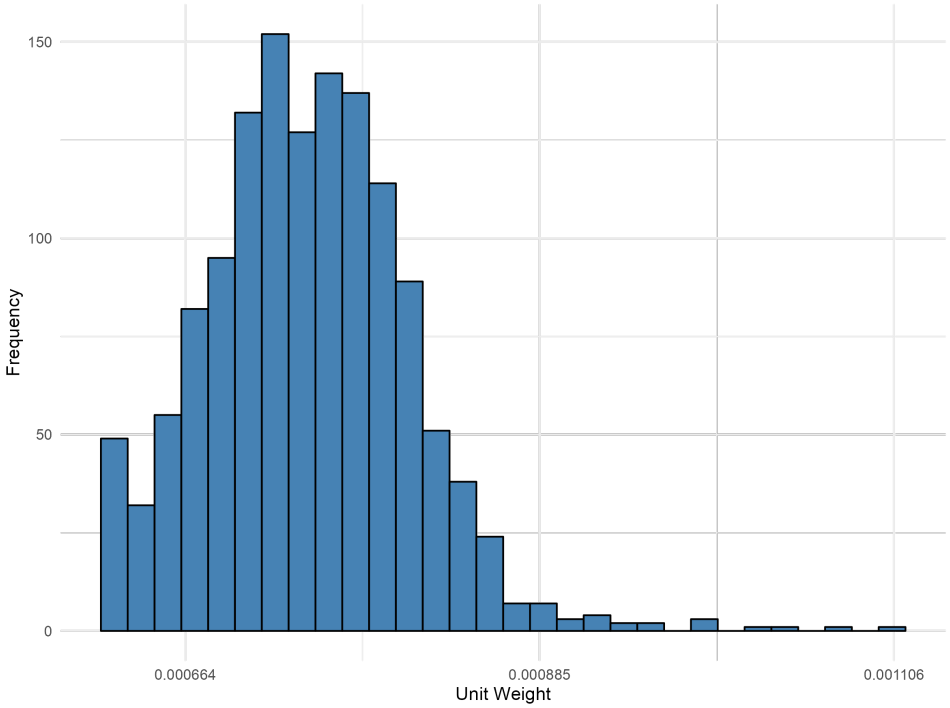
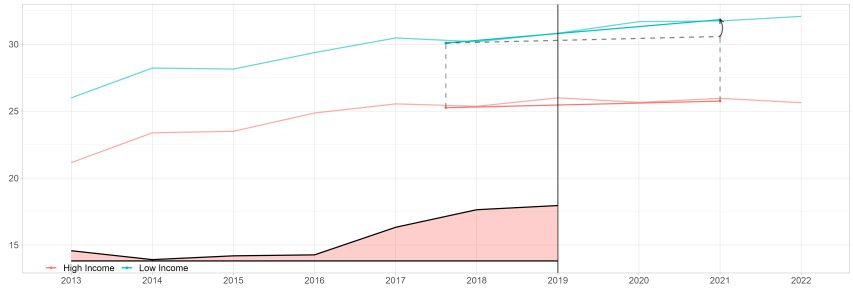
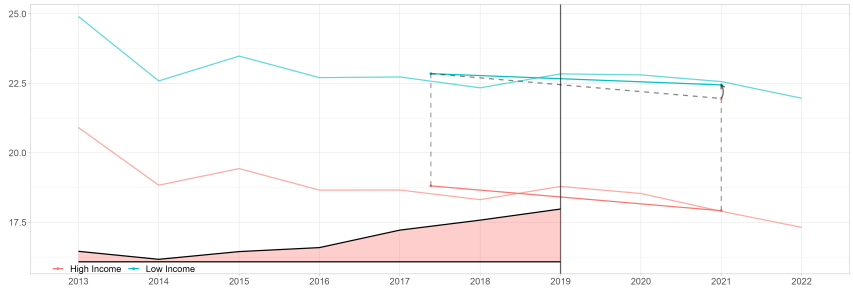


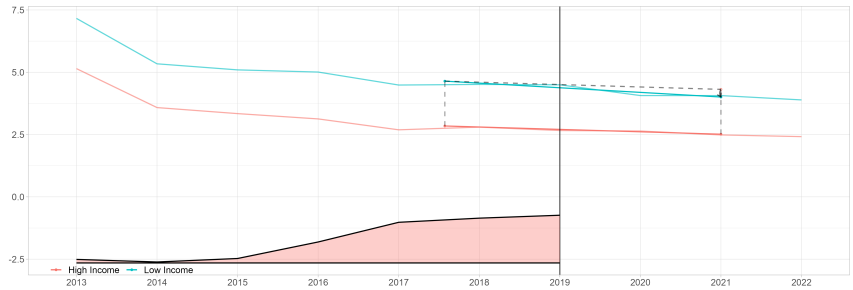
Figure A3: Histogram of Unit Weights in Synthetic Diff-in-Diff Approach



(a) Outcome *Gesamtschule*: $\theta(se) = 1.256^{***}\ (0.283)$



(b) Outcome *Realschule*: $\theta(se) = 0.488^{**}\ (0.226)$



(c) Outcome *Hauptschule*: $\theta(se) = -0.307^{***}\ (0.101)$

Notes: Units of analysis: schools. Estimation methods: Synthetic Diff-in-Diff on multiple treated units. Sample period: 2013–2021 (treatment from 2020). Standard errors: jackknife. *p<0.1; **p<0.05; ***p<0.01
The vertical line indicates the last pre-pandemic year 2019. All panels show the trend of the transition rate from primary schools to the secondary school type in percent by schools in high and low-income neighborhoods. The arrows indicate the estimated effects θ. The synthetic diff-in-diff estimator compares the change in the transition rate in low-income schools with the unit- and time-weighted change in the transition rate in high-income schools. The time weights are shown in the lower parts of each panel, with more weight given to later years in the pre-treatment period.

Figure A4: Effect on Low-Income Schools compared to High-Income Schools (State Median)

	High Income (N=13510)		Low Income (N=13400)			
	Mean	SD.	Mean	SD	Δ	SE
Share *Gymnasium*	48.1	16.2	34.5	13.2	-13.6***	0.2
Share *Gesamtschule*	24.7	17.7	29.9	18.2	5.1***	0.2
Share *Realschule*	18.6	13.8	22.9	14.6	4.3***	0.2
Share *Hauptschule*	3.0	5.7	4.8	7.2	1.8***	0.1
Pupils	55.2	20.6	55.0	19.4	-0.2	0.2
Population (in 1,000)	3.1	2.9	3.7	2.8	0.6***	0.0
Income p.c. (in 1,000)	24.1	3.2	19.4	2.0	-4.8***	0.0
Share Primary School Aged Kids	3.7	0.5	3.6	0.5	-0.1***	0.0
Share Male Pupils	50.6	7.7	50.4	7.7	-0.2*	0.1
Share Non-German Pupils	5.4	6.3	9.7	10.1	4.3***	0.1

Notes: Unit of observation: schools. Socio-demographic composition correspond to the 1x1 km grid cell of the school. School transition rates for the period 2013 to 2022. The other variables have a four-year lag, i.e. they are based on the period 2009 to 2018. Income groups are divided by neighborhood income p.c. compared to state level median income p.c. in 2019.
$+ = .1, * = .05, ** = .01, *** = 0.001$

Table A1: Summary Statistics by Income Group

	Lower (County Median)	Higher (County Median)
Lower (State)	10,870	2,640
Higher (State)	2,880	10,520

Table A2: Cross-Table Income Group Assignment