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Abstract

This paper provides evidence on the causal relationship between education and poverty. I construct a novel database comprising compulsory schooling reforms in 32 European countries and use them as instruments for education. I find economically large poverty-reducing effects of education among people aged 30 to 80. This holds true for both objective measures of poverty (relative income poverty, lack of basic necessities, weak labor market attachment) and a subjective measure of poverty (self-assessed difficulties in making ends meet). An additional year of education thus reduces not only the likelihood of being classified as living in poverty but also the likelihood of considering oneself to live in poverty. Increases in labor force participation and full-time employment as well as better health are potential mechanisms behind these results.

JEL codes: I32, I24, I26

Keywords: poverty, education, compulsory schooling, social exclusion

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1 Introduction

The fight against poverty has featured high on the political agenda in recent years, not only in developing countries, but also in Europe. In 2010, the member states of the European Union (EU) adopted the Europe 2020 strategy. One of the five headline targets of this strategy concerns poverty and social exclusion. The EU-wide target is to have at least 20 million fewer people in - or at risk of - poverty or social exclusion¹ by 2020 compared to the level in 2008, corresponding to a reduction of the poverty rate from about 23% to 19%. The Europe 2020 strategy notes that *“better educational levels help employability, and progress in increasing the employment rate helps to reduce poverty”*. Thus, education is acknowledged as a fundamental tool to prevent and to lift people out of poverty. Whether education has a causal effect on poverty and the size of the effect remains to be determined in a European context.

There is abundant evidence on the positive and potentially large effects of education on personal earnings for most developed countries in the world.² Studies such as Buchinsky (1994) for the US and Harmon et al. (2003) and Brunello et al. (2009) for Western European countries typically find that these effects are present along the whole earnings distribution, which hints at a protective function of education against poverty.³ Oreopoulos (2007), Oreopoulos and Salvanes (2011), and Heckman et al. (2018) provide direct causal evidence of a poverty-reducing effect of education, relying on income-based and welfare receipt-based measures in Canada, the UK, and the US. However, these studies reduce poverty to a one-dimensional measure essentially based on (household) income. Other objective measures of poverty that capture for instance the availability of basic necessities in a household are arguably also relevant. Another previously overlooked dimension is people’s own assessment of their poverty status.

In this paper, I study the effects of education on poverty in a European context. To identify the causal effect, I follow Brunello et al. (2009) and rely on exogenous variation from compulsory schooling reforms across European countries. The identification strategy uses both cross-country variation and variation across birth cohorts in the length of compulsory schooling, while imposing fixed effects at the country level and the birth cohort level.⁴ The idea here is to emulate country-specific studies that exploit regional varia-

¹The EU definition of poverty differs widely from the United Nations definition of extreme poverty, as the latter is zero or close to zero in all EU member states. Instead, the EU definition of poverty and social exclusion covers three objective dimensions; relative income poverty, lack of basic necessities, and weak labor market attachment.

²There are some studies that indicate zero returns to additional compulsory schooling, such as Pischke and von Wachter (2008) and Kamhöfer and Schmitz (2016) for Germany, although Cygan-Rehm (2018) casts doubt on their results, as well as Grenet (2013) for France and Oosterbeek and Webbink (2007) for the Netherlands.

³These findings do not automatically imply a poverty-reducing effect of education, if poverty is defined at the household level. Children or adults without any earnings are usually not classified as living in poverty, as long as they have a parent or a spouse, who earns enough to support all persons living in the same household. If education were positively linked to both a greater household size and higher personal earnings, the former factor could theoretically outweigh the latter one and increase the risk of poverty.

⁴The crucial assumption in the identification strategy is that conditional on country fixed effects, birth cohort fixed effects, and country-specific linear trends, exposure to a reform is as good as random.

tion in the implementation of a reform that changes the length of compulsory schooling in different regions of a country at different points in time, thus affecting different birth cohorts (see, e.g., Acemoglu and Angrist (2001) for the US, Meghir and Palme (2005) for Sweden, and Pischke and von Wachter (2008) for Germany). For the empirical strategy in this paper to work, increases in the length of compulsory schooling must have induced students to obtain more years of schooling than they would have in the absence of the increase. Provided that more education reduces poverty, students who were required to stay in school for some additional years should then be relatively less likely to live in poverty in adulthood.

For the empirical analysis, I create a new database of compulsory schooling reforms with unprecedented coverage, containing information on all reforms that have affected birth cohorts born between 1935 and 1995 in 32 European countries (the 28 EU member states, plus Iceland, Norway, Serbia, and Switzerland). I combine this information with data from the European Union Statistics on Income and Living Conditions (EU-SILC) survey. This large-scale individual-level survey allows me to look at poverty in a comprehensive manner. More specifically, I consider two main measures of poverty. The first one is the EU definition of poverty and social exclusion, which is an objective measure of poverty. It is comprised of three sub-indicators of which one is a relative measure of poverty (relative income poverty) and two are absolute measures of poverty (lack of basic necessities and weak labor market attachment). The second main measure of poverty is subjective and is based on whether individuals consider their households to have difficulties in making ends meet.

I find economically large poverty-reducing effects of education that are larger than the pure correlation would suggest, relying on 37 compulsory schooling reforms across 23 countries in my preferred specification. An additional year of education leads to a relative reduction of living in poverty and social exclusion of about 29%. Significant reductions in all three sub-dimensions of this poverty measure contribute to this result. The results for the sub-indicators relative income poverty and severe material deprivation resemble the findings for the US in Oreopoulos (2007) and Cole et al. (2014), respectively. I also find a relative reduction of subjectively-assessed difficulties in making ends meet of about 17% due to an additional year of education. The effects are roughly equally large in people of working age (30-59 years) and in older people (61-80 years). The effect sizes are also similar among urban and rural dwellers. By contrast, the effects are much more pronounced in women and in people living in Eastern Europe than in men and in people living in Western Europe, respectively.

The results are robust to different model specifications and the inclusion or exclusion of certain countries. Placebo tests that introduce “false” reforms both before and after the actual reforms indicate that the results are not driven by country-specific trends or structural breaks that have an impact on poverty. I also provide evidence of possible mechanisms behind the results. Similar to Fischer et al. (2016) and Brunello et al. (2017), I find that increases in labor force participation and full-time employment, and to a lesser

extent increased personal income, might be potential mechanisms. As evidenced by Hamad et al. (2018), I can also verify a positive effect on health. A reduced likelihood of children living in the household might be an additional mechanism, whereas there is no causal evidence of changes in household size or likelihood of being married.

This paper builds on a vast literature that studies the effects of education on both market returns and non-market returns (see Card (1999), Heckman et al. (2006), Grossman (2006), and Lochner (2011) for reviews of the literature). Studies on market returns focus predominantly on earnings and to a lesser extent on heterogeneous effects across the earnings distribution, while few studies focus specifically on poverty. Oreopoulos and Salvanes (2011) and Heckman et al. (2018) show that more education reduces the likelihood of being on welfare in the US. Participation in welfare overlaps with living in a state of poverty. Nevertheless, some people might not be classified as poor despite receiving certain welfare benefits and, arguably more commonly, even people not on welfare can by some dimension be classified as poor.

Among relevant studies on non-market returns of education, positive effects on well-being and life satisfaction even after conditioning on personal income have been found (Oreopoulos and Salvanes, 2011). This might partly capture how people perceive to live in financially constrained circumstances, with more educated people being more aware of the potentially transitory nature of their poverty status. In summary, the few studies investigating the effects of education on poverty-related outcomes find reductions in poverty due to more education. In this paper, I add to this literature and provide the first comprehensive assessment of the causal effects of education on both objectively-measured and subjectively-measured poverty.

This paper is also related to a large literature focusing on different policies to reduce poverty. One general theme is the evaluation of the effects of different welfare programs, such as the Earned Income Tax Credit, the Supplementary Nutrition Assistance Program, the Supplemental Security Income, the Temporary Assistance for Needy Families, and Medicaid, on poverty in the US (see, e.g., Hoynes and Patel (2018); Meyer and Wu (2018); Sommers and Oellerich (2013)). Another theme concerns the effects of minimum wages on poverty (see, e.g., Dube (2019); MaCurdy (2015); Neumark et al. (2018)). Once implemented, these anti-poverty policies can yield benefits rather quickly. By contrast, policies aiming to increase education are a long-term investment that can yield positive returns over the entire life course.

The rest of the paper is organized as follows. Section 2 describes the data and the compulsory schooling reform database. The empirical model and the identification strategy are explained in Section 3. Section 4 details the selection of reforms from the database for the analysis. The results along with robustness checks are presented in Section 5. Potential mechanisms are discussed in Section 6. Section 7 concludes.

2 Data

The data for the empirical analysis in this paper come from the EU-SILC (European Union Statistics on Income and Living Conditions) survey. The EU-SILC survey is used by the European Commission for monitoring the progress towards the Europe 2020 targets in the area of poverty and social exclusion. The survey has been conducted annually since 2004 by the national statistical offices and is coordinated by Eurostat. It yields nationally representative data for all 28 member states and Iceland, Norway, Serbia, and Switzerland. The total sample size encompasses over 600,000 individuals every year. The sample unit is the household and all its members. The primary mode of data collection is face-to-face personal interviews, but in countries with extensive registers (covering personal information such as income and education), individual telephone interviews with each household member aged 16 and older might be used to elicit personal information on work-related circumstances and health. In the analysis, I use cross-sectional data for the year 2015, which is the latest available year with full information on all 32 countries.⁵

2.1 Measures of poverty

Poverty is a multi-faceted concept (Bourguignon and Chakravarty, 2003). The perhaps most well-known poverty measure is that of extreme poverty. Developed by the World Bank in 1990, it was defined as having less than \$1 per day per person to live on. In developed countries, extreme poverty is zero or close to zero. Instead, measures of either absolute poverty (based on a certain amount of money needed to cover basic needs such as food, clothing, and shelter) or relative poverty (based on one’s economic status in relation to all other inhabitants of a country) can be used. Another measure used in previous studies is whether one qualifies for and claims means-tested social benefits. A criticism of these concepts is their narrow focus on income. The concept of social exclusion (e.g., exclusion from the welfare system, the labor market, social engagement in society) is broader but also more fuzzy (Atkinson and Da Voudi, 2000; Madanipour et al., 2015). All of these measures of poverty are based on predefined indicators. By contrast, subjective measures of poverty rely on people’s own assessment of their personal circumstances.

Based on the EU-SILC survey, the European Commission defined a poverty indicator called “at risk of poverty or social exclusion” (AROPE). This indicator is comprised of three sub-indicators, which capture whether people are at risk of poverty in terms of low income, material deprivation, and/or low work intensity. As described below, the first sub-indicator measures poverty in relative terms and the other two sub-indicators measure it in absolute terms. All of these sub-indicators are objective measures. Being considered poor by any of these three sub-indicators means that a person is AROPE (Jenkins, 2018). The EU-SILC survey also contains a question that captures people’s subjective assessment of whether they live in a state of poverty. Taken together, these two main indicators (plus

⁵In previous years, not all 32 countries were part of the EU-SILC survey. I do not pool cross-sections from different years, as the survey is based on a four-year rolling panel, meaning that some individuals that appear in 2015 have also been interviewed in 2012, 2013, and/or 2014.

the three sub-indicators) allow for a comprehensive measurement of poverty.

All measures of poverty refer to all members of the household alike in the EU-SILC survey. Every household has a main respondent who provides household-level information. The main respondent is (one of) the head(s) of the household, who in some sense can “speak for” the household. He or she answers questions related to the material deprivation status of the household and the subjective assessment of whether the household can make ends meet. All household members provide information on income and labor market history individually.⁶

The first sub-indicator of AROPE is “at risk of poverty”. It is defined as having an annual equivalized disposable income⁷ of less than 60% of the national median equivalized disposable income after social transfers. It is thus a measure of relative income poverty based on national circumstances. The second sub-indicator of AROPE is “severe material deprivation”. It is defined as not being able to afford at least four of the following nine items, which are considered to be “desirable or necessary to lead an adequate life”: pay all bills on time; take one week annual holiday away from home; eat a meal with meat, fish, or the vegetarian equivalent every other day; face unexpected expenses; keep the home adequately warm; a telephone; a TV; a washing machine; a car.⁸ It is thus a measure of the availability of basic necessities. The third sub-indicator of AROPE is “very low work intensity”. It is defined as a household in which the members of working age (aged 18 to 59, excluding students aged 18 to 24) worked less than 20% of their total work potential during the previous 12 months.⁹ It is thus a measure of weak labor market attachment.

The subjective measure of poverty refers to the main respondent’s perceived level of difficulty experienced by the household in making ends meet. The assessment is supposed to be based on the household’s total income. In the analysis, I code the answer categories “with great difficulty” and “with difficulty” as an indication of poverty.¹⁰

In the main sample used in the empirical analysis, 30.7% of all individuals live in households that consider themselves as poor; see Table 1. By contrast, the incidence of AROPE is 23.1%.¹¹ Notably, 14.8% of the individuals in the sample are both AROPE

⁶The fact that an individual’s poverty status is dependent on all other household members and possibly even based on survey questions not answered by herself/himself means that the effect of education might be diluted. In a robustness check, I show that the results based on the sample of “main respondents” are not statistically different from the sample of “non-main respondents”.

⁷The equivalized disposable income is the total household income divided by the number of “equivalent household members”, using the modified OECD equivalence scale; i.e., 1.0 to the first adult, 0.5 to the second and each subsequent person aged 14 and older, 0.3 to each child aged under 14.

⁸The capacity to afford any of the nine items refers to the household. Bills include rental and mortgage payments, utility bills, and other loan payments. Unexpected expenses amount to one twelfth of the national income-based poverty threshold. A telephone, a TV, a washing machine, or a car is only counted as unaffordable if the household would like to have the item but cannot afford it, and not if the household does not want or need it.

⁹Households composed only of children, of students aged less than 25, and of people aged 60 and older are excluded from the calculation of the indicator. The work potential is the number of months during which the household members theoretically could have worked.

¹⁰The other categories “with some difficulty”, “fairly easily”, “easily”, and “very easily” are coded as not feeling poor. Defining the poverty indicator more narrowly based on the category “with great difficulty” or more broadly based on the categories “with great difficulty”, “with difficulty”, and “with some difficulty” yields qualitatively similar results in the main analysis (results available upon request).

¹¹Note that there is some East-West division between European countries in the poverty rates, which I

and subjectively poor (39.0% are poor by any of these dimensions). That is, around two thirds of individuals who are classified as poor are also feeling poor, whereas around half of those who are feeling poor are classified as poor. Similarly, the three sub-indicators of AROPE overlap to some extent, as, e.g., a long-term unemployed person might have a low income and hence cannot afford several basic necessities. Yet only 1.4% of all individuals in the sample are classified as poor by all three sub-indicators simultaneously.

2.2 Sample restrictions

In this study, I quantify education as years spent in education. The number of years of education is not directly asked for in the EU-SILC survey, but it can be inferred from the year when the highest level of formal education was attained after subtracting the year of birth and the school starting age that applied to the birth cohort of the individual. Owing to this calculation, I have to drop countries in which the birth year of individuals is randomly perturbed (Germany and Malta), as well as countries in which the year when the highest level of formal education was attained is censored (Denmark, Norway, and Sweden)¹² in the disseminated EU-SILC data. This leaves 27 countries and 533,991 individuals for the analysis.

The crude calculation of the years of education will introduce measurement error. For instance, if a person finished lower secondary education and afterwards attended high school for one year before dropping out without obtaining a high school degree, the one-year attendance of high school would not be part of her/his calculated years of education. Another source of measurement error are people who study toward a higher degree in adult life after already having worked for a couple of years. As long as these educational patterns do not change abruptly from one birth cohort to the next one within a country, the estimation results will not be affected. Nonetheless, to minimize measurement error, I remove outliers in the years-of-education variable based on individuals' highest ISCED level attained.¹³

In the analysis, I include all individuals who are between 30 and 80 years old. The lower limit of 30 years ensures that people have completed their education and have had time to establish themselves on the labor market and move out from the parental household. 80 years is the upper limit because information on age is truncated at age 81 in the EU-SILC

address in section 5.2. But both AROPE and the subjective measure reflect national costs of living rather than a uniform level of costs of living across Europe.

¹²This information is also censored for Portugal and Slovenia, but the year of truncation is so far back in time that it does not affect people aged 80 or less.

¹³As individuals with less than primary education (International Standard Classification of Education (ISCED) level 0) do not have an entry for the year when the highest level of education was attained, I impute 3 years of education for them. Among individuals with ISCED level 1 (primary education), I drop individuals with fewer than 3 and more than 9 years of education. At ISCED level 2 (lower secondary education), those with fewer than 7 and more than 12 years are dropped. At ISCED level 3 (upper secondary education), those with fewer than 10 and more than 15 years are dropped. At ISCED level 4 (post-secondary non-tertiary education), those with fewer than 12 and more than 18 years are dropped. At ISCED level 5 and above (tertiary education), those with fewer than 14 and more than 22 years are dropped. Keeping all outliers in the sample slightly reduces the size of the point estimates of the two main measures of poverty, but both remain negative and significant at the 1% level (results available upon request).

data.¹⁴ This reduces the number of individuals from 533,991 to 345,012. I further drop all foreign-born individuals (33,709 cases), as they were not subject to national school laws, unless they had migrated to the country before school starting age. Finally, I drop observations with missing values on the year when the highest level of formal education was attained (except those with ISCED level 0) (5,772 cases) and the corresponding ISCED level (634 cases), negative years of education (124 cases), other outliers in the years-of-education variable as described above (51,323 cases), and missing values on the two main poverty measures (226 cases). This yields a sample of 253,224 individuals from 27 countries born between 1935 and 1985. Summary statistics for the final sample used in the empirical analysis are shown in Table 1.

2.3 Compulsory schooling reforms

For all 32 countries in the EU-SILC survey, I constructed a database containing information on compulsory schooling reforms. The database covers all birth cohorts from 1935 to 1995. Both in terms of number of countries and birth cohorts covered, this database goes markedly beyond any previous collection of reforms. For instance, Brunello et al. (2009) cover 12 countries and cohorts born between 1934 and 1969. The database covers both extensions and reductions in the length of compulsory schooling. Compulsory schooling has been free of charge in all countries throughout the covered period, and none of the reforms entailed an introduction or abolition of fees (except partly in a reform in Cyprus). The reforms in the database cover those at ISCED level 1 and above. Another contribution of this database rests in the use of original reports and research articles written by country-level experts (and an effort to identify and check the actual laws underlying all reforms) to gather information on all reforms, rather than relying on secondary sources which sometimes contain errors. More details on the compilation of the database and on each reform are provided in Online Appendix B.

Table B1 in Online Appendix B summarizes all reforms. A clear upward trend in the length of compulsory schooling is noticeable (despite some temporary reductions) across all countries over time. Cohorts born in the 1930s often had to attend school for around seven years, whereas nine to ten years applied to cohorts born in the 1990s. Portugal recorded the most significant increase from three years (for cohorts born until 1949) to twelve years (for cohorts born since 1997), whereas Croatia and Serbia have made no changes to their eight-year obligation since the 1938 cohort. Whenever a country made changes to the length of compulsory schooling, the provisions in other countries were most likely part of the deliberations of local policy makers. For instance, Fischer et al. (2013) note that Sweden benchmarked itself against other Western European countries in the debate preceding the reform in 1936. Reforms in Eastern Europe were more influenced by the Soviet model, and after 1990 by Western European countries (Cerych, 1997).

¹⁴In the case of Portugal it is truncated at age 80. I drop 80-year-olds in Portugal in the analysis.

3 Empirical strategy

The main challenge with estimating the causal effect of education on poverty is that education is not randomly assigned. This implies that any “naive” regression of poverty on education that does not control for the non-randomness of education will yield a coefficient that is biased. For instance, ill health may both lower education and increase poverty, leading to a downward bias in a regression that does not control for ill health. Alternatively, poverty might be transmitted across generations, and people end up living in poverty in adulthood because they themselves grew up in a poor household, which negatively affected their educational attainment.

In this study, I address the potential endogeneity of education using an instrumental variables (IV) strategy. In particular, I use exogenous variation created by changes in the length of compulsory schooling within and between European countries to identify the causal effect of education on poverty. I estimate the following equations for individual i , born in year t in country¹⁵ c :

$$Poverty_{itc} = \alpha_0 + \alpha_1 Education_{itc} + \gamma_c + \delta_t + \zeta_{tc} + \epsilon_{itc} \quad (1)$$

$$Education_{itc} = \beta_0 + \beta_1 CompEducation_{itc} + \eta_c + \theta_t + \kappa_{tc} + \nu_{itc}. \quad (2)$$

Here, $Education_{itc}$ stands for the number of years of education, and $CompEducation_{itc}$ is the number of years of compulsory schooling that applied to the individual. The coefficient of interest is α_1 in equation (1), which would be endogenous unless instrumented for according to the first-stage regression in equation (2). γ_c and η_c are country-fixed effects to control for national differences in poverty patterns. δ_t and θ_t are birth cohort-fixed effects to control for differences between all birth cohorts. ζ_{tc} and κ_{tc} are country-specific trends in birth cohorts¹⁶ to ensure that underlying trends in poverty are not incorrectly ascribed to changes in the length of compulsory schooling. ϵ_{itc} and ν_{itc} are error terms.

Following similar studies with a multi-country setup (e.g., Brunello et al. (2017)) or a multi-region setup (e.g., Pischke and von Wachter (2008)) as well as the advice by Cameron and Miller (2015), I cluster standard errors at the country-by-birth-cohort level in the estimations. Bertrand et al. (2004) advocate clustering standard errors at the country-level, which Black et al. (2008) show increases standard errors considerably in their study. In this study, the latter method also increases standard errors but the differences are negligible.

The empirical strategy follows an established literature¹⁷, which uses compulsory schooling reforms as a source of exogenous variation. The exact empirical setup in this paper draws inspiration from country-specific studies¹⁸ that take advantage of differences

¹⁵Note that I use “country” synonymously with “reform” here, as a country can have several reforms that affect different cohorts and that each enter separately into the IV regression.

¹⁶The trend is defined relative to the first birth cohort affected by a reform. In case of a linear trend, this is equivalent to controlling for the age of individuals.

¹⁷See Grossman (2006) and Lochner (2011) for reviews.

¹⁸Examples are Pekkarinen (2008) for Finland, Black et al. (2008) for Norway and the US, Felgueroso et al. (2014) for Spain, Lundborg and Majlesi (2018) for Sweden, Balestra and Backes-Gellner (2017) for

in the timing of the implementation of a certain reform across regions or municipalities. This resembles a difference-in-differences technique using cross-municipality and cross-time variation in the length of compulsory schooling to estimate the causal impact of education on different outcomes. Brunello et al. (2009) were the first ones to emulate such a staggered implementation on the country-level in a sample of European countries, drawing on different compulsory schooling reforms in these countries. Subsequent studies¹⁹ have used the same multi-country strategy of pooling over reforms to exploit exogenous variation from changes in the length of compulsory schooling across birth cohorts within each country and across countries for any given birth cohort. In order to mimic a country-specific study, these studies typically confine themselves to reforms that entailed changes in the length of compulsory schooling at roughly similar levels of education. I follow this approach in this study.

In line with the above-mentioned multi-country studies, I only include five birth cohorts before and after a reform in the estimation, instead of including all birth cohorts aged 30 to 80.²⁰ The choice of a five-year bandwidth rests partly on the fact that the reforms are spread out over a long period (from 1938 to 1983). As some countries changed the length of compulsory schooling several times during this period, the bandwidth is supposed to include only the change in question and not previous or subsequent changes. It also limits the influence of other reforms of the education systems (such as changes in curriculum or structure of the system) that occurred before or after a compulsory schooling reform. The size of the bandwidth is thus a question of potentially introducing bias if chosen too broadly and of efficiency in terms of sample size as well as of achieving sufficiently large overlap between “treated” and “untreated” birth cohorts across countries.

The IV strategy relies on the assumption that changes in the length of compulsory schooling induce changes in people’s eventual years of education obtained (i.e., a first stage should exist). This assumption is testable but it is also intuitive, as the very purpose of compulsory schooling reforms is to change the minimum number of years of education obtained. Furthermore, changes in the length of compulsory schooling should be unrelated to poverty other than through their effect on people’s years of education obtained (i.e., the exclusion restriction should hold). This assumption is untestable, but policy changes of that kind are unrelated to individuals’ socioeconomic characteristics and only affect individuals according to their date of birth.²¹ One concern pointed out by, e.g., Black and Devereux (2011), Holmlund et al. (2011), and Lundborg et al. (2014), is that compulsory schooling reforms might be correlated with other simultaneous changes. Examples are changes in school quality (through altered student-teacher ratios, delayed tracking or the

Switzerland, Pischke and von Wachter (2008) for West Germany.

¹⁹Examples are Brunello, Fabbri and Fort (2013); Brunello et al. (2016, 2017); Fort et al. (2016); Mazzonna (2014); Schneeweis et al. (2014); Stella (2013); Weiss (2015).

²⁰In a robustness check, I show that the exact size of the bandwidth does not affect the results and neither does abandoning it altogether.

²¹The date of birth is arguably not timed by individuals’ parents based on attempts to change future poverty outcomes. In fact, the database in Online Appendix B shows that all compulsory schooling reforms (except in Switzerland) were enacted after the affected individuals had been born.

abolition of different tracks²², or changes in the curriculum), peer group composition, and assortative mating, which might have a direct effect on poverty.²³ Brunello, Fort, Weber and Weiss (2013) and Bolzern and Huber (2017) try to address the internal validity of the compulsory schooling reform-instrument in different pooled samples of European countries and do not reject its validity.

The empirical strategy provides a causal effect of education on poverty based on a subgroup of all individuals, the compliers, who changed their educational attainment in response to the change in the length of compulsory schooling. The identified effect is thus a local average treatment effect (LATE) (Imbens and Angrist, 1994). The compliers are presumably concentrated among individuals with lower levels of education, who only attend school as long as the law obliges them to. Their returns on an additional year of education might be higher than the ones of the average person (Card, 2001). However, an increase in the length of compulsory schooling can also induce a shift of the whole educational distribution, as individuals with higher levels of education may feel a need to obtain more schooling as a means to keep distinguishing themselves from low-educated individuals.

4 Selection of reforms

Table B1 in Online Appendix B lists 83 reforms²⁴ covered by the database on compulsory schooling reforms. Not all of these reforms are suitable for the empirical analysis for the following reasons. First, after excluding the five countries with censored data mentioned in section 2.2, there are 74 reforms in 27 countries left. Second, owing to the considered age range from 30 to 80 years and data from 2015, I have to disregard reforms that became effective too early or too late. I include reforms in which the first birth cohort affected was born between 1938 and 1983, in order to have at least three birth cohorts before and after every reform. This reduces the number of reforms to 51. Third, due to the indirect calculation of the years of education obtained (see section 2.2), I have to disregard reforms that changed the length of compulsory schooling through a change in school starting age that only affected birth cohorts about to start school.²⁵ This is because in many of these reforms, most children used to enroll in school at the new school starting age already before the reform, and thus the indirect calculation of the years of education based on the official school starting age would create an artificial discontinuity at the reform date. This

²²The review by Betts (2011) shows that changes in tracking often result in effects that are insignificant or close to zero.

²³Another theoretical concern is the systematic movement to or from a country in response to a reform. However, selective international mobility by parents is arguably less of concern due to language barriers and restrictions in movement of people across borders.

²⁴There are actually 88 reforms listed, but I count the two reforms in Portugal in 1956 and 1960 as one, as they affected the same birth cohort. I also count the two extensions in the different regions of the UK from 9 to 10 years and from 10 to 11 years as only two, as I analyze the UK as one country given that the sample size for Northern Ireland is too small to analyze the 1947/1953 reform separately.

²⁵This concerns the reforms in Denmark 2008, Iceland 1991, Malta 1988, Netherlands 1985, Northern Ireland 1989, Norway 1994, and Slovenia 1999. By contrast, the reforms in Lithuania 1998 and Romania 1968+2003 imposed the new lengths also on birth cohorts already in school.

brings the number of reforms down to 50 in 27 countries.

In line with, e.g., Brunello, Fabbri and Fort (2013), Cavaille and Marshall (2019) and Fort et al. (2016), I test the existence and strength of a first stage for each one of the 50 reforms. The purpose of this test is to determine which reforms were effective in raising (in case of extensions in the length of compulsory schooling) or lowering (in case of reductions) the education level. It can also be viewed as a test of the monotonicity assumption of the IV strategy in order to identify reforms that are contaminated by defiers. I test the first stage according to:

$$Education_i = \alpha + \beta CompEducation_i + \gamma Trend_i + \delta(Trend_i * CompEducation_i) + \epsilon_i \quad (3)$$

for individual i . This amounts to a regression discontinuity design in which $CompEducation_i$ is the number of years of compulsory schooling that applied to the individual and that was changed by the compulsory schooling reform. $Trend_i$ is the running variable in terms of birth cohort and ϵ_i is an error term. Due to the small bandwidth, I only consider linear trends in birth cohorts²⁶ and use robust standard errors. The interaction of $Trend_i$ and $CompEducation_i$ allows for flexible trends, but imposing a common trend yields similar results.

I estimate equation (3) using bandwidths of four, five, and six years pre-reform and post-reform. The coefficient of interest is β . For the main analysis, I select all reforms in which the t-statistic of β is greater than -0.674, i.e., not significantly *negative* at the 50% significance level in all three regressions with bandwidths of four to six years. In robustness tests, I consider both a narrower sample of reforms with strictly *positive* regression coefficients (i.e., a t-statistic of greater than 0) and the widest possible sample of all 50 reforms.

Table 2 lists the 37 reforms in 23 countries which fulfill the selection criteria and which I use in the main analysis.²⁷ 20 reforms entailed increases or decreases by one year in the length of compulsory schooling, eight reforms by both two years and three years, and one by four years. 32 reforms extended the length and five reduced it. The reforms concerned changes in the length of compulsory schooling at roughly similar levels of education, mostly in the range of 7 to 10 years.

Figure 1 provides a graphical presentation of the first stage of the selected reforms. There is a clear discontinuity in the mean years of education attained at the first birth cohort affected by the reforms. This is true for reforms that entailed increases and decreases in the length of compulsory schooling. Figure 2 shows instead the whole educational dis-

²⁶Using quadratic trends yields similar results.

²⁷Various reasons might explain why the estimations of the first stage of the other 13 reforms yield effects that run counter to the intention of the reforms. The reforms in Greece in 1976, Czechia in 1990, Estonia in 1992, and Lithuania in 1991 coincided with the transition from the communist rule (military regime in Greece) to a democratic rule, which might have affected the enforcement of the school attendance laws. The reform in Romania in 1965 was the third reform in 17 years and it was (potentially in reaction to its ineffectiveness) followed up only three years later by a more profound reform. In the case of the reforms in Portugal in 1956 and 1960, students could finish compulsory schooling within a rather large age range which was not affected by the reforms, but if students started to enroll in school earlier after the reform, the indirect calculation of their years of education would create an erroneous discontinuity.

tribution and how it shifted in response to changes in the length of compulsory schooling. This sheds more light on who the compliers are, who help to identify the causal effect. Most of the shift is concentrated around the new higher or lower number of years of compulsory schooling (mostly between 7 and 10 years). This suggests that the reforms shifted indeed some students from the previous lower (higher) level to the new higher (lower) level, i.e., students who only attend school as long as they are obliged to.

In terms of increases in the length of compulsory schooling in Panel (a) in Figure 2, the shift of the educational distribution is also visible at higher levels of education. This could be owing to students who felt enticed to continue even beyond the compulsory school age thanks to the new obligation, as they acquired a taste for education during the additional compulsory year(s). It could also be due to potentially more able students, who tried to keep distinguishing themselves in terms of education from the now higher-educated students with the minimum level of schooling. In terms of decreases in the length of compulsory schooling in Panel (b) in Figure 2, there is a slight increase of the educational attainment visible at the tertiary education level. Students who in response to a worsening attitude towards education try to defy this development by investing more into education might explain this pattern. In a robustness check, I address this group of potential defiers by dropping all reforms entailing a reduction in the length of compulsory schooling.

5 Results

5.1 Main results

In this section, I present the results on the effects of education on poverty. For the interpretation of the estimated effects, note that all measures of poverty are dummy variables. Since I effectively estimate a linear probability model with IV, the estimated regression coefficients can be interpreted as probabilities of living in a state of poverty. Note that the coefficients capture the total impact to which several underlying mechanisms might contribute. I will discuss these in the next section.

Table 3 presents the main estimates of the effects of education on poverty. Column 1 shows the main results based on the preferred model specification. The results for the main objective measure of poverty (at risk of poverty or social exclusion, AROPE) are shown in Panel A. The IV estimate is -0.100, meaning that one additional year of education significantly reduces the risk of being AROPE by 10.0 percentage points (pp) among people aged 30 to 80. This represents an economically large decrease. Compared to the pre-reform mean of AROPE of about 35% in people with lower secondary education (ISCED level 2), this equals a 29% decrease in relative terms.²⁸

²⁸I choose to compare the IV estimates to the pre-reform means in this group of people based on graphical evidence in Figure 2, which indicates that the compliers are mostly located between 7 and 10 years of education. This corresponds roughly to individuals with lower secondary education (ISCED level 2). Angrist and Pischke (2009) recommend the kappa weighting method by Abadie (2003) to determine mean characteristics of the compliers. As the method requires that both the instrumental and the endogenous variable are binary, it cannot be used in this study.

The IV estimates for the three sub-indicators of AROPE in Panels B to D of Table 3 reveal that all of these sub-dimensions contribute to the overall result. An additional year of education reduces the risk of relative income poverty by 4.3 pp (18% in relative terms), of severe material deprivation by 2.7 pp (16%), and of very low work intensity by 2.6 pp (33%); the latter is only significant at the 10% level. The results on relative income poverty can be compared to the findings in Oreopoulos (2007) for Canada and the US, which are based on a sample of 25 to 64-year-olds. The author obtains an IV effect of an additional year of education of -2.6 pp (sample mean: 22.7%) for the likelihood to be below the low-income cut-off in Canada. For the US, the IV effect is -6.4 pp (sample mean: 22.0%) for the likelihood to be below the poverty line. The size of the US estimate is in line with the IV effect of -4.3 pp (sample mean: 14.8%) for Europe in this study.²⁹ The results on severe material deprivation (which contain aspects such as the ability to pay all bills on time and to face unexpected expenses) resemble the results in Cole et al. (2014), who find a reduced likelihood that a person declares bankruptcy, experiences a foreclosure, or has delinquent credit card payments in the US.

The IV estimate for the subjective measure of poverty in Panel E of Table 3 is also negative and statistically significant. It indicates that an additional year of education reduces the risk of experiencing difficulties in making ends meet by 6.9 pp. This corresponds to a 17% decrease in relative terms, if compared to the pre-reform mean of this measure (40%) in the above-mentioned group of people with lower secondary education. The reduced-form estimates of all outcomes in column 1 of Table 3 also indicate that one additional year of compulsory schooling significantly reduces the risk of poverty. Overall, the empirical evidence points to a potentially strong protective function of education against poverty in adulthood.³⁰

All IV estimates in Table 3 are larger than the corresponding ordinary least squares (OLS) estimates. Across the different outcomes, they are between two to three times larger than the OLS estimates. Overly large IV estimates can in general be the result of weak instruments. The conventional test for weak instruments is the rule of thumb by Staiger and Stock (1997) according to which instruments are weak when the first-stage F-statistic is less than 10. In the main specification in column 1, the F-statistic of the first stage is 47.5 (see bottom of Table 3), dispelling any concerns of a weak instrument. The first-stage coefficient indicates that one additional year of compulsory schooling increases the education level by 0.16 years, which is of a similar size as in previous studies with a comparable European multi-country setup (e.g., in Brunello et al. (2017) and Stella (2013)).

²⁹The results in this paper are less comparable to those based on welfare receipt in Heckman et al. (2018) and Oreopoulos and Salvanes (2011). Information on different types of social benefits that people or households receive is available in EU-SILC data. However, as different European countries have different welfare systems, benefits receipt is difficult to compare in a meaningful way. For instance, housing benefits are a common means to help poor households. In some countries housing benefits are paid out in cash (and hence recorded in EU-SILC data), whereas other countries provide these benefits indirectly through social housing or through rent control.

³⁰Using a single indicator for being objectively or subjectively poor, I also obtain a significant relative decrease of 23% (IV estimate: -0.118; standard error: 0.024).

The explanation for the size of the IV estimates rests in the fact that the estimates are identified by the compliers of the reforms. As shown in Figure 2, the compliers are mostly concentrated at lower levels of education. The gains from additional education might be much higher among this low-educated group of people. According to Card (2001), this helps to explain why the effect for this group (i.e., the LATE) is higher than the average effect (i.e., the ATE) across the whole population estimated via OLS (provided that education is not endogenous). An additional explanation is that IV corrects classical measurement error in the education variable, which causes attenuation bias (Card, 2001).

Table 3 presents also results for five alternative model specifications. The main specification in column 1 includes country-reform-specific linear trends in birth cohorts, a sex dummy as a control variable³¹, and clusters standard errors by country-reform and birth cohort. Adding quadratic trends in column 2 increases the IV estimates slightly in Panels A to D and reduces it in Panel E. The F-statistic of the first stage decreases to 27.0, but it is still very much indicative of a strong instrument. In column 3, I remove all trends in birth cohorts. This reduces all point estimates (except in Panel D) and removes the significance from the estimate for severe material deprivation. When no control variables are included in column 4, the results remain virtually unchanged compared to the main estimates. Clustering standard errors at the level of the 37 country-reforms in column 5 slightly increases all standard errors, which is enough to render the point estimate for very low work intensity insignificant.³² In column 6, I add personal weights provided in the EU-SILC data. Compared to the main estimates in column 1, this reduces the size of the IV estimates slightly (except in Panel B). The estimates for severe material deprivation and very low work intensity are rendered insignificant, owing also to a somewhat less precise estimation.

5.2 Heterogeneous effects

In Tables 4 and 5, I split the sample according to different characteristics in order to shed light on heterogeneity in the main results. Columns 1 and 2 of Table 4 show the results separately for men and women. All IV estimates as well as the reduced-form estimates for the four objective measures in Panels A to D are insignificant for men. Only the subjective measure of poverty in Panel E indicates a significant reduction for men. However, in the case of men, the instrument seems to be weak with an F-statistic of 7.3. The first-stage coefficient is also only half as large as that for women. By contrast, in the sample of women, more education significantly reduces poverty in all dimensions, which is backed up by a strong first stage. The latter finding is probably the result of women benefiting more from changes in compulsory schooling as they historically have had lower levels of

³¹The inclusion of other, though possibly endogenous, personal and household characteristics, such as dummy variables for being married, any children aged 0-17 living in the household, and the number of household members, does not change the main results (results available upon request).

³²Using heteroscedasticity-robust standard errors only renders the estimate for severe material deprivation insignificant (results available upon request).

education than men.³³ Previous studies have also highlighted that returns to education are higher among women (see, e.g., Harmon et al. (2003) and Dougherty (2005)).

Columns 3 and 4 of Table 4 present results for working age individuals (aged 30-59) and older individuals (aged 61-80).³⁴ In both age groups, education causally reduces AROPE, yet the sub-indicators of AROPE are statistically insignificant.³⁵ More education also significantly reduces difficulties in making ends meet in the working age group, whereas the negative point estimate for the group of older individuals narrowly misses to reach statistical significance. Selective mortality might however influence the estimates for the older group as low-educated people on average die at earlier ages.³⁶

The results for people living in rural areas and urban areas³⁷ are displayed in columns 5 and 6 of Table 4. Brunello et al. (2017) suggest that children living in rural areas were historically more affected by compulsory schooling reforms in Europe due to a generally lower level of education in the countryside. Here I find that the reforms had a similar impact in terms of the first stage for both rural and urban dwellers. In addition, education reduces poverty measured as AROPE and difficulties in making ends meet in both groups alike (the results are a bit more dissimilar for the sub-indicators of AROPE). This might be because the distinction between living in a rural or an urban area is based on the current place of residence rather than the place of residence during childhood and adolescence (due to data limitations in the EU-SILC survey). Migration (mostly) from rural to urban areas in adulthood might also play a role here. Indeed, using a sample of European countries, Weiss (2015) finds that education has a positive causal effect on the likelihood to move within one's country and on the likelihood to move from a rural area to a city.³⁸

Columns 1 and 2 of Table 5 provide a comparison of the estimates for countries in Eastern Europe and Western Europe.³⁹ The results reveal a heterogeneous picture. In

³³EU-SILC data indicate indeed that among older birth cohorts, men's average number of years of education exceed those of women, whereas the reverse is true for younger cohorts.

³⁴I choose not to include 60-year-olds, as some of them were still 59 at the time of the survey interview and hence were included in the measure for very low work intensity, which stops at age 59.

³⁵Note that the effect for the older group is identified through compulsory schooling reforms that changed the length at lower levels of education than the reforms that are used for the working age group. If the poverty-reducing benefits of schooling are marginally decreasing, the effect in the working age group should be smaller. Since the working age group is younger than the older group, poverty is measured at different stages of life, which makes it difficult to compare the estimates.

³⁶The causal effect of education on mortality has been studied extensively in the literature. For instance, Fischer et al. (2013) and Lundborg et al. (2016) find significant reductions in Sweden, whereas Clark and Royer (2013) in the UK, Malamud et al. (2018) in Romania, and Gathmann et al. (2015) using a sample of nine European countries find no effect (or only a small one). Galama et al. (2018) provide a review of the literature and conclude that the effect is ambiguous and depends on the context studied.

³⁷Using the classification in the EU-SILC data, I define rural area as "thinly-populated area", and urban area as both "densely-populated area" and "intermediate area".

³⁸Another aspect concerns education-induced international migration. The estimates in this paper are based on people living in the country that they were born in. The "stayers" could benefit either more or less from additional compulsory schooling than those who leave the country. If those benefiting the most leave the country, the estimates in this paper would underestimate the effect of education on poverty. Aparicio Fenoll and Kuehn (2017) find however that additional compulsory schooling reduces international migration across European countries among people aged 25 to 44. Yet migration flows across the EU member states are in general limited. In 2015, there were around 11.3 million EU-28 citizens of working age (20-64 years) living in a member state other than their country of citizenship, corresponding to 3.7% of the total working-age population in the EU-28 (Fries-Tersch et al., 2017).

³⁹Eastern Europe consists here of Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania,

Eastern Europe, education significantly reduces all measures of poverty, whereas in Western Europe none of the five (negative) IV estimates reaches significance (and neither do the reduced-form estimates). The first-stage coefficient for Western Europe is only somewhat smaller than the one for Eastern Europe, yet the F-statistic, which is above 10 in both cases, is only half as large in Western Europe. The tendency of Western European countries to have more comprehensive and redistributive welfare systems, which are better equipped to protect against poverty, might help to explain the different patterns.⁴⁰

In columns 3 to 5 of Table 5, I show results for a sample split according to the highest education level attained in order to learn where the effects are located. Among individuals with at most lower secondary education (ISCED level 2 or lower) in column 3, there are no significant effects of education on poverty. This is not surprising as many compulsory schooling reforms entailed an increase from ISCED level 2 to level 3. Hence, a potentially large group of compliers, who only attend school as long as they are obliged to, is excluded along with other compliers, who became motivated to stay in school beyond the compulsory level. The small first-stage coefficient as well as the F-statistic of below 10 are a reflection of this. The same argument might explain why there are hardly any significant effects in people with upper secondary education (ISCED level 3) in column 4. In people with at least post-secondary education (ISCED level 4 and above) in column 5, I find no significant effects and the instrument becomes very weak, as this group was arguably least affected by compulsory schooling reforms. This sample split highlights that the full sample is required to capture all compliers along the whole educational distribution, something which also Meghir and Palme (2005) and Brunello et al. (2009) observe.

5.3 Robustness

The identification strategy in this paper relies on compulsory schooling reforms as a source of exogenous variation. One concern is that the reforms pick up unobserved time trends or structural breaks in the respective countries. Similar to Schneeweis et al. (2014) and Brunello et al. (2017), I conduct a falsification test in which the reform dates are moved forward or backwards in time to address this concern. If the identification strategy is correct, the estimated first-stage coefficient should be smaller than in the main sample and effectively indicate a weak instrument. In addition, the reduced-form estimates should be insignificant, as these false reforms should have no effect on the outcomes. Table A1 presents the results of the placebo regressions in which the reforms are moved backwards or forward in time by two⁴¹ or three years. This is done both for the case when the five-year bandwidth is anchored at the actual reform date and when the bandwidth is shifted in accordance with the false reform. In all considered cases, the estimates of the first-stage

Poland, Romania, Slovakia, and Slovenia. The remaining countries are in Western Europe.

⁴⁰Note also that while it is true that the incidence of poverty is lower in Western Europe in the main sample (the mean of AROPE is 18% compared to 26% in Eastern Europe), AROPE contains a relative component (relative income poverty) defined on the country level. Also the subjective measure of difficulties in making ends meet (its mean is 20% in Western Europe and 37% in Eastern Europe) depends more on the national costs of living rather than on a uniform European level of costs of living.

⁴¹The exclusion of the two closely spaced reforms in the Netherlands does not alter the results.

coefficients are small and actually negative. The corresponding F-statistics are all below 10, indicating weak instruments. The reduced-form estimates are close to zero and mostly insignificant, and the ones that are significant point into the opposite direction compared to the main results. These results are thus supportive of the identification strategy.

In another test of the identification strategy, I replace the poverty outcomes with an indicator for individuals' sex, which is the only pre-determined personal characteristic available in the EU-SILC data. The reduced-form estimate of the years-of-compulsory-education variable is -0.003 and insignificant (standard error: 0.004). Furthermore, Panel (a) in Figure A1 shows that the share of men in the sample does not change in response to changes in compulsory schooling. This is also true for the share of survey interviews conducted during the second quarter of 2015 in Panel (b) in Figure A1. This lends further credibility to the identification strategy as pre-determined personal characteristics and survey characteristics should be unaffected by the reforms.

To investigate the robustness of the main results, I estimate different versions of the main model specification in Table A2. In the main specification, five birth cohorts are included before and after each reform in an attempt to strike a balance between introducing bias and increasing efficiency. In columns 1 and 2, I show that choosing a smaller bandwidth of four birth cohorts or a larger bandwidth of six birth cohorts has little impact on the results, although some of the sub-indicators of AROPE lose significance. This result is not surprising given that I selected the reforms in section 4 also using these bandwidths. A tougher robustness test is to abandon the bandwidth altogether and estimate the model using all birth cohorts before and after each reform ranging from 1935 to 1985. Column 3 of Table A2 shows that this slightly increases the point estimates for AROPE, relative income poverty, and severe material deprivation, reduces it for difficulties in making ends meet, and renders the estimate for very low work intensity insignificant. The first-stage coefficient along with the F-statistic is reduced, but the overall results are similar to the main results.

In column 4 of Table A2, I drop the first birth cohort affected by a compulsory schooling reform, as done by, e.g., Fort et al. (2016). Even though the database in Online Appendix B provides detailed information on the first birth cohort affected, the fact that EU-SILC data do not provide information on birth month puts constraints on the analysis (e.g., in the case of Austria or the UK). The first birth cohort affected might thus consist of a mix of individuals who were or were not affected by the reform, depending on their birth month and age of school entry. The results of this test in column 4 show that the estimates for AROPE and difficulties in making ends meet are mostly unaffected, whereas the sub-indicators of AROPE lose significance.

In columns 5 and 6 of Table A2, I split the sample into main respondents, who answer all poverty-related questions on behalf of the household, and into other respondents, whose answers only contribute directly to the household-based measures of relative income poverty and very low work intensity. The point estimates of the two main poverty measures are larger for main respondents than for non-main respondents, yet they are not

significantly different from each other. This shows how the positive effects of an additional year of education of one household member, who is not the main respondent, spread to other household members and their objective and subjective poverty situation.

The robustness of the results regarding the selection of compulsory schooling reforms is addressed in Table A3. In the main sample, I include the 37 reforms whose first stage is not significantly negative. Instead, I could have selected the 27 reforms in which the estimates of the first stage are strictly positive (irrespective of being statistically significant or not), in order to focus on reforms which likely brought about actual changes in the years of education. Column 1 shows that the results based on this trimmed sample are very similar to the main results, including the first-stage coefficient. By contrast, when I consider all 50 reforms in column 2, the instrument becomes weak with an F-statistic of 7.9, and the first-stage coefficient is essentially halved. The estimates for AROPE and very low work intensity retain statistical significance though.

As the aim of the empirical strategy is to emulate a staggered implementation of a reform across regions within a country, it is appropriate to focus on reforms that entailed changes in the length of compulsory schooling at roughly similar levels of education. In the main sample, most reforms are already in the range of 7 to 10 years.⁴² In column 3 of Table A3, I only select reforms that extended the length of compulsory schooling from a minimum of 8 years, or lowered it to a minimum of 8 years. 25 reforms in 18 countries of the reforms listed in Table 2 meet this criterion. The estimation results are remarkably similar to the main results, with possibly even a bit larger effects for AROPE. Another concern is the inclusion of reforms that involved the abolition (or introduction) of tuition fees. This applies only to the reform in Cyprus in 1985 and its exclusion has no impact on the results; see column 4. Closely spaced reforms might affect the results if they occur within the bandwidth of five years. There are two closely spaced reforms in the Netherlands, but their exclusion in column 5 has no impact on the results; if anything, they become strengthened. Lastly, graphical evidence in Figure 2 shows that there is potentially a group of defiers among the five reforms which reduced the length of compulsory schooling. Their exclusion in column 6 yields almost identical estimates compared to the main results.⁴³

As a final robustness test, I investigate the representativeness of the results based on different ways of weighting individual observations in Table A4. I already showed in Table 3 that the inclusion of personal survey weights has a modest influence on the results. However, the meaningfulness of solely including survey weights in a multi-country-reform setting can be questioned. As a remedy, I compute results based on four different kinds of so-called senate weights. Column 1 of Table A4 presents results using senate weights on the reform level, which means that each one of the 37 reforms is weighted equally. This hardly

⁴²Notable outliers are the reforms in Portugal 1964 and in Romania 1958. Excluding these two reforms does not alter the results in any noteworthy way (results available upon request).

⁴³Studying the effects solely based on the five reductions yields a significant first stage (estimate: 0.148; standard error: 0.054) but the F-statistic is 7.6, indicating a weak instrument. The reduced-form estimates for the two main poverty measures are negative but insignificant (results available upon request). However, these results are based on a small sample and there is not sufficient overlap between the reforms (two reforms are implemented at the same time, and the other three reforms are implemented around 35 years later and within three consecutive years).

changes the size of the point estimates, yet reduces the significance of the sub-indicators of AROPE a bit. Column 2 relies on senate weights on the country level, weighting the 23 countries (and multiple reforms within the same country) equally. This reduces the estimate for AROPE by a third whereas the estimate for difficulties in making ends meet remains almost unchanged. The estimates for the three sub-indicators of AROPE also become smaller and lose significance. In columns 3 and 4, I use senate weights on the reform level and the country level, respectively, which are based on the personal survey weights (instead of the sheer number of observations). This yields comparable estimates to columns 1 and 2.

6 Potential mechanisms

The results in this paper show that education has a large causal effect on reducing the likelihood of living in poverty in adulthood. In this section, I evaluate potential mechanisms behind these results. The data at hand allow me to explore mechanisms related to income, labor market status, health, and household characteristics.

Poverty in general, and all measures of it in this study, is clearly tied to individuals' current and historical performance in the labor market. Through a paid employment, people earn money needed to get by financially not just right now. They earn entitlements to social benefits that they receive if they become unemployed, sick, disabled, etc. during working age, and they earn pension entitlements that they can claim once they retire. To test this channel, I draw on the same empirical setup as in the main analysis. The first measure that I consider is whether individuals received any personal income⁴⁴ during the last year. The IV estimate in column 1 in Panel A of Table A5 shows that an additional year of education significantly increases the likelihood of receiving any personal income by 3.3 pp in people aged 30 to 80. This can be viewed as a test of an effect on the extensive margin of currently working or having worked. When looking instead at the intensive margin in column 2 and estimating the effect on the logarithm of personal income, I obtain insignificant returns to education, albeit of a reasonable size of 6.7% (see, e.g., Harmon et al. (2003) for a set of estimates for European countries).

As the estimates for 30 to 80-year-olds include pensioners, most of whom receive at least some minimum pension in all European countries, I consider separately people of working age (30 to 59 years) and disregard social benefits. In columns 3 and 4 in Panel A of Table A5, the IV estimates for receiving any personal earnings⁴⁵ (3.8 pp) and the returns based on those earnings (7.4%) are insignificant. However, I do obtain significant estimates based on people's self-defined economic status at the time of the survey interview. The IV

⁴⁴I follow the official definition of personal income used by Eurostat. It is defined as the sum of employee cash or near cash income, non-cash employee income (e.g., a company car), cash benefits or losses from self-employment, pension from individual private plans, old-age benefits, survivor benefits, unemployment benefits, sickness benefits, disability benefits, and education-related allowances. All income sources are measured in gross terms. I put negative incomes on any of these sources to zero.

⁴⁵Analogously to personal income, personal earnings are defined as the sum of employee cash or near cash income, non-cash employee income, and cash benefits or losses from self-employment.

estimate in column 5 indicates a 3.6 pp increase in being economically active⁴⁶, which is evidence of an effect on the extensive margin of labor market attachment. Note also that the size of the effect is almost identical to the (insignificant) one for having any personal earnings.⁴⁷ In column 6, the IV estimate for working full-time (as an employee or self-employed) indicates a 4.8 pp increase, which points to an effect on the intensive margin. These results on the importance of education for labor market-related factors are similar to recent evidence in, e.g., Fischer et al. (2016), Brunello et al. (2017) and Delaney and Devereux (2019) who studied (lifetime) earnings, pensions, and labor market attachment.

A prerequisite for participation in the labor market and consequently protection against poverty is good health. In columns 1 to 3 in Panel B of Table A5, I consider the effects of education on three measures of health. I find an increased likelihood to report to be in good health⁴⁸, a reduced likelihood to experience any limitations in activities because of health problems⁴⁹, but no significant changes in the likelihood to suffer from any chronic illness or condition.⁵⁰ These findings resemble the results in Oreopoulos (2007) on self-reported health and disabilities that limit daily activities. They are also consistent with the conclusion drawn in the review by Hamad et al. (2018) on the effects of education on health.

Additional potential mechanisms relate to the composition of the household. Marriage could be a means to avoid poverty, as it provides a safety net in case of temporary or permanent loss of income. However, in column 4 in Panel B of Table A5, I find no evidence of a causal effect of education on the likelihood of being married, which is similar to, e.g., Anderberg and Zhu (2014) who looked at women in the UK. Next, I show in column 5 that there is no causal effect of education on the household size. On the one hand, a greater number of people in the household could mean that more people can contribute to the pool of common resources. On the other hand, it could mean that there are more people to take care of, which puts a strain on the resources of the household. The latter point is especially relevant for the case of children living in the household. In column 6, I find a causal effect of more education reducing the likelihood of any children (aged 0 to 17) living in the household⁵¹, which thus might help to reduce poverty.

Two more potential mechanisms are worth mentioning, although they cannot be ad-

⁴⁶A person is currently economically active if he/she is an employee (working full-time or part-time), self-employed (full-time or part-time), or unemployed.

⁴⁷This holds also true for the IV estimate for being employed (as an employee or self-employed) which is 4.4 pp and significant at the 10% level (not shown in Table A5).

⁴⁸The underlying question in the EU-SILC survey asks people on their general health level, with five possible answer categories (very good, good, fair, bad, very bad). I turn this variable into an indicator variable and classify “very good” and “good” as being in good health.

⁴⁹For the underlying indicator variable, I group the answers “strongly limited” and “limited” into one category, while “not limited” constitutes the other category.

⁵⁰An example for why education might reduce health limitations but not chronic conditions is diabetes. If one suffers from the disease, more educated people may follow the medical advice more closely and hence are more able to control the impairments of the disease.

⁵¹In the literature there is mixed evidence on the effects of education on fertility. For instance, Cygan-Rehm and Maeder (2013) find a negative relationship for Germany, while Fort et al. (2016) only find a negative relationship for the UK (which Geruso and Royer (2018) cannot confirm) but not for a sample of other Western European countries.

dressed with EU-SILC data. First, education has been shown to have a large causal effect on reducing participation in criminal activity (Lochner and Moretti, 2004; Hjalmarsson et al., 2015). As criminal records impair future labor market prospects (Freeman, 1999; Ahmed and Lång, 2017), this can increase the risk of living in poverty. Second, there is a vast literature on how poverty is related to worse decision-making and cognitive abilities (see, e.g., Mani et al. (2013) and Haushofer and Fehr (2014) and the reviews of previous literature therein). Education may improve the ability to manage one’s financial resources, which may facilitate the accumulation of a financial cushion that helps to protect against poverty. Studies such as Crespo et al. (2014), Schneeweis et al. (2014), and Carlsson et al. (2015) provide causal evidence of a positive effect of education on cognitive abilities. Evidence of a causal effect of education on improved financial decision-making is mixed; Cole et al. (2014) and Black et al. (2018) find such effects in the context of financial portfolio choices whereas Banks et al. (2018) do not.

7 Conclusion

In this paper, I examine the causal effects of education on poverty in adulthood. Using 37 compulsory schooling reforms across 23 European countries as an instrument, I find economically large effects of an additional year of education on reducing the likelihood of living in poverty. These effects are not limited to a one-dimensional measure based on income. In addition to reducing the likelihood of relative income poverty, education also reduces the likelihood of lacking basic necessities in the household, and living in a household with weak labor market attachment. This holds also true for the summary measure of poverty and social exclusion, which spans across these three objectively-measured dimensions. Investigating instead the subjectively-assessed poverty status, I show that an additional year of education reduces the likelihood of experiencing difficulties in making ends meet. Thus, an additional year of education reduces not only the likelihood of being classified as living in poverty but also the likelihood of considering oneself to live in poverty.

The findings in this paper have important policy implications. Taking as an example the Europe 2020 strategy with its aim to reduce rates of poverty and social exclusion from 23% in 2008 to 19% in 2020, the potential contribution of increasing educational attainment is considerable. The magnitude of the main estimate for poverty and social exclusion in this paper (10 pp) cannot be viewed as an effect across the entire population given its LATE nature. It points however to large gains among the lower-educated part of the population, who might benefit from additional years of education. Compulsory attendance of upper secondary education or compulsory vocational training after completion of lower secondary education are measures that could be taken and that most European countries have not yet introduced.

References

- Aakvik, A., Salvanes, K. G. and Vaage, K. (2010), ‘Measuring heterogeneity in the returns to education using an education reform’, *European Economic Review* **54**(4), 483–500.
- Abadie, A. (2003), ‘Semiparametric instrumental variable estimation of treatment response models’, *Journal of Econometrics* **113**(2), 231–263.
- Acemoglu, D. and Angrist, J. (2001), How large are human-capital externalities? Evidence from compulsory schooling laws, in B. S. Bernanke and K. Rogoff, eds, ‘NBER Macroeconomics Annual 2000’, MIT Press, Cambridge, MA, pp. 9–59.
- Ahmed, A. M. and Lång, E. (2017), ‘The employability of ex-offenders: A field experiment in the Swedish labor market’, *IZA Journal of Labor Policy* **6**(1), 6.
- Anderberg, D. and Zhu, Y. (2014), ‘What a difference a term makes: The effect of educational attainment on marital outcomes in the UK’, *Journal of Population Economics* **27**(2), 387–419.
- Angrist, J. D. and Pischke, J.-S. (2009), *Mostly Harmless Econometrics: An Empiricist’s Companion*, Princeton University Press, Princeton, NJ.
- Aparicio Fenoll, A. and Kuehn, Z. (2017), ‘Compulsory schooling laws and migration across European countries’, *Demography* **54**(6), 2181–2200.
- Arnet, M. (2000), *Das Schulkonkordat vom 29. Oktober 1970 - Entstehung Geschichte Kommentar*, Schweizerische Konferenz der kantonalen Erziehungsdirektoren (EDK), Bern.
- Atkinson, R. and Da Voudi, S. (2000), ‘The concept of social exclusion in the European Union: Context, development and possibilities’, *JCMS: Journal of Common Market Studies* **38**(3), 427–448.
- Balestra, S. and Backes-Gellner, U. (2017), ‘Heterogeneous returns to education over the wage distribution: Who profits the most?’, *Labour Economics* **44**, 89–105.
- Banks, J., Carvalho, L. S. and Perez-Arc, F. (2018), ‘Education, decision-making, and economic rationality’, *Review of Economics and Statistics* (forthcoming).
- Bertrand, M., Duflo, E. and Mullainathan, S. (2004), ‘How much should we trust differences-in-differences estimates?’, *Quarterly Journal of Economics* **119**(1), 249–275.
- Betts, J. R. (2011), The economics of tracking in education, in E. A. Hanushek, S. Machin and L. Woessmann, eds, ‘Handbook of the Economics of Education’, Vol. 3, Elsevier, Amsterdam, pp. 341–381.
- Black, S. E. and Devereux, P. J. (2011), Recent developments in intergenerational mobility, in D. Card and O. Ashenfelter, eds, ‘Handbook of Labor Economics’, Vol. 4, Elsevier, Amsterdam, pp. 1487–1541.

- Black, S. E., Devereux, P. J., Lundborg, P. and Majlesi, K. (2018), ‘Learning to take risks? The effect of education on risk-taking in financial markets’, *Review of Finance* **22**(3), 951–975.
- Black, S. E., Devereux, P. J. and Salvanes, K. G. (2008), ‘Staying in the classroom and out of the maternity ward? The effect of compulsory schooling laws on teenage births’, *Economic Journal* **118**(530), 1025–1054.
- Bolzern, B. and Huber, M. (2017), ‘Testing the validity of the compulsory schooling law instrument’, *Economics Letters* **159**, 23–27.
- Bourguignon, F. and Chakravarty, S. R. (2003), ‘The measurement of multidimensional poverty’, *Journal of Economic Inequality* **1**(1), 25–49.
- Brandolini, A. and Cipollone, P. (2002), ‘Return to education in Italy: 1992-1997’, *Unpublished Working Paper* (Version September 25, 2002).
- Brilli, Y. and Tonello, M. (2018), ‘Does increasing compulsory education decrease or displace adolescent crime? New evidence from administrative and victimization data’, *CESifo Economic Studies* **64**(1), 15–49.
- Brunello, G., Fabbri, D. and Fort, M. (2013), ‘The causal effect of education on body mass: Evidence from Europe’, *Journal of Labor Economics* **31**(1), 195–223.
- Brunello, G., Fort, M., Schneeweis, N. and Winter-Ebmer, R. (2016), ‘The causal effect of education on health: What is the role of health behaviors?’, *Health Economics* **25**(3), 314–336.
- Brunello, G., Fort, M. and Weber, G. (2009), ‘Changes in compulsory schooling, education and the distribution of wages in Europe’, *Economic Journal* **119**(536), 516–539.
- Brunello, G., Fort, M., Weber, G. and Weiss, C. T. (2013), ‘Testing the internal validity of compulsory school reforms as instrument for years of schooling’, *IZA Discussion Paper* (No. 7533).
- Brunello, G., Weber, G. and Weiss, C. T. (2017), ‘Books are forever: Early life conditions, education and lifetime earnings in Europe’, *Economic Journal* **127**(600), 271–296.
- Buchinsky, M. (1994), ‘Changes in the U.S. wage structure 1963-1987: Application of quantile regression’, *Econometrica* **62**(2), 405–458.
- Cabus, S. J. and De Witte, K. (2011), ‘Does school time matter? On the impact of compulsory education age on school dropout’, *Economics of Education Review* **30**(6), 1384–1398.
- Cameron, A. C. and Miller, D. L. (2015), ‘A practitioner’s guide to cluster-robust inference’, *Journal of Human Resources* **50**(2), 317–372.

- Card, D. (1999), The causal effect of education on earnings, *in* O. C. Ashenfelter and D. Card, eds, ‘Handbook of Labor Economics’, Vol. 3, Elsevier, Amsterdam, pp. 1801–1863.
- Card, D. (2001), ‘Estimating the return to schooling: Progress on some persistent econometric problems’, *Econometrica* **69**(5), 1127–1160.
- Carlsson, M., Dahl, G. B., Öckert, B. and Rooth, D.-O. (2015), ‘The effect of schooling on cognitive skills’, *Review of Economics and Statistics* **97**(3), 533–547.
- Cavaille, C. and Marshall, J. (2019), ‘Education and anti-immigration attitudes: Evidence from compulsory schooling reforms across Western Europe.’, *American Political Science Review* **113**(1), 254–263.
- Cerych, L. (1997), ‘Educational reforms in Central and Eastern Europe: Processes and outcomes’, *European Journal of Education* **32**(1), 75–96.
- CIA (1953), ‘Schools in Yugoslavia’, Central Intelligence Agency.
- Clark, D. and Royer, H. (2013), ‘The effect of education on adult mortality and health: Evidence from Britain’, *American Economic Review* **103**(6), 2087–2120.
- Cole, S., Paulson, A. and Shastry, G. K. (2014), ‘Smart money? The effect of education on financial outcomes’, *Review of Financial Studies* **27**(7), 2022–2051.
- Commission of the European Communities (1987), *The Education Structures in the Member States of the European Communities*, Office for Official Publications of the European Communities, Luxembourg.
- Crespo, L., López-Noval, B. and Mira, P. (2014), ‘Compulsory schooling, education, depression and memory: New evidence from SHARELIFE’, *Economics of Education Review* **43**, 36–46.
- Cygan-Rehm, K. (2018), ‘Is additional schooling worthless? Revising the zero returns to compulsory schooling in Germany’, *CESifo Working Papers* (No. 7191).
- Cygan-Rehm, K. and Maeder, M. (2013), ‘The effect of education on fertility: Evidence from a compulsory schooling reform’, *Labour Economics* **25**, 35–48.
- Delaney, J. M. and Devereux, P. J. (2019), ‘More education, less volatility? The effect of education on earnings volatility over the life cycle’, *Journal of Labor Economics* **37**(1), 101–137.
- Domovic, V. and Vizek Vidovic, V. (2015), Croatia: An overview of educational reforms, 1950-2014, *in* T. Corner, ed., ‘Education in the European Union: Post-2003 Member States’, Bloomsbury Academic, London, pp. 27–50.
- Dougherty, C. (2005), ‘Why are the returns to schooling higher for women than for men?’, *Journal of Human Resources* **40**(4), 969–988.

- Dube, A. (2019), ‘Minimum wages and the distribution of family incomes’, *American Economic Journal: Applied Economics* (forthcoming).
- Eurydice (1996), *A Decade of Reforms at Compulsory Education Level in the European Union (1984-94)*, Education, Audiovisual and Culture Executive Agency, Brussels.
- Eurydice (2012), *Key Data on Education in Europe 2012*, Education, Audiovisual and Culture Executive Agency, Brussels.
- Felgueroso, F., Gutiérrez-Domènech, M. and Jiménez-Martín, S. (2014), ‘Dropout trends and educational reforms: The role of the LOGSE in Spain’, *IZA Journal of Labor Policy* **3**(1), 9.
- Fischer, M., Karlsson, M. and Nilsson, T. (2013), ‘Effects of compulsory schooling on mortality: Evidence from Sweden’, *International Journal of Environmental Research and Public Health* **10**(8), 3596–3618.
- Fischer, M., Karlsson, M., Nilsson, T. and Schwarz, N. (2016), ‘The sooner the better? Compulsory schooling reforms in Sweden’, *IZA Discussion Paper* (No. 10430).
- Fort, M. (2006), ‘Educational reforms across Europe: A toolbox for empirical research’, *Unpublished Working Paper* (Version May 11, 2006).
- Fort, M., Schneeweis, N. and Winter-Ebmer, R. (2016), ‘Is education always reducing fertility? Evidence from compulsory schooling reforms’, *Economic Journal* **126**(595), 1823–1855.
- Freeman, R. B. (1999), The economics of crime, in O. C. Ashenfelter and D. Card, eds, ‘Handbook of Labor Economics’, Vol. 3, Elsevier, Amsterdam, pp. 3529–3571.
- Fries-Tersch, E., Tugran, T. and Bradley, H. (2017), *2016 Annual Report on intra-EU Labour Mobility*, Publications Office of the European Union, Luxembourg.
- Gabric, A. (2000), ‘The education system in Slovenia in the 20th century’, *Družboslovne razprave* **XVI**(55-71), 447–459.
- Galama, T., Lleras-Muney, A. and van Kippersluis, H. (2018), *The Effect of Education on Health and Mortality: A Review of Experimental and Quasi-Experimental Evidence*, Oxford Research Encyclopedia of Economics and Finance.
- Garrouste, C. (2010), *100 Years of Educational Reforms in Europe: A Contextual Database*, Publications Office of the European Union, Luxembourg.
- Gathmann, C., Jürges, H. and Reinhold, S. (2015), ‘Compulsory schooling reforms, education and mortality in twentieth century Europe’, *Social Science & Medicine* **127**, 74–82.
- Georgeoff, J. (1979), Rural education in Bulgaria: Contemporary development and policies, in I. Volgyes, ed., ‘The Peasantry of Eastern Europe’, Pergamon Press, Oxford, pp. 123–139.

- Geruso, M. and Royer, H. (2018), ‘The impact of education on family formation: Quasi-experimental evidence from the UK’, *NBER Working Paper* (No. 24332).
- Grenet, J. (2013), ‘Is extending compulsory schooling alone enough to raise earnings? Evidence from French and British compulsory schooling laws’, *Scandinavian Journal of Economics* **115**(1), 176–210.
- Grossman, M. (2006), Education and nonmarket outcomes, in E. A. Hanushek and F. Welch, eds, ‘Handbook of the Economics of Education’, Vol. 1, Elsevier, Amsterdam, pp. 577–633.
- Guglietti, M. (2013), ‘31 dicembre 1962 legge 1859, istituzione e ordinamento della scuola media’, Cisl Scuola.
- Hamad, R., Elser, H., Tran, D. C., Rehkopf, D. H. and Goodman, S. N. (2018), ‘How and why studies disagree about the effects of education on health: A systematic review and meta-analysis of studies of compulsory schooling laws’, *Social Science & Medicine* **212**, 168–178.
- Harmon, C., Oosterbeek, H. and Walker, I. (2003), ‘The returns to education: Microeconomics’, *Journal of Economic Surveys* **17**(2), 115–156.
- Haushofer, J. and Fehr, E. (2014), ‘On the psychology of poverty’, *Science* **344**(6186), 862–867.
- Heckman, J. J., Humphries, J. E. and Veramendis, G. (2018), ‘The nonmarket benefits of education and ability’, *Journal of Human Capital* **12**(2), 282–304.
- Heckman, J. J., Lochner, L. J. and Todd, P. E. (2006), Earnings functions, rates of return and treatment effects: The Mincer equation and beyond, in E. A. Hanushek and F. Welch, eds, ‘Handbook of the Economics of Education’, Vol. 1, Elsevier, Amsterdam, pp. 307–458.
- Hjalmarsson, R., Holmlund, H. and Lindquist, M. J. (2015), ‘The effect of education on criminal convictions and incarceration: Causal evidence from micro-data’, *Economic Journal* **125**(587), 1290–1326.
- Holmlund, H., Lindahl, M. and Plug, E. (2011), ‘The causal effect of parents’ schooling on children’s schooling: A comparison of estimation methods’, *Journal of Economic Literature* **49**(3), 615–651.
- Hoynes, H. W. and Patel, A. J. (2018), ‘Effective policy for reducing poverty and inequality? The Earned Income Tax Credit and the distribution of income’, *Journal of Human Resources* **53**(4), 859–890.
- Hörner, W., Döbert, H., von Kopp, B. and Mitter, W. (2007), *The Education Systems of Europe*, 1 edn, Springer, Dordrecht.

- Imbens, G. W. and Angrist, J. D. (1994), ‘Identification and estimation of local average treatment effects’, *Econometrica* **62**(2), 467–475.
- Jenkins, S. P. (2018), ‘Perspectives on poverty in Europe’, *IZA Discussion Paper* (No. 12014).
- Jung-Miklaszewska, J. (2003), *The System of Education in the Republic of Poland - Schools and Diplomas (Translated version of: System Edukacji w Rzeczypospolitej Polskiej. Szkoły i dyplomy)*, Bureau for Academic Recognition and International Exchange, Warsaw.
- Kamhöfer, D. A. and Schmitz, H. (2016), ‘Reanalyzing zero returns to education in Germany’, *Journal of Applied Econometrics* **31**(5), 912–919.
- Kazamias, A. M. (1978), ‘The politics of educational reform in Greece: Law 309/1976’, *Comparative Education Review* **22**(1), 21–45.
- Kontogiannopoulos, V. N. (1978), ‘Goals of educational reform policies’, *Comparative Education Review* **22**(1), 3–6.
- Liwiński, J. (2018a), ‘The impact of compulsory education on employment and earnings in a transition economy’, *GLO Discussion Paper* (No. 193).
- Liwiński, J. (2018b), ‘The impact of compulsory schooling on earnings: Evidence from the 1999 education reform in Poland’, *GLO Discussion Paper* (No. 253).
- Lochner, L. (2011), Nonproduction benefits of education: Crime, health, and good citizenship, in E. A. Hanushek, S. Machin and L. Woessmann, eds, ‘Handbook of the Economics of Education’, Vol. 4, Elsevier, Amsterdam, pp. 183–282.
- Lochner, L. and Moretti, E. (2004), ‘The effect of education on crime: Evidence from prison inmates, arrests, and self-reports’, *American Economic Review* **94**(1), 155–189.
- Lundborg, P., Lyttkens, C. H. and Nystedt, P. (2016), ‘The effect of schooling on mortality: New evidence from 50,000 Swedish twins’, *Demography* **53**(4), 1135–1168.
- Lundborg, P. and Majlesi, K. (2018), ‘Intergenerational transmission of human capital: Is it a one-way street?’, *Journal of Health Economics* **57**, 206–220.
- Lundborg, P., Nilsson, A. and Rooth, D.-O. (2014), ‘Parental education and offspring outcomes: Evidence from the Swedish compulsory school reform’, *American Economic Journal: Applied Economics* **6**(1), 253–78.
- MacCurdy, T. (2015), ‘How effective is the minimum wage at supporting the poor?’, *Journal of Political Economy* **123**(2), 497–545.
- Madanipour, A., Shucksmith, M. and Talbot, H. (2015), ‘Concepts of poverty and social exclusion in Europe’, *Local Economy* **30**(7), 721–741.

- Malamud, O., Mitrut, A. and Pop-Eleches, C. (2018), ‘The effect of education on mortality and health: Evidence from a schooling expansion in Romania’, *NBER Working Paper* (No. 24341).
- Malamud, O. and Pop-Eleches, C. (2010), ‘General education versus vocational training: Evidence from an economy in transition’, *Review of Economics and Statistics* **92**(1), 43–60.
- Mani, A., Mullainathan, S., Shafir, E. and Zhao, J. (2013), ‘Poverty impedes cognitive function’, *Science* **341**(6149), 976–980.
- Mazzonna, F. (2014), ‘The long lasting effects of education on old age health: Evidence of gender differences’, *Social Science & Medicine* **101**, 129–138.
- Meghir, C. and Palme, M. (2003), ‘Ability, parental background and education policy: Empirical evidence from a social experiment’, *IFS Working Papers* (No. 03/05).
- Meghir, C. and Palme, M. (2005), ‘Educational reform, ability, and family background’, *American Economic Review* **95**(1), 414–424.
- Meyer, B. D. and Wu, D. (2018), ‘The poverty reduction of social security and means-tested transfers’, *ILR Review* **71**(5), 1106–1153.
- Ministry of Education, Science and Sport (2001), ‘The development of education: National report of the Republic of Slovenia’, Ministry of Education, Science and Sport, Ljubljana.
- Murtin, F. and Viarengo, M. (2011), ‘The expansion and convergence of compulsory schooling in Western Europe, 1950–2000’, *Economica* **78**(311), 501–522.
- Neumark, D., Asquith, B. J. and Bass, B. (2018), ‘Longer-run effects of anti-poverty policies on disadvantaged neighborhoods’, *NBER Working Paper* (No. 25231).
- Nica, I. and Birzea, C. (1973), ‘Educational innovation in European socialist countries: A comparative overview’, *International Review of Education / Internationale Zeitschrift für Erziehungswissenschaft / Revue Internationale de l’Education* **19**(4), 447–459.
- Oosterbeek, H. and Webbink, D. (2007), ‘Wage effects of an extra year of basic vocational education’, *Economics of Education Review* **26**(4), 408–419.
- Oreopoulos, P. (2007), ‘Do dropouts drop out too soon? Wealth, health and happiness from compulsory schooling’, *Journal of Public Economics* **91**(11), 2213–2229.
- Oreopoulos, P. and Salvanes, K. G. (2011), ‘Priceless: The nonpecuniary benefits of schooling’, *Journal of Economic Perspectives* **25**(1), 159–184.
- Pekkarinen, T. (2008), ‘Gender differences in educational attainment: Evidence on the role of tracking from a Finnish quasi-experiment’, *Scandinavian Journal of Economics* **110**(4), 807–825.

- Pischke, J.-S. and von Wachter, T. (2008), ‘Zero returns to compulsory schooling in Germany: Evidence and interpretation’, *Review of Economics and Statistics* **90**(3), 592–598.
- Pons, E. and Gonzalo, M. T. (2002), ‘Returns to schooling in Spain: How reliable are instrumental variable estimates?’, *LABOUR* **16**(4), 747–770.
- Robles-Zurita, J. A. (2017), ‘Cognitive skills and the LOGSE reform in Spain: Evidence from PIAAC’, *SERIEs* **8**(4), 401–415.
- Schneeweis, N., Skirbekk, V. and Winter-Ebmer, R. (2014), ‘Does education improve cognitive performance four decades after school completion?’, *Demography* **51**(2), 619–643.
- Sommers, B. D. and Oellerich, D. (2013), ‘The poverty-reducing effect of Medicaid’, *Journal of Health Economics* **32**(5), 816–832.
- Staiger, D. and Stock, J. H. (1997), ‘Instrumental variables regression with weak instruments’, *Econometrica* **65**(3), 557–586.
- Stella, L. (2013), ‘Intergenerational transmission of human capital in Europe: Evidence from SHARE’, *IZA Journal of European Labor Studies* **2**(1), 1–24.
- Tomich, V. (1963), ‘Education in Yugoslavia and the new reform: The legal basis, organization, administration, and program of the secondary schools’, Office of Education, US Department of Health, Education, and Welfare. Bulletin, No. 20, OE-14089.
- van Kippersluis, H., O’Donnell, O. and van Doorslaer, E. (2011), ‘Long-run returns to education: Does schooling lead to an extended old age?’, *Journal of Human Resources* **46**(4), 695–721.
- Vieira, J. (1999), ‘Returns to education in Portugal’, *Labour Economics* **6**(4), 535–541.
- Weiss, C. T. (2015), ‘Education and regional mobility in Europe’, *Economics of Education Review* **49**, 129–141.
- Zivojnović, P. and Levi, Z. (1959), ‘School reform in Yugoslavia (Yugoslavia’s new education act)’, *International Review of Education / Internationale Zeitschrift für Erziehungswissenschaft / Revue Internationale de l’Education* **5**(4), 469–477.

Figures and Tables

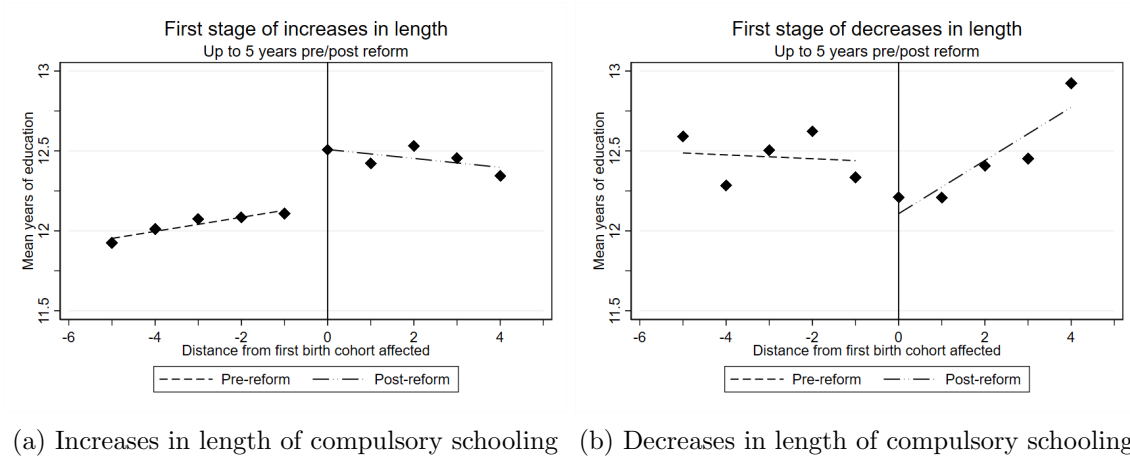


Figure 1: Years of education by birth cohort before and after compulsory schooling reforms
Notes: All underlying reforms include at least three pre-reform and post-reform birth cohorts.

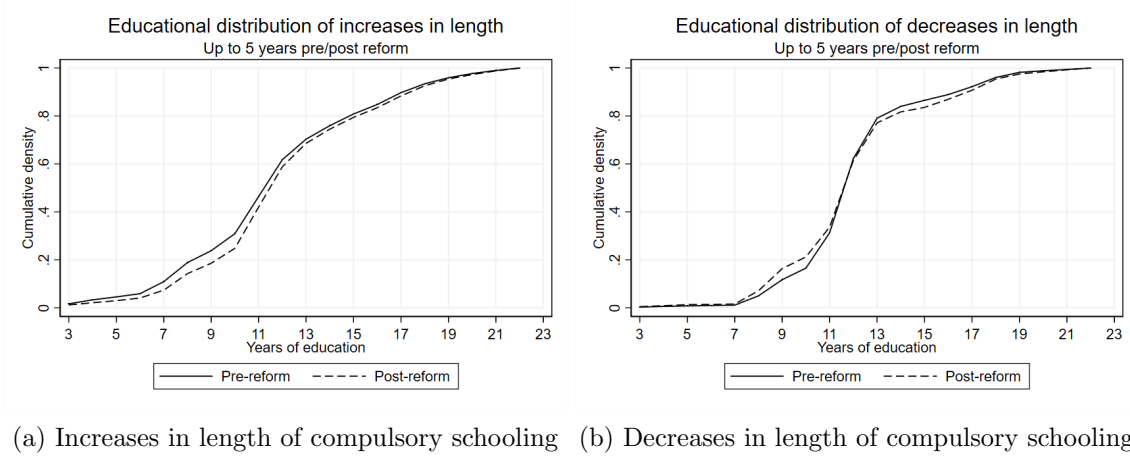


Figure 2: Educational distribution before and after compulsory schooling reforms

Table 1: Descriptive statistics

| | Mean | Std. Dev. | Min | Max |
|--|--------|-----------|------|------|
| <i>Poverty measures</i> | | | | |
| At risk of poverty or social exclusion | .232 | .422 | 0 | 1 |
| - Relative income poverty | .148 | .355 | 0 | 1 |
| - Severe material deprivation | .103 | .304 | 0 | 1 |
| - Very low work intensity | .063 | .244 | 0 | 1 |
| Difficulties in making ends meet | .307 | .461 | 0 | 1 |
| Poor by any dimension | .390 | .488 | 0 | 1 |
| <i>Education</i> | | | | |
| Years of education | 12.27 | 3.74 | 3 | 22 |
| Years of compulsory education | 8.47 | 1.58 | 4 | 12 |
| <i>Socio-economic characteristics</i> | | | | |
| Year of birth | 1959.8 | 13.2 | 1935 | 1985 |
| Age | 55.2 | 13.2 | 30 | 80 |
| Male | .466 | .499 | 0 | 1 |
| Any personal income | .920 | .271 | 0 | 1 |
| Any personal earnings | .561 | .496 | 0 | 1 |
| Economically active | .558 | .497 | 0 | 1 |
| Employed | .501 | .500 | 0 | 1 |
| Employed, full-time | .430 | .495 | 0 | 1 |
| In good subjective health | .551 | .497 | 0 | 1 |
| Any chronic health problems | .387 | .487 | 0 | 1 |
| Any health limitations | .323 | .468 | 0 | 1 |
| Married | .661 | .473 | 0 | 1 |
| Household size | 2.83 | 1.44 | 1 | 15 |
| Single-person household | .138 | .345 | 0 | 1 |
| Any children aged 0-17 in household | .273 | .446 | 0 | 1 |
| Living in rural area | .431 | .495 | 0 | 1 |
| Observations | 63,996 | | | |

Notes: The sample includes up to five birth cohorts before and after a reform. There are slightly fewer observations for the economically active, employed, and employed full-time variables (all 63,955), the health-related variables (57,811, 58,895, and 58,873, respectively, in order of appearance), the marriage variable (63,993), and the rural area variable (58,766).

Table 2: Overview of selected compulsory schooling reforms

| Country | Change in ... | | | Reform date | First birth cohort affected | Sample size |
|----------------|-------------------------------|---------------------|--------------------|-------------|-----------------------------|-------------|
| | years of compulsory schooling | school starting age | school leaving age | | | |
| Austria | 8 to 9 | 6 | 14 to 15 | 1962 | 1952 | 1,259 |
| Belgium | 8 to 9+3* | 6 | 14 to 18 | 1983 | 1968 | 1,392 |
| Bulgaria 1 | 7 to 8 | 7 | 14 to 15 | 1959 | 1946 | 1,751 |
| Bulgaria 2 | 8 to 9 | 7 | 15 to 16 | 1969 | 1958 | 1,748 |
| Croatia | 7 to 8 | 7 | 14 to 15 | 1952 | 1938 | 786 |
| Cyprus | 6 to 9 | 6 | 12 to 15 | 1985 | 1973 | 932 |
| Czechia 1 | 9 to 8 | 6 | 15 to 14 | 1953 | 1939 | 1,354 |
| Czechia 2 | 8 to 9 | 6 | 14 to 15 | 1960 | 1947 | 2,564 |
| Estonia 1 | 7 to 8 | 7 | 14 to 15 | 1958 | 1945 | 937 |
| Estonia 2 | 8 to 11 | 7 | 15 to 18 | 1970 | 1955 | 1,249 |
| Finland | 6 to 9 | 7 | 13 to 16 | 1968 | 1963 | 2,572 |
| France | 8 to 10 | 6 | 14 to 16 | 1959 | 1953 | 2,663 |
| Hungary | 8 to 10 | 6 | 14 to 16 | 1993 | 1979 | 1,958 |
| Iceland | 8 to 9 | 7 | 15 to 16 | 1974 | 1968 | 577 |
| Latvia 1 | 7 to 8 | 7 | 14 to 15 | 1958 | 1945 | 982 |
| Latvia 2 | 8 to 11 | 7 | 15 to 18 | 1970 | 1955 | 1,168 |
| Latvia 3 | 11 to 9 | 7 | 18 to 16 | 1991 | 1974 | 1,246 |
| Lithuania 1 | 7 to 8 | 7 | 14 to 15 | 1958 | 1945 | 1,106 |
| Lithuania 2 | 8 to 11 | 7 | 15 to 18 | 1970 | 1955 | 1,333 |
| Luxembourg | 8 to 9 | 6 | 14 to 15 | 1963 | 1950 | 527 |
| Netherlands 1 | 8 to 9+1* | 6 | 14 to 16 | 1968/1971 | 1957 | 2,067 |
| Netherlands 2 | 9+1 to 10+1* | 6 | 16 to 17 | | 1959 | 2,089 |
| Poland 1 | 7 to 8 | 7 | 14 to 15 | 1961 | 1952 | 4,609 |
| Poland 2 | 8 to 9+2* | 7 | 15 to 18 | 1999 | 1982 | 3,095 |
| Portugal 1 | 4 to 6 | 7 | 12 to 14 | 1964 | 1957 | 2,242 |
| Portugal 2 | 6 to 9 | 6 | 14 to 15 | 1986 | 1980 | 1,748 |
| Romania 1 | 4 to 7 | 7 | 14 | 1958 | 1947 | 2,442 |
| Romania 2 | 8 to 10 | 7 to 6 | 15 to 16 | 1968 | 1953 | 2,930 |
| Romania 3 | 10 to 8 | 6 | 16 to 14 | 1990 | 1976 | 2,284 |
| Slovakia 1 | 9 to 8 | 6 | 15 to 14 | 1953 | 1939 | 793 |
| Slovakia 2 | 9 to 10 | 6 | 15 to 16 | 1978 | 1964 | 1,909 |
| Slovakia 3 | 10 to 9 | 6 | 16 to 15 | 1990 | 1975 | 2,095 |
| Slovakia 4 | 9 to 10 | 6 | 15 to 16 | 1998 | 1983 | 1,552 |
| Slovenia | 7 to 8 | 7 | 14 to 15 | 1952 | 1938 | 1,074 |
| Spain | 8 to 10 | 6 | 14 to 16 | 1990 | 1982 | 2,400 |
| Switzerland | 8 to 9 | 6 | 14 to 15 | 1970 | 1971 | 1,064 |
| United Kingdom | 10 to 11 | 5 | 15 to 16 | 1972 | 1958 | 1,499 |

Notes: * The additional compulsory years can be completed on a part-time education basis. As it is not possible to determine whether an individual's highest level of education was attained through part-time or full-time education in the data, I count one year of compulsory part-time education as one year of compulsory full-time education in the instrumental variable to be consistent with the calculation of the education variable. Online Appendix B provides a description of all reforms. In the analysis, I assign the new shorter length to the first birth cohort affected in the case of reductions in compulsory schooling by multiple years.

Table 3: Main results

| | (1) | (2) | (3) | (4) | (5) | (6) |
|--|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| <i>Panel A: At risk of poverty or social exclusion</i> | | | | | | |
| 2SLS | -0.100*** (0.024) | -0.118*** (0.027) | -0.080*** (0.020) | -0.100*** (0.024) | -0.100*** (0.031) | -0.084*** (0.031) |
| Reduced form | -0.016*** (0.004) | -0.021*** (0.005) | -0.012*** (0.003) | -0.016*** (0.004) | -0.016*** (0.005) | -0.014*** (0.005) |
| OLS | -0.029*** (0.001) | -0.029*** (0.001) | -0.029*** (0.001) | -0.029*** (0.001) | -0.029*** (0.003) | -0.031*** (0.001) |
| <i>Panel B: Relative income poverty</i> | | | | | | |
| 2SLS | -0.043** (0.021) | -0.071*** (0.021) | -0.031** (0.016) | -0.042** (0.021) | -0.043* (0.022) | -0.059** (0.029) |
| Reduced form | -0.007** (0.003) | -0.013*** (0.003) | -0.005** (0.002) | -0.007** (0.003) | -0.007* (0.004) | -0.010** (0.005) |
| OLS | -0.022*** (0.001) | -0.022*** (0.001) | -0.022*** (0.001) | -0.022*** (0.001) | -0.022*** (0.002) | -0.024*** (0.001) |
| <i>Panel C: Severe material deprivation</i> | | | | | | |
| 2SLS | -0.027** (0.013) | -0.040** (0.018) | -0.005 (0.010) | -0.026** (0.013) | -0.027* (0.014) | -0.025 (0.018) |
| Reduced form | -0.004** (0.002) | -0.007** (0.003) | -0.001 (0.002) | -0.004** (0.002) | -0.004* (0.002) | -0.004 (0.003) |
| OLS | -0.015*** (0.001) | -0.015*** (0.001) | -0.015*** (0.001) | -0.015*** (0.001) | -0.015*** (0.002) | -0.015*** (0.001) |
| <i>Panel D: Very low work intensity</i> | | | | | | |
| 2SLS | -0.026* (0.015) | -0.031* (0.018) | -0.037*** (0.013) | -0.026* (0.015) | -0.026 (0.016) | -0.012 (0.016) |
| Reduced form | -0.004* (0.002) | -0.006* (0.003) | -0.006*** (0.002) | -0.004* (0.002) | -0.004 (0.003) | -0.002 (0.003) |
| OLS | -0.009*** (0.001) | -0.009*** (0.001) | -0.009*** (0.001) | -0.009*** (0.001) | -0.009*** (0.001) | -0.011*** (0.001) |
| <i>Panel E: Difficulties in making ends meet</i> | | | | | | |
| 2SLS | -0.069*** (0.021) | -0.065** (0.027) | -0.038** (0.016) | -0.069*** (0.021) | -0.069*** (0.022) | -0.064*** (0.022) |
| Reduced form | -0.011*** (0.003) | -0.012*** (0.004) | -0.006** (0.002) | -0.011*** (0.003) | -0.011*** (0.003) | -0.011*** (0.004) |
| OLS | -0.026*** (0.001) | -0.026*** (0.001) | -0.026*** (0.001) | -0.026*** (0.001) | -0.026*** (0.002) | -0.028*** (0.001) |
| First stage | 0.161*** (0.023) | 0.178*** (0.034) | 0.154*** (0.020) | 0.161*** (0.023) | 0.161*** (0.021) | 0.166*** (0.037) |
| F-statistic | 47.5 | 27.0 | 57.5 | 47.2 | 58.4 | 19.6 |
| Observations | 63,996 | 63,996 | 63,996 | 63,996 | 63,996 | 63,996 |
| Trend | linear | quadratic | none | linear | linear | linear |
| Controls | YES | YES | YES | NO | YES | YES |
| Clusters | R x BC | R x BC | R x BC | R x BC | R | R x BC |
| Survey weights | NO | NO | NO | NO | NO | YES |

Notes: *** p<0.01, ** p<0.05, * p<0.1. Each coefficient represents a separate regression. Fixed effects for country-reform and birth cohort are included in all specifications together with a country-reform-specific linear or quadratic trend. Controls include a sex dummy. The sample window is five years before and after each reform, and individuals are aged 30 to 80. Standard errors in parentheses are clustered at the country-reform-by-birth-cohort level (R x BC) or the country-reform level (R).

Table 4: Heterogeneity of results across sex, age, and area of settlement

| | (1) Men | (2) Women | (3) Age 30-59 | (4) Age 61-80 | (5) Rural area | (6) Urban area |
|--|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| <i>Panel A: At risk of poverty or social exclusion</i> | | | | | | |
| 2SLS | -0.064 (0.047) | -0.115*** (0.024) | -0.057** (0.027) | -0.063*** (0.024) | -0.115*** (0.040) | -0.109*** (0.034) |
| Reduced form | -0.007 (0.005) | -0.024*** (0.005) | -0.009** (0.004) | -0.014*** (0.005) | -0.019*** (0.006) | -0.015*** (0.004) |
| OLS | -0.027*** (0.001) | -0.031*** (0.001) | -0.031*** (0.001) | -0.026*** (0.001) | -0.034*** (0.001) | -0.027*** (0.001) |
| <i>Panel B: Relative income poverty</i> | | | | | | |
| 2SLS | -0.019 (0.043) | -0.053*** (0.018) | -0.049 (0.031) | -0.030 (0.022) | -0.026 (0.029) | -0.065** (0.030) |
| Reduced form | -0.002 (0.005) | -0.011*** (0.004) | -0.008 (0.005) | -0.007 (0.005) | -0.004 (0.005) | -0.009** (0.004) |
| OLS | -0.020*** (0.001) | -0.025*** (0.001) | -0.023*** (0.001) | -0.022*** (0.001) | -0.027*** (0.001) | -0.019*** (0.001) |
| <i>Panel C: Severe material deprivation</i> | | | | | | |
| 2SLS | 0.003 (0.028) | -0.042*** (0.015) | -0.027 (0.017) | -0.023 (0.018) | -0.008 (0.026) | -0.054** (0.022) |
| Reduced form | 0.000 (0.003) | -0.009*** (0.003) | -0.004 (0.003) | -0.005 (0.004) | -0.001 (0.004) | -0.008*** (0.003) |
| OLS | -0.014*** (0.001) | -0.015*** (0.001) | -0.016*** (0.001) | -0.013*** (0.001) | -0.018*** (0.001) | -0.015*** (0.001) |
| <i>Panel D: Very low work intensity</i> | | | | | | |
| 2SLS | 0.016 (0.029) | -0.043*** (0.015) | -0.017 (0.018) | - (0.018) | -0.040* (0.022) | -0.047** (0.020) |
| Reduced form | 0.002 (0.003) | -0.009*** (0.003) | -0.003 (0.003) | - (0.003) | -0.006* (0.003) | -0.007*** (0.003) |
| OLS | -0.009*** (0.001) | -0.009*** (0.001) | -0.015*** (0.001) | - (0.001) | -0.009*** (0.001) | -0.010*** (0.001) |
| <i>Panel E: Difficulties in making ends meet</i> | | | | | | |
| 2SLS | -0.088* (0.054) | -0.064*** (0.020) | -0.063** (0.025) | -0.048 (0.032) | -0.080** (0.035) | -0.092*** (0.034) |
| Reduced form | -0.009* (0.005) | -0.014*** (0.004) | -0.010*** (0.003) | -0.011 (0.007) | -0.013** (0.005) | -0.013*** (0.004) |
| OLS | -0.026*** (0.001) | -0.026*** (0.001) | -0.028*** (0.001) | -0.022*** (0.001) | -0.027*** (0.001) | -0.029*** (0.001) |
| First stage | 0.106*** (0.039) | 0.211*** (0.034) | 0.154*** (0.029) | 0.229*** (0.050) | 0.161*** (0.033) | 0.142*** (0.030) |
| F-statistic | 7.3 | 38.9 | 28.3 | 20.8 | 23.2 | 22.4 |
| Observations | 29,840 | 34,156 | 34,812 | 26,764 | 25,322 | 33,444 |

Notes: *** p<0.01, ** p<0.05, * p<0.1. Each coefficient represents a separate regression. Fixed effects for country-reform and birth cohort are included in all specifications together with a country-reform-specific linear trend, and in columns (3) to (6) also a sex dummy. The sample window is five years before and after each reform, and in columns (1)-(2) and (5)-(6) individuals are aged 30 to 80. Information on the area of settlement is not available for the Netherlands and Slovenia. Standard errors in parentheses are clustered at the country-reform-by-birth-cohort level.

Table 5: Heterogeneity of results across groups of countries and education level

| | (1) | (2) | (3) | (4) | (5) |
|--|----------------------|----------------------|---|---------------------------------|--|
| | Eastern Europe | Western Europe | At most lower secondary education | Upper secondary education | At least post- secondary education |
| <i>Panel A: At risk of poverty or social exclusion</i> | | | | | |
| 2SLS | -0.132*** (0.035) | -0.026 (0.032) | -0.180 (0.121) | -0.442* (0.234) | -0.126 (0.144) |
| Reduced form | -0.023*** (0.005) | -0.004 (0.005) | -0.011 (0.007) | -0.015*** (0.006) | -0.005 (0.004) |
| OLS | -0.036*** (0.001) | -0.020*** (0.001) | -0.037*** (0.002) | -0.018*** (0.002) | -0.005*** (0.001) |
| <i>Panel B: Relative income poverty</i> | | | | | |
| 2SLS | -0.061*** (0.023) | -0.019 (0.026) | 0.042 (0.110) | -0.271 (0.179) | 0.014 (0.093) |
| Reduced form | -0.011*** (0.004) | -0.003 (0.004) | 0.003 (0.007) | -0.009** (0.005) | 0.001 (0.003) |
| OLS | -0.029*** (0.001) | -0.014*** (0.001) | -0.032*** (0.002) | -0.015*** (0.002) | -0.003*** (0.001) |
| <i>Panel C: Severe material deprivation</i> | | | | | |
| 2SLS | -0.038** (0.018) | -0.019 (0.014) | -0.041 (0.080) | -0.077 (0.098) | 0.004 (0.073) |
| Reduced form | -0.007** (0.003) | -0.003 (0.002) | -0.003 (0.005) | -0.003 (0.003) | 0.000 (0.003) |
| OLS | -0.021*** (0.001) | -0.007*** (0.001) | -0.020*** (0.002) | -0.010*** (0.001) | -0.003*** (0.001) |
| <i>Panel D: Very low work intensity</i> | | | | | |
| 2SLS | -0.037** (0.016) | -0.024 (0.033) | -0.067 (0.081) | 0.062 (0.110) | -0.026 (0.080) |
| Reduced form | -0.007** (0.003) | -0.003 (0.005) | -0.004 (0.005) | 0.002 (0.003) | -0.001* (0.003) |
| OLS | -0.008*** (0.001) | -0.011*** (0.001) | -0.013*** (0.002) | -0.004*** (0.001) | -0.001* (0.001) |
| <i>Panel E: Difficulties in making ends meet</i> | | | | | |
| 2SLS | -0.098*** (0.032) | -0.029 (0.023) | -0.116 (0.107) | -0.033 (0.164) | -0.392 (0.360) |
| Reduced form | -0.017*** (0.004) | -0.004 (0.003) | -0.007 (0.007) | -0.001 (0.006) | -0.014*** (0.004) |
| OLS | -0.032*** (0.001) | -0.018*** (0.001) | -0.020*** (0.002) | -0.020*** (0.002) | -0.005*** (0.002) |
| First stage | 0.177*** (0.031) | 0.140*** (0.037) | 0.064*** (0.022) | 0.035** (0.015) | 0.036 (0.031) |
| F-statistic | 32.7 | 14.3 | 8.1 | 5.6 | 1.3 |
| Observations | 40,965 | 23,031 | 17,882 | 29,820 | 16,294 |

Notes: *** p<0.01, ** p<0.05, * p<0.1. Each coefficient represents a separate regression. Fixed effects for country-reform and birth cohort are included in all specifications together with a country-reform-specific linear trend and a sex dummy. The sample window is five years before and after each reform, and individuals are aged 30 to 80. Standard errors in parentheses are clustered at the country-reform-by-birth-cohort level.

Online Appendix A - Additional Figures and Tables

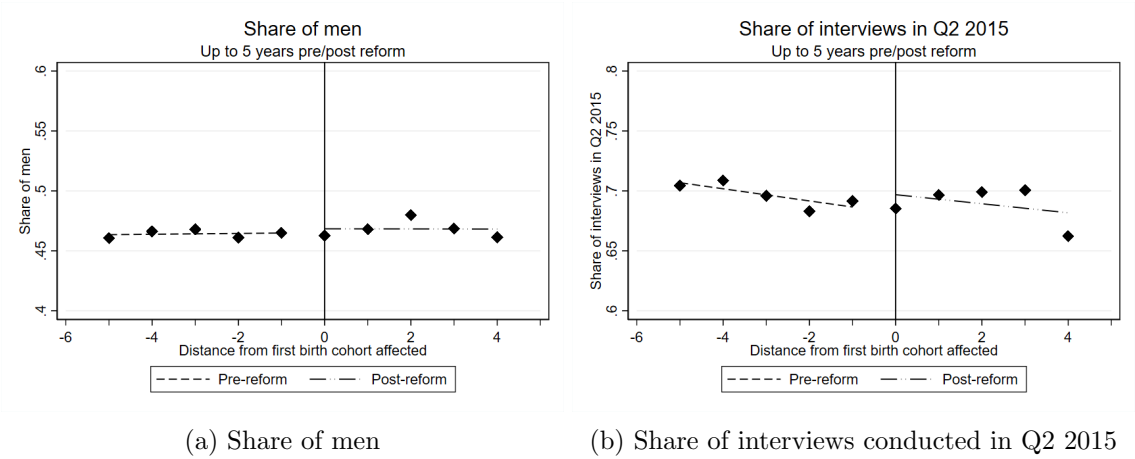


Figure A1: Characteristics before and after compulsory schooling reforms

Table A1: Placebo test

| | (1) 2 years backwards | (2) 3 years backwards | (3) 2 years forward | (4) 3 years forward |
|--|-----------------------------|-----------------------------|---------------------------|---------------------------|
| <i>Panel A: At risk of poverty or social exclusion</i> | | | | |
| Reduced form (fixed window) | 0.010** (0.004) | 0.003 (0.004) | 0.001 (0.004) | 0.002 (0.003) |
| Reduced form (shifted window) | 0.008** (0.004) | 0.002 (0.004) | 0.002 (0.004) | 0.007** (0.004) |
| <i>Panel B: Relative income poverty</i> | | | | |
| Reduced form (fixed window) | 0.004 (0.003) | -0.002 (0.003) | -0.002 (0.003) | -0.001 (0.003) |
| Reduced form (shifted window) | 0.002 (0.003) | -0.003 (0.003) | -0.000 (0.003) | 0.001 (0.003) |
| <i>Panel C: Severe material deprivation</i> | | | | |
| Reduced form (fixed window) | 0.003 (0.002) | -0.000 (0.002) | -0.000 (0.002) | 0.002 (0.002) |
| Reduced form (shifted window) | 0.006*** (0.002) | 0.002 (0.002) | -0.003 (0.002) | -0.001 (0.002) |
| <i>Panel D: Very low work intensity</i> | | | | |
| Reduced form (fixed window) | 0.002 (0.003) | 0.007** (0.003) | -0.002 (0.003) | -0.001 (0.003) |
| Reduced form (shifted window) | 0.000 (0.003) | 0.003 (0.002) | 0.000 (0.003) | 0.003 (0.003) |
| <i>Panel E: Difficulties in making ends meet</i> | | | | |
| Reduced form (fixed window) | 0.010*** (0.003) | 0.012*** (0.003) | -0.003 (0.003) | 0.004 (0.003) |
| Reduced form (shifted window) | 0.011*** (0.003) | 0.010*** (0.003) | 0.000 (0.003) | 0.004 (0.003) |
| First stage (fixed window) | -0.085*** (0.027) | -0.033 (0.027) | 0.003 (0.027) | -0.059** (0.028) |
| F-statistic (fixed window) | 9.6 | 1.5 | 0.0 | 4.5 |
| First stage (shifted window) | -0.066** (0.028) | -0.006 (0.028) | -0.017 (0.027) | -0.049* (0.026) |
| F-statistic (shifted window) | 5.5 | 0.0 | 0.4 | 3.5 |
| Observations (fixed window) | 63,996 | 63,996 | 63,996 | 63,996 |
| Observations (shifted window) | 63,035 | 62,150 | 63,448 | 62,607 |

Notes: *** p<0.01, ** p<0.05, * p<0.1. Each coefficient represents a separate regression. Fixed effects for country-reform and birth cohort are included in all specifications together with a country-reform-specific linear trend and a sex dummy. The sample window is five years before and after each actual reform (fixed window) or each false reform (shifted window), and individuals are aged 30 to 80. Standard errors in parentheses are clustered at the country-reform-by-birth-cohort level.

Table A2: Robustness tests - Model specification

| | (1) | (2) | (3) | (4) | (5) | (6) |
|--|----------------------|----------------------|----------------------|--|----------------------|------------------------|
| | 4-year bandwidth | 6-year bandwidth | No bandwidth | Omit first birth cohort affected | Main respondent | Non-main respondent |
| <i>Panel A: At risk of poverty or social exclusion</i> | | | | | | |
| 2SLS | -0.107*** (0.026) | -0.072*** (0.020) | -0.116*** (0.025) | -0.095** (0.043) | -0.122*** (0.032) | -0.075** (0.033) |
| Reduced form | -0.017*** (0.004) | -0.011*** (0.003) | -0.012*** (0.002) | -0.011** (0.005) | -0.020*** (0.005) | -0.011** (0.004) |
| OLS | -0.029*** (0.001) | -0.029*** (0.001) | -0.029*** (0.000) | -0.029*** (0.001) | -0.030*** (0.001) | -0.028*** (0.001) |
| <i>Panel B: Relative income poverty</i> | | | | | | |
| 2SLS | -0.043** (0.021) | -0.029* (0.018) | -0.092*** (0.022) | -0.029 (0.032) | -0.066** (0.027) | -0.015 (0.028) |
| Reduced form | -0.007** (0.003) | -0.005 (0.003) | -0.009*** (0.001) | -0.003 (0.004) | -0.011** (0.005) | -0.002 (0.004) |
| OLS | -0.022*** (0.001) | -0.022*** (0.001) | -0.022*** (0.000) | -0.023*** (0.001) | -0.024*** (0.001) | -0.021*** (0.001) |
| <i>Panel C: Severe material deprivation</i> | | | | | | |
| 2SLS | -0.031* (0.016) | -0.018 (0.012) | -0.032*** (0.011) | -0.019 (0.020) | -0.022 (0.020) | -0.029 (0.027) |
| Reduced form | -0.005* (0.003) | -0.003 (0.002) | -0.003*** (0.001) | -0.002 (0.002) | -0.004 (0.003) | -0.004 (0.004) |
| OLS | -0.015*** (0.001) | -0.015*** (0.001) | -0.015*** (0.000) | -0.015*** (0.001) | -0.016*** (0.001) | -0.014*** (0.001) |
| <i>Panel D: Very low work intensity</i> | | | | | | |
| 2SLS | -0.027 (0.017) | -0.019 (0.015) | -0.018 (0.014) | -0.011 (0.027) | -0.020 (0.019) | -0.032 (0.022) |
| Reduced form | -0.004 (0.003) | -0.003 (0.002) | -0.002 (0.001) | -0.001 (0.003) | -0.003 (0.003) | -0.005 (0.003) |
| OLS | -0.009*** (0.001) | -0.009*** (0.001) | -0.010*** (0.000) | -0.009*** (0.001) | -0.008*** (0.001) | -0.010*** (0.001) |
| <i>Panel E: Difficulties in making ends meet</i> | | | | | | |
| 2SLS | -0.094*** (0.028) | -0.045*** (0.017) | -0.060*** (0.018) | -0.099** (0.040) | -0.077*** (0.030) | -0.059* (0.031) |
| Reduced form | -0.015*** (0.004) | -0.007*** (0.003) | -0.006*** (0.001) | -0.012*** (0.004) | -0.013*** (0.005) | -0.009* (0.005) |
| OLS | -0.026*** (0.001) | -0.025*** (0.001) | -0.026*** (0.000) | -0.026*** (0.001) | -0.026*** (0.001) | -0.025*** (0.001) |
| First stage | 0.156*** (0.026) | 0.158*** (0.021) | 0.099*** (0.021) | 0.118*** (0.028) | 0.164*** (0.033) | 0.146*** (0.037) |
| F-statistic | 35.2 | 55.3 | 22.4 | 17.9 | 24.4 | 15.9 |
| Observations | 52,039 | 75,774 | 326,180 | 57,398 | 35,167 | 28,829 |

Notes: *** p<0.01, ** p<0.05, * p<0.1. Each coefficient represents a separate regression. Fixed effects for country-reform and birth cohort are included in all specifications together with a country-reform-specific linear trend and a sex dummy. The sample window is five years before and after each reform, unless otherwise indicated, and individuals are aged 30 to 80. Standard errors in parentheses are clustered at the country-reform-by-birth-cohort level.

Table A3: Robustness tests - Sample selection

| | (1) | (2) | (3) | (4) | (5) | (6) |
|--|----------------------|----------------------|-----------------------------|--------------------------|--|-------------------------|
| | Fewer reforms | All reforms | Reforms of similar range | Excluding Cyprus 1985 | Excluding Netherlands 1968/71+1975 | Excluding reductions |
| <i>Panel A: At risk of poverty or social exclusion</i> | | | | | | |
| 2SLS | -0.114*** (0.029) | -0.136*** (0.049) | -0.135*** (0.036) | -0.102*** (0.024) | -0.106*** (0.027) | -0.110*** (0.027) |
| Reduced form | -0.021*** (0.004) | -0.010*** (0.003) | -0.020*** (0.005) | -0.017*** (0.004) | -0.017*** (0.004) | -0.018*** (0.004) |
| OLS | -0.033*** (0.001) | -0.029*** (0.001) | -0.030*** (0.001) | -0.029*** (0.001) | -0.031*** (0.001) | -0.028*** (0.001) |
| <i>Panel B: Relative income poverty</i> | | | | | | |
| 2SLS | -0.049** (0.020) | -0.041 (0.037) | -0.063** (0.027) | -0.046** (0.021) | -0.042* (0.023) | -0.041* (0.022) |
| Reduced form | -0.009** (0.004) | -0.003 (0.003) | -0.009** (0.004) | -0.008** (0.003) | -0.007* (0.004) | -0.006* (0.004) |
| OLS | -0.026*** (0.001) | -0.022*** (0.001) | -0.022*** (0.001) | -0.022*** (0.001) | -0.024*** (0.001) | -0.021*** (0.001) |
| <i>Panel C: Severe material deprivation</i> | | | | | | |
| 2SLS | -0.035** (0.015) | -0.002 (0.026) | -0.043** (0.020) | -0.029** (0.013) | -0.033** (0.015) | -0.030** (0.014) |
| Reduced form | -0.006** (0.003) | -0.000 (0.002) | -0.006** (0.003) | -0.005** (0.002) | -0.005** (0.002) | -0.005** (0.002) |
| OLS | -0.017*** (0.001) | -0.015*** (0.001) | -0.016*** (0.001) | -0.015*** (0.001) | -0.016*** (0.001) | -0.014*** (0.001) |
| <i>Panel D: Very low work intensity</i> | | | | | | |
| 2SLS | -0.031* (0.016) | -0.058** (0.029) | -0.014 (0.022) | -0.026* (0.015) | -0.038** (0.015) | -0.029* (0.016) |
| Reduced form | -0.006** (0.003) | -0.004** (0.002) | -0.002 (0.003) | -0.004* (0.002) | -0.006*** (0.002) | -0.005* (0.003) |
| OLS | -0.009*** (0.001) | -0.010*** (0.001) | -0.012*** (0.001) | -0.009*** (0.001) | -0.009*** (0.001) | -0.009*** (0.001) |
| <i>Panel E: Difficulties in making ends meet</i> | | | | | | |
| 2SLS | -0.087*** (0.025) | -0.055 (0.038) | -0.067** (0.029) | -0.064*** (0.020) | -0.081*** (0.023) | -0.077*** (0.022) |
| Reduced form | -0.016*** (0.004) | -0.004 (0.003) | -0.010*** (0.004) | -0.011*** (0.003) | -0.013*** (0.003) | -0.012*** (0.003) |
| OLS | -0.028*** (0.001) | -0.026*** (0.001) | -0.026*** (0.001) | -0.025*** (0.001) | -0.028*** (0.001) | -0.025*** (0.001) |
| First stage | 0.183*** (0.028) | 0.072*** (0.025) | 0.147*** (0.032) | 0.166*** (0.024) | 0.158*** (0.023) | 0.159*** (0.025) |
| F-statistic | 42.8 | 7.9 | 21.0 | 47.4 | 47.0 | 40.0 |
| Observations | 46,412 | 92,817 | 42,815 | 63,064 | 59,840 | 56,224 |

Notes: *** p<0.01, ** p<0.05, * p<0.1. Each coefficient represents a separate regression. Fixed effects for country-reform and birth cohort are included in all specifications together with a country-reform-specific linear trend and a sex dummy. The sample window is five years before and after each reform, and individuals are aged 30 to 80. Standard errors in parentheses are clustered at the country-reform-by-birth-cohort level.

Table A4: Robustness tests - Representativeness

| | (1) | (2) | (3) | (4) |
|--|------------------------|----------------------|----------------------------|-----------------------------|
| | Type of senate weights | | | |
| | Reform | Country | Reform + survey weights | Country + survey weights |
| <i>Panel A: At risk of poverty or social exclusion</i> | | | | |
| 2SLS | -0.099*** (0.025) | -0.069*** (0.024) | -0.106*** (0.028) | -0.076*** (0.028) |
| Reduced form | -0.016*** (0.004) | -0.011*** (0.004) | -0.017*** (0.005) | -0.012*** (0.005) |
| OLS | -0.027*** (0.001) | -0.025*** (0.001) | -0.028*** (0.001) | -0.026*** (0.001) |
| <i>Panel B: Relative income poverty</i> | | | | |
| 2SLS | -0.036* (0.021) | -0.017 (0.021) | -0.047** (0.022) | -0.030 (0.023) |
| Reduced form | -0.006* (0.003) | -0.003 (0.003) | -0.008** (0.004) | -0.005 (0.004) |
| OLS | -0.021*** (0.001) | -0.019*** (0.001) | -0.021*** (0.001) | -0.019*** (0.001) |
| <i>Panel C: Severe material deprivation</i> | | | | |
| 2SLS | -0.024* (0.014) | -0.018 (0.013) | -0.021 (0.017) | -0.021 (0.018) |
| Reduced form | -0.004* (0.002) | -0.003 (0.002) | -0.003 (0.003) | -0.003 (0.003) |
| OLS | -0.014*** (0.001) | -0.012*** (0.001) | -0.014*** (0.001) | -0.012*** (0.001) |
| <i>Panel D: Very low work intensity</i> | | | | |
| 2SLS | -0.025 (0.016) | -0.017 (0.017) | -0.016 (0.018) | -0.007 (0.020) |
| Reduced form | -0.004 (0.003) | -0.003 (0.003) | -0.003 (0.003) | -0.001 (0.003) |
| OLS | -0.009*** (0.001) | -0.008*** (0.001) | -0.009*** (0.001) | -0.009*** (0.001) |
| <i>Panel E: Difficulties in making ends meet</i> | | | | |
| 2SLS | -0.067*** (0.022) | -0.063*** (0.021) | -0.051** (0.024) | -0.068*** (0.025) |
| Reduced form | -0.011*** (0.003) | -0.010*** (0.003) | -0.008** (0.004) | -0.011*** (0.004) |
| OLS | -0.025*** (0.001) | -0.024*** (0.001) | -0.025*** (0.001) | -0.024*** (0.001) |
| First stage | 0.159*** (0.025) | 0.163*** (0.028) | 0.161*** (0.032) | 0.158*** (0.035) |
| F-statistic | 41.0 | 34.1 | 25.6 | 20.2 |
| Observations | 63,996 | 63,996 | 63,996 | 63,996 |

Notes: *** p<0.01, ** p<0.05, * p<0.1. Each coefficient represents a separate regression. Fixed effects for country-reform and birth cohort are included in all specifications together with a country-reform-specific linear trend and a sex dummy. The sample window is five years before and after each reform, and individuals are aged 30 to 80. Senate weights in columns (1) and (2) weight each reform or each country (irrespective of the number of reforms in the country) equally. Senate weights in columns (3) and (4) are computed analogously based on personal survey weights. Standard errors in parentheses are clustered at the country-reform-by-birth-cohort level.

Table A5: Mechanisms

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|------------------------------|-----------------------------------|---------------------------|--------------------------------|------------------------|---------------------------|
| <i>Panel A: Labor market-related measures</i> | | | | | | |
| | Any personal income | Log of personal income | Any personal earnings | Log of personal earnings | Economically active | Employed full-time |
| | Age 30-59 | | | | | |
| 2SLS | 0.033** (0.013) | 0.067 (0.044) | 0.038 (0.025) | 0.074 (0.058) | 0.036* (0.019) | 0.048* (0.025) |
| Reduced form | 0.005** (0.002) | 0.011 (0.008) | 0.006 (0.004) | 0.012 (0.010) | 0.006* (0.003) | 0.008* (0.004) |
| OLS | 0.009*** (0.001) | 0.084*** (0.002) | 0.022*** (0.001) | 0.088*** (0.003) | 0.016*** (0.001) | 0.028*** (0.001) |
| First stage | 0.161*** (0.023) | 0.158*** (0.024) | 0.154*** (0.029) | 0.169*** (0.032) | 0.156*** (0.029) | 0.156*** (0.029) |
| F-statistic | 47.5 | 41.5 | 28.3 | 25.9 | 29.2 | 29.2 |
| Observations | 63,996 | 58,872 | 34,812 | 28,221 | 34,775 | 34,775 |
| <i>Panel B: Health-related and household-related measures</i> | | | | | | |
| | Good subjective health | Any chronic health problems | Any health limitations | Married | Household size | Any children aged 0-17 |
| 2SLS | 0.084*** (0.023) | -0.026 (0.021) | -0.056** (0.025) | 0.016 (0.019) | -0.092 (0.059) | -0.045** (0.019) |
| Reduced form | 0.013*** (0.003) | -0.004 (0.003) | -0.009** (0.004) | 0.003 (0.003) | -0.015 (0.009) | -0.007*** (0.003) |
| OLS | 0.019*** (0.001) | -0.011*** (0.001) | -0.015*** (0.001) | 0.007*** (0.001) | -0.033*** (0.003) | -0.002*** (0.001) |
| First stage | 0.156*** (0.025) | 0.159*** (0.024) | 0.159*** (0.024) | 0.161*** (0.023) | 0.161*** (0.023) | 0.161*** (0.023) |
| F-statistic | 37.7 | 43.4 | 43.3 | 47.5 | 47.5 | 47.5 |
| Observations | 57,811 | 58,895 | 58,873 | 63,993 | 63,996 | 63,996 |

Notes: *** p<0.01, ** p<0.05, * p<0.1. Each coefficient represents a separate regression. Fixed effects for country-reform and birth cohort are included in all specifications together with a country-reform-specific linear trend and a sex dummy. The sample window is five years before and after each reform, and individuals are aged 30 to 80, unless otherwise indicated. Standard errors in parentheses are clustered at the country-reform-by-birth-cohort level.

Online Appendix B

Database of compulsory schooling reforms in Europe

This section provides a detailed summary of the database comprising all compulsory schooling reforms in the 32 countries in the EU-SILC survey. The database is supposed to cover all reforms affecting the birth cohorts from 1935 to 1995. In some cases, the coverage stretches even slightly beyond this range of cohorts. The database covers both extensions and reductions in the length of compulsory schooling. It comprises reforms that changed compulsory schooling at ISCED level 1 and above. Even though one or two years of kindergarten may have been made compulsory for some of the above-mentioned birth cohorts (e.g., in Luxembourg), this concerns only preschool education classified as ISCED level 0. In this regard it should also be noted that some countries (Malta, the Netherlands, and the UK) start with formal education classified as ISCED level 1 already at the age of 5 (and Northern Ireland at the age of 4), whereas all other countries do so at the age of 6 or 7.

A description of all the reforms in each of the 32 countries can be found further below. Table B1 provides an overview of the key features of all reforms.

Data collection

The information in the database is mainly based on the country-specific chapters in Hörner et al. (2007) and country reports⁵² from the European Commission’s Education, Audiovisual and Culture Executive Agency (EACEA), which maintains the Eurydice network and its Eurybase database. Further information was obtained from reports by the Commission of the European Communities (1987) and Eurydice (1996), as well as from the Population Europe Resource Finder and Archive (PERFAR) website⁵³. All of these publications and sources were written by country-level experts. In many cases, these sources provide either directly enough details on the reforms or at least enough information to identify the law that initiated a specific reform. In the latter case, I checked these laws to the best of my abilities and read up on the details of the reforms, especially concerning the first birth cohort affected by the implementation of the reform. This is an important issue as the date when a reform is signed and the date of its implementation can lie several years apart. In case of conflicting information on a reform in these sources (and lack of access to the law), either information from the most convincing source was used or, if available, information from country-specific empirical studies that relied on that reform in their identification strategy was used.

I deliberately did not obtain information on compulsory schooling reforms from published studies with a multi-country setting. Virtually all previous studies that have relied on multi-country compulsory schooling reforms in their empirical strategy have either di-

⁵²These country reports have been published between 2005 and 2010 and are called “The Education System in [country]” or “Organisation of the education system in [country]”.

⁵³www.perfar.eu

rectly or indirectly used information gathered by Fort (2006) and to a much lesser extent by Garrouste (2010) and Murtin and Viarengo (2011). In the report by Fort (2006), which has never made it past the working paper stage, the author provides information for 14 Western European countries. In several cases (e.g., Austria or Denmark), this information is erroneous and has unfortunately spread to subsequent studies. The other two sources also focus mostly on Western European countries, seem to contain fewer errors, but provide also less detail on all reforms. Aparicio Fenoll and Kuehn (2017) provide information on compulsory schooling reforms for 31 European countries passed between 1950 and 1990, relying mainly on Hörner et al. (2007) and Fort (2006). Their compilation also contains several errors, as the authors either pick the wrong reform date (e.g., for Austria), or as their strict application of an algorithm to deduce the first birth cohort affected (based on the structural change of the education system) has them ignore the fact that many laws explicitly specify the first birth cohort affected (e.g., in Denmark, Finland, or the UK).

Algorithm to determine the first birth cohort affected

Three issues in determining the first birth cohort affected by a change in the length of compulsory schooling deserve further explanation. First, in some countries, certain compulsory schooling reforms have been implemented gradually across regions or municipalities. Even though information on the spatio-temporal implementation is available for some of these reforms, EU-SILC data only contain a crude regional classification of the current place of residence of individuals for some countries and no information on the place of residence of individuals during their compulsory school age. For these reforms (in Finland, Germany, Norway, Romania, Spain, Sweden, Switzerland, the UK), I attempted to pick the reform date which affected the largest share of students during the implementation period.

Second, for some reforms that entailed a change in the length of compulsory schooling by *one year*, it was not possible to determine exactly the first birth cohort affected. In the case of an increase by one year and unknown circumstances (e.g., the one-year increase from 7 to 8 years in Bulgaria implemented in the 1960/61 school year), I always assumed that the cohort attending the last grade of the previous compulsory schooling length was the first to be affected (in the case of Bulgaria, the seventh graders in the 1959/60 school year). In the case of a decrease by one year and unknown circumstances (e.g., the one-year decrease from 9 to 8 years in Czechia implemented in the 1953/54 school year), I always assumed that the cohort attending the second last grade of the previous compulsory schooling length was the first to be affected (in the case of Czechia, the eighth graders in the 1952/53 school year).

Third, for some reforms that entailed a change in the length of compulsory schooling by *more than one year*, it was not possible to determine exactly the first birth cohort affected. In the case of increases by several years and unknown circumstances (e.g., the three-year increase from 6 to 9 years in Cyprus implemented in the 1985/86 school year), I always assumed that the cohort attending the last grade of the previous compulsory schooling length was the first to be affected (in the case of Cyprus, the sixth graders in the 1984/85

school year). This means that I assume that those who had finished the previous last grade and left school but who after the law change fall into the new age range of compulsory attendance are not forced to go back (i.e., Cypriots who finished sixth grade in 1983 or 1984). As a consequence, I also miss cases in which students intended to continue only for one year beyond the old length of compulsory schooling, but who after the law change are forced to stay in school for some more years, in case the law is only enforced for students who are still enrolled in school (i.e., Cypriots who voluntarily attended seventh grade in 1984/85 and wanted to leave school thereafter but who were forced to stay for two more years). Yet students who voluntarily stay in school after the end of compulsory schooling are probably aiming at finishing a higher degree, which usually takes more than one additional year to complete (in the case of Cyprus, all three years of lower secondary school). In the case of decreases by several years and unknown circumstances (e.g., the two-year decrease from 11 to 9 years in Latvia implemented in the 1991/92 school year), I always assumed that the cohort attending the second last grade of the previous compulsory schooling length was the first to be affected (in the case of Latvia, the tenth graders in the 1990/91 school year).

Table B1: Overview of compulsory schooling reforms in Europe

| Country | Change in ... | | | Reform date | First birth cohort affected |
|----------|-------------------------------|---------------------|--------------------|-------------|-----------------------------|
| | years of compulsory schooling | school starting age | school leaving age | | |
| Austria | 8 to 9 | 6 | 14 to 15 | 1962 | 1952 |
| Belgium | 8 to 9+3* | 6 | 14 to 18 | 1983 | 1968 |
| Bulgaria | 7 to 8 | 7 | 14 to 15 | 1959 | 1946 |
| Bulgaria | 8 to 9 | 7 | 15 to 16 | 1969 | 1958 |
| Croatia | 4 to 7 | 7 | 11 to 14 | 1945 | 1935 |
| Croatia | 7 to 8 | 7 | 14 to 15 | 1952 | 1938 |
| Cyprus | 6 to 9 | 6 | 12 to 15 | 1985 | 1973 |
| Czechia | 8 to 9 | 6 | 14 to 15 | 1948 | 1934 |
| Czechia | 9 to 8 | 6 | 15 to 14 | 1953 | 1939 |
| Czechia | 8 to 9 | 6 | 14 to 15 | 1960 | 1947 |
| Czechia | 9 to 10 | 6 | 15 to 16 | 1978 | 1964 |
| Czechia | 10 to 9 | 6 | 16 to 15 | 1990 | 1975 |
| Denmark | 7 to 9 | 7 | 14 to 16 | 1972 | 1958 |
| Denmark | 9 to 10 | 7 to 6 | 16 | 2008 | 2003 |
| Estonia | 7 to 8 | 7 | 14 to 15 | 1958 | 1945 |
| Estonia | 8 to 11 | 7 | 15 to 18 | 1970 | 1955 |
| Estonia | 11 to 9 | 7 | 18 to 16 | 1992 | 1975 |
| Finland | 6 to 9 | 7 | 13 to 16 | 1968 | 1963 |

* The additional compulsory years can be completed on a part-time education basis.

Table B1: Overview of compulsory schooling reforms in Europe (continued)

| Country | Change in ... | | | Reform date | First birth cohort affected |
|------------------|-------------------------------|---------------------|--------------------|-------------|-----------------------------|
| | years of compulsory schooling | school starting age | school leaving age | | |
| France | 8 to 10 | 6 | 14 to 16 | 1959 | 1953 |
| Germany | 8 to 9 | 6 | 14 to 15 | 1967 | 1953 |
| Greece | 6 to 9 | 6 | 12 to 15 | 1976 | 1964 |
| Hungary | 8 to 10 | 6 | 14 to 16 | 1993 | 1979 |
| Hungary | 10 to 12 | 6 | 16 to 18 | 1999 | 1992 |
| Iceland | 8 to 9 | 7 | 15 to 16 | 1974 | 1968 |
| Iceland | 9 to 10 | 7 to 6 | 16 | 1991 | 1985 |
| Ireland | 8 to 9 | 6 | 14 to 15 | 1972 | 1958 |
| Ireland | 9 to 10 | 6 | 15 to 16 | 2000 | 1987 |
| Italy | 5 to 8 | 6 | 11 to 14 | 1962 | 1952 |
| Italy | 8 to 9 | 6 | 14 to 15 | 1999 | 1985 |
| Italy | 9 to 10 | 6 | 15 to 16 | 2006 | 1992 |
| Latvia | 7 to 8 | 7 | 14 to 15 | 1958 | 1945 |
| Latvia | 8 to 11 | 7 | 15 to 18 | 1970 | 1955 |
| Latvia | 11 to 9 | 7 | 18 to 16 | 1991 | 1974 |
| Lithuania | 7 to 8 | 7 | 14 to 15 | 1958 | 1945 |
| Lithuania | 8 to 11 | 7 | 15 to 18 | 1970 | 1955 |
| Lithuania | 11 to 9 | 7 | 18 to 16 | 1991 | 1974 |
| Lithuania | 9 to 10 | 6/7 | 16 | 1998 | 1983 |
| Luxembourg | 7 to 8 | 6 | 13 to 14 | 1945 | 1932 |
| Luxembourg | 8 to 9 | 6 | 14 to 15 | 1963 | 1950 |
| Luxembourg | 9 to 10 | 6 | 15 to 16 | 2009 | 1994 |
| Malta | 8 to 10 | 6 | 14 to 16 | 1974 | 1960 |
| Malta | 10 to 11 | 6 to 5 | 16 | 1988 | 1983 |
| Netherlands | 7 to 8 | 6 | 13 to 14 | 1947 | 1937 |
| Netherlands | 8 to 9+1* | 6 | 14 to 16 | 1968/1971 | 1957 |
| Netherlands | 9+1 to 10+1* | 6 | 16 to 17 | 1975 | 1959 |
| Netherlands | 10+1 to 12+1* | 6 to 5 | 17 to 18 | 1985 | 1980 |
| Netherlands | 12+1 to 13 | 5 | 18 | 2007 | 1990 |
| Norway | 7 to 9 | 7 | 14 to 16 | 1959/1969 | 1951 |
| Norway | 9 to 10 | 7 to 6 | 16 | 1994 | 1991 |
| Poland | 7 to 8 | 7 | 14 to 15 | 1961 | 1952 |
| Poland | 8 to 9+2* | 7 | 15 to 18 | 1999 | 1982 |
| Portugal (boys) | 3 to 4 | 7 | 12 | 1956 | 1950 |
| Portugal (girls) | 3 to 4 | 7 | 12 | 1960 | 1950 |
| Portugal | 4 to 6 | 7 | 12 to 14 | 1964 | 1957 |

* The additional compulsory years can be completed on a part-time education basis.

Table B1: Overview of compulsory schooling reforms in Europe (continued)

| Country | Change in ... | | | Reform date | First birth cohort affected |
|-----------------------|-------------------------------|---------------------|--------------------|-------------|-----------------------------|
| | years of compulsory schooling | school starting age | school leaving age | | |
| Portugal | 6 to 9 | 6 | 14 to 15 | 1986 | 1980 |
| Portugal | 9 to 12 | 6 | 15 to 18 | 2009 | 1997 |
| Romania | 7 to 4 | (7) | (11) | 1948 | 1935 |
| Romania | 4 to 7 | 7 | 14 | 1958 | 1947 |
| Romania | 7 to 8 | 7 | 15 | 1965 | 1951 |
| Romania | 8 to 10 | 7 to 6 | 15 to 16 | 1968 | 1953 |
| Romania | 10 to 8 | 6 | 16 to 14 | 1990 | 1976 |
| Romania | 8 to 9 | 7 | 15 to 16 | 1999 | 1985 |
| Romania | 9 to 10 | 7 to 6 | 16 | 2003 | 1988 |
| Romania | 10 to 11 | 6 | 16 to 17 | 2011 | 2006 |
| Serbia | 4 to 7 | 7 | 11 to 14 | 1945 | 1935 |
| Serbia | 7 to 8 | 7 | 14 to 15 | 1952 | 1938 |
| Slovakia | 8 to 9 | 6 | 14 to 15 | 1948 | 1934 |
| Slovakia | 9 to 8 | 6 | 15 to 14 | 1953 | 1939 |
| Slovakia | 8 to 9 | 6 | 14 to 15 | 1960 | 1947 |
| Slovakia | 9 to 10 | 6 | 15 to 16 | 1978 | 1964 |
| Slovakia | 10 to 9 | 6 | 16 to 15 | 1990 | 1975 |
| Slovakia | 9 to 10 | 6 | 15 to 16 | 1998 | 1983 |
| Slovenia | 4 to 7 | 7 | 11 to 14 | 1945 | 1935 |
| Slovenia | 7 to 8 | 7 | 14 to 15 | 1952 | 1938 |
| Slovenia | 8 to 9 | 7 to 6 | 15 | 1999 | 1993 |
| Spain | 7 to 8 | 6 | 13 to 14 | 1970 | 1958 |
| Spain | 8 to 10 | 6 | 14 to 16 | 1990 | 1982 |
| Sweden | 6 to 7 | 7 | 13 to 14 | 1936 | 1923 |
| Sweden | 7 to 9 | 7 | 14 to 16 | 1962 | 1951 |
| Switzerland | 8 to 9 | 6 | 14 to 15 | 1970 | 1971 |
| UK - England+Wales | 9 to 10 | 5 | 14 to 15 | 1944 | 1933 |
| UK - England+Wales | 10 to 11 | 5 | 15 to 16 | 1972 | 1958 |
| UK - England | 11 to 11+2* | 5 | 16 to 18 | 2008 | 1997 |
| UK - Northern Ireland | 9 to 10 | 5 | 14 to 15 | 1947/1953 | 1943 |
| UK - Northern Ireland | 10 to 11 | 5 | 15 to 16 | 1972 | 1958 |
| UK - Northern Ireland | 11 to 12 | 5 to 4 | 16 | 1989 | 1986 |
| UK - Scotland | 9 to 10 | 5 | 14 to 15 | 1945 | 1933 |
| UK - Scotland | 10 to 11 | 5 | 15 to 16 | 1972 | 1958 |

* The additional compulsory years can be completed on a part-time education basis.

Description of compulsory schooling reforms by country

Austria: The Federal Law (No. 241/1962) on Compulsory Schooling of July 25, 1962 extended the length of compulsory schooling from 8 to 9 years. Unlike the rest of the law, the provision on the extension came into force on September 1, 1966. The reform maintained that compulsory schooling starts on September 1 after a child's sixth birthday. People born between September 1952 and August 1953 who had to start school in the 1959/60 school year and were in eight grade in the 1966/67 school year were the first to be affected by the reform. However, also people born between September 1951 and August 1952 who had to repeat one of the first eight grades were affected.⁵⁴ For the purpose of this study, the earliest affected birth cohort is 1952.

Belgium: The 1983 Law on Compulsory Education of June 29, 1983 extended the length of compulsory schooling from 8 to 12 years⁵⁵ in all three communities of the country, but maintained the school starting age at 6. Notably, education on a full-time basis became merely compulsory until the age of 15 and had to include at least seven years of lower education and the first two years of secondary education. During the three remaining years until the age of 18, only part-time education was compulsory. The law notes that it does not apply to people born before January 1, 1968 who already have left school, and defines transitional provisions for the 1968 and 1969 birth cohorts. The 1968 birth cohort is only required to have two years of secondary education, putting the length of compulsory full-time education to nine years. The 1969 birth cohort is required to stay in education until the age of 17, corresponding to nine years of compulsory full-time education and two years of compulsory part-time education. For the purpose of this study, the earliest affected birth cohort is 1968.

Bulgaria: The 1921 Public Enlightenment Act introduced seven years of compulsory schooling starting at the age of 7. The 1959 Law on Further Closer Links between School and Life and on the Further Development of Public Education extended compulsory schooling from 7 to 8 years, while maintaining school starting age at 7. The earliest birth cohort affected by this change is 1946, provided that the extension took effect in the 1960/61 school year, affecting those who were in seventh grade in the 1959/60 school year. Educational reforms proposed in 1969-1970 extended the length of compulsory schooling from 8 to 9 years.⁵⁶ Students would start school at the age of 7 and could leave school at

⁵⁴Note that people born between September 1951 and August 1952 were not affected if they never had to repeat a grade, as they completed compulsory schooling right before the law change (i.e., August 31, 1966, although school had effectively already ended for them before the summer holidays) and hence could not be forced to go back to school.

⁵⁵In 1953, the government proposed to increase compulsory schooling from 8 to 9 years until the age of 15, and in the 1970s several other attempts were made to increase it to the age of 16, but neither of these propositions were enacted.

⁵⁶There is conflicting information on the exact details of the reform. Nica and Birzea (1973) report for the pre-reform period in around 1970 that school starting age was six years, the length of compulsory

the age of 16 after the reform. This change was implemented on a gradual basis starting in the 1973/74 school year (Georgeoff, 1979). The earliest birth cohort affected by this extension is 1958, which was in eighth grade in the 1972/73 school year. The 1991 Public Education Act confirmed that full-time education is compulsory for children between the ages of 7 and 16.

Croatia: After WWI, Croatia became part of Yugoslavia and education was compulsory for four years. Although the 1929 Law on Elementary Schools stipulated eight years of compulsory schooling, it was not enforced until the outbreak of WWII, and no new 8-year schools were opened nor any teaching plan or program drawn up for such a school (CIA, 1953; Tomich, 1963). A law passed on October 26, 1945 stipulated seven years of compulsory schooling, with schooling starting at the age of 7 (CIA, 1953; Tomich, 1963). The earliest birth cohort affected by this reform is 1935, provided that the change took effect in the 1946/47 school year, affecting those who were in fourth grade in the 1945/46 school year. In 1952⁵⁷, compulsory schooling was extended to eight years, while maintaining school starting age at 7. The earliest birth cohort affected by this reform is 1938, provided that the change took effect in the 1952/53 school year, affecting those who were in seventh grade in the 1951/52 school year. However, the aim of eight years of compulsory schooling in all of Yugoslavia was not fully achieved until the late 1950s, but the Croatian part, especially Dalmatia, might have reached it faster, as 6-year and 8-year primary schools existed there even before WWII (Tomich, 1963). The General Law on Education of June 25, 1958 established a uniform compulsory 8-year school of general education for children between the ages of 7 and 15 (Tomich, 1963; Zivojnović and Levi, 1959). There has been no change in the length of compulsory schooling or schooling starting age⁵⁸ in Croatia after becoming an independent country.

Cyprus: Before Cyprus' independence from the UK in 1960, much of the primary education sector, which seems to have covered children from age 6 to 11, was under the direct responsibility of the British authorities. In practice, primary education had been universal since 1945, but not compulsory. For the Greek-speaking part of the population, six years of education in primary school starting at the age of 6 were made compulsory and free of charge in 1962. The first grade of lower secondary school became free of charge (though not compulsory) in the 1972/73 school year and grades two and three in the

schooling eight years, and school leaving age 14 years. Georgeoff (1979) notes that the reform would extend the length from 8 to 10 years, which is to be achieved by lowering school starting age from 7 to 6 years and increasing school leaving age to 16 years. However, at the latest by the 1980/81 school year, compulsory schooling encompassed nine years from age 7 to 16 (Eurydice, 2012). Thus, it seems that the reform only led to an extension from 8 to 9 years of compulsory schooling, and that regular school starting age had always been seven years.

⁵⁷There is conflicting information on the year of the extension. Contrary to Hörner et al. (2007), Tomich (1963) and Gabric (2000) cite 1950 and Domovic and Vizek Vidovic (2015) cite 1951.

⁵⁸The current Law on Education in Primary and Secondary Schools states that compulsory schooling begins by enrollment in the first grade of primary school, lasting for eight years, between the ages of 6 and 15. In most international comparisons, school starting age is however reported to be seven years, as children are on average about six and a half years old when they start school.

1985/86 school year. In the 1985/86 school year, these three years of lower secondary school became compulsory, which extended the length of compulsory schooling from 6 to 9 years. The earliest birth cohort affected by this reform is 1973, as this cohort was in the sixth and final grade of primary school in the 1984/85 school year.

Czechia: After WWI, Czechoslovakia introduced eight years of compulsory schooling through the Small School Act of June 1922. The school starting age was six years and remained unchanged in all subsequent reforms. Act No. 95/1948 (passed in April) on the Basic Regulation of Comprehensive Education extended the length of compulsory schooling to nine years. The earliest birth cohort affected by this reform is 1934, provided that the change took effect in the 1948/49 school year, affecting those who were in eighth grade in the 1947/48 school year. Act No. 31/1953 on the Education System and Teacher Training reduced the length of compulsory schooling to eight years again. The earliest birth cohort affected by this reform is 1939, which could stop education after the eighth grade in the 1952/53 school year, provided that the change took effect in the 1953/54 school year. Act No. 186/1960 (passed in December) on the Education and Training System restored nine years of compulsory schooling. The earliest birth cohort affected by this reform is 1947, provided that the change took effect in the 1961/62 school year, affecting those who were in eighth grade in the 1960/61 school year. In 1976, the Communist Party initiated a reform on the Further Development of the Czechoslovak Education System, which entailed both a change in the structure of the primary and secondary education system and an extension of the length of compulsory schooling to ten years (consisting of eight grades in basic school and two grades in secondary school). A law in 1978 formalized these changes and they were gradually implemented starting around 1979. The earliest birth cohort affected by this reform is 1964, provided that the change took effect in the 1979/80 school year, affecting those who were in ninth grade in the 1978/79 school year. Act No. 29/1984 of March 22, 1984 on the System of Basic and Secondary Schools confirmed the new structure of the education system and the length of compulsory schooling. Act No. 171/1990 of May 3, 1990 amended the 1984 Act and reduced the length of compulsory schooling again to nine years. It stipulated that students in ninth grade in the 1989/1990 school year would complete compulsory school attendance by the end of this school year. This affected the student cohort born between September 1974 and August 1975. For the purpose of this study, the earliest affected birth cohort is 1975.

Denmark: The Primary School Act of May 18, 1937 introduced seven years of compulsory education, starting during the year a child turns 7 and lasting until the end of the school year during which a child turns 14. However, the structure of the school differed between the countryside and the capital region. This structural difference was abolished by the Executive Order on the Primary School Act of June 18, 1958. During the 1960s, it became more common for students to stay in school after completing compulsory education. The amendment of the Primary School Act of June 17, 1972 extended the length

of compulsory education from 7 to 9 years, while maintaining school starting age at 7. The eighth grade became compulsory in the 1972/73 school year and the ninth grade in the 1973/74 school year. The earliest birth cohort affected by this change is 1958, which was in seventh grade in the 1971/72 school year. A new Primary School Act of June 26, 1975 involved another structural change of the primary school by introducing a voluntary kindergarten class (grade zero) followed by nine compulsory grades and a voluntary tenth grade. On May 20, 2008, an amendment of the Primary School Act extended compulsory education from 9 to 10 years, by making attendance of the kindergarten class compulsory. Children have to start this class at the age of 6 and it is generally classified as ISCED level 1. The earliest affected birth cohort is 2003, as the provision came into effect in the 2009/10 school year.

Estonia: In the Republic of Estonia, six years of education were compulsory between the ages of 8 and 16 between 1920 and 1934, and between the ages of 8 and 14 between 1934 to 1940. In 1940, Estonia came under the rule of the Soviet Union and in 1941 of Nazi Germany before being taken back by the Soviet Union in late 1944. It is not well documented what the consequences for the education system in Estonia have been during WWII. In the Soviet Union, compulsory schooling had been four years in rural areas and seven years in urban areas since 1930, with schooling starting at the age of 7. When the Soviet Union regained control over Estonia in 1944, seven years of compulsory schooling starting at the age of 7 were introduced.⁵⁹ The Act of December 24, 1958 extended compulsory schooling from 7 to 8 years starting from the 1959/60 school year. The earliest birth cohort affected by this reform is 1945, which was in seventh grade in the 1958/59 school year. Starting in 1970, compulsory secondary education was introduced. This extended the length of compulsory schooling from 8 to 10 years, but it took until around 1980 to implement this reform in the whole Soviet Union. However, in Estonia this extension resulted in an increase from 8 to 11 years, as the structure of (upper) secondary education in the Baltic states differed slightly from the Soviet model. The earliest birth cohort affected by this reform is 1955, provided that the change took effect in the 1970/71 school year, affecting those who were in eighth grade in the 1969/70 school year. Starting in the 1986/87 school year, a transition was formally initiated to lower the school starting age from 7 to 6 years and to extend the length of compulsory schooling from 11 to 12 years (from 10 to 11 years in the rest of the Soviet Union). It seems that in Estonia this transition was never completed as the increase from 11 to 12 years was only initiated in June 1988 and in the 1989/90 school year the school starting age was reversed to 7 again. After Estonia's independence, the Education Act of March 23, 1992 abolished compulsory upper secondary education and introduced nine years of compulsory schooling starting at the age of 7. The earliest birth cohort affected by this change from 11 to 9 years of compulsory schooling is 1975, which could stop education at the end of the tenth grade in

⁵⁹Some sources cite 1949 as the year when seven years of schooling were made compulsory, as this was the year when it was introduced throughout the whole Soviet Union. Due to the ambiguity of the exact date and details, I do not consider this reform in the analysis.

the 1991/92 school year.

Finland: In 1921, six years of compulsory schooling starting at the age of 7 were introduced. The Education Act 467/1968 changed the structure of the education system. A nine-grade comprehensive school was introduced and compulsory schooling was extended from 6 to 9 years to cover all nine grades, while maintaining school starting age at 7. According to Pekkarinen (2008), this reform was gradually implemented by all municipalities between 1972 and 1977. Most students across all parts of Finland were affected by the implementation in 1974 (Pekkarinen, 2008; Brunello et al., 2009). An important feature of the reform was that students starting the fifth grade in the year of implementation were the first ones affected. The earliest birth cohort affected by the reform in 1974 is thus 1963. It should also be noted that, according to Pekkarinen (2008), the vast majority of students, especially those living in urban municipalities in the south, already obtained nine years of schooling before the reform. The new nine-grade comprehensive school made it however possible for all students to continue education at the upper secondary level; the previous tracking system prevented some students from doing so.

France: In 1936, eight years of compulsory schooling between the ages of 6 and 14 were introduced. The decree of January 6, 1959 extended the length of compulsory schooling from 8 to 10 years, while maintaining school starting age at 6. The decree stipulated that the extension only applies to those who turn 6 years of age after January 1, 1959. The earliest birth cohort affected by the reform is thus 1953.

Germany: The Compulsory School Act of July 6, 1938 introduced eight years of compulsory schooling, starting at the age 6 in what was then Nazi Germany. In East Germany, the Education Act of December 2, 1959 extended compulsory schooling from 8 to 10 years. Education was supposed to take place in a ten-grade polytechnic school, which had to be established gradually until fall 1964. After 1945, the ten states in West Germany extended compulsory schooling from 8 to 9 years, but they did so in different years as educational matters had been and still are mostly determined by the German states. However, in four West German states (Baden-Württemberg, Hesse, North Rhine-Westphalia, Rhineland-Palatinate) this extension was implemented in 1967, with the earliest birth cohort affected being 1953 (Cygan-Rehm and Maeder, 2013).⁶⁰ Since these four states accounted for almost half of the entire population of both West Germany and East Germany, this reform date could be used in the analysis. Mostly after the reunification in 1990, there have been further extensions in compulsory schooling. Some states extended compulsory full-time education to ten years and most have introduced compulsory vocational training (i.e., part-time education) at least until the age of 18, but there is no reform date that could be assumed to be representative of all of Germany.

⁶⁰Pischke and von Wachter (2008) and Cygan-Rehm and Maeder (2013) cite different dates of the extension in four of the ten states, but they agree on the four states that implemented it in 1967.

Greece: Compulsory schooling for six years from the age of 6 to 12 has existed since 1927. In 1964, compulsory schooling was extended from 6 to 9 years. However, this reform was never completed (Kontogiannopoulos, 1978). During the military regime (April 1967 - July 1974), the length of compulsory schooling was reversed to six years. Article 16 of the 1975 Greek Constitution enshrined nine years of compulsory schooling. This provision was made a reality by the Education Act of April 5, 1976 (Law 309/1976). It extended the length of compulsory schooling from 6 to 9 years, as of the 1976/77 school year (Kazamias, 1978), although its full implementation took until 1980. The earliest birth cohort affected by this reform is 1964, which was in sixth grade in the 1975/76 school year.

Hungary: In 1940, nine years of compulsory schooling were introduced, consisting of eight years of primary education and one year of “general practical economics”. WWII rendered it probably impossible to implement this change. In 1945, an eight-grade general primary school was established, which seemed to coincide with the length of compulsory schooling. Legislative Decree No. 15 of 1951 stipulated eight years of uninterrupted compulsory schooling, starting at the age of 6 and lasting until the end of the school year in which a student turns 14. Legislative Decree No. 29 of 1959 formally extended the length of compulsory schooling from 8 to 9 years, while maintaining school starting age at 6. However, it stated that the obligation to attend school ceases by the end of the school year in which a student successfully finishes the eighth grade of primary school. Only if a student fails to complete the eighth grade, he/she has to stay in school until the end of the school year in which he/she turns 15. These regulations relating to compulsory schooling were supposed to be enforced gradually from the 1959/60 school year over a four-year period. The earliest birth cohort affected by this reform is 1945, which spent its eighth year in school in the 1958/59 school year. Act 3 of 1961 on the Educational System formally extended the length of compulsory schooling from 9 to 10 years, while maintaining school starting age at 6. It obliged students to remain in school until they successfully finished the eighth grade of primary school, or, if they fail to do so, until the end of the school year in which they turn 16. Students who successfully finished the eighth grade before turning 16, had to attend “training school” unless they continued in secondary education, started a vocational training, or entered into an employment exceeding four hours per day. These changes entered into force on the day of the promulgation of the act on October 17, 1961. The earliest birth cohort affected by this reform is 1947, which spent its eighth year in school in the 1960/61 school year. Act 1 of 1985 on Education confirmed the provisions of the 1961 Act. Act 79 of 1993 on Public Education removed any exceptions to not staying in school for ten years between the age of 6 and the end of the school year in which a student turns 16. For the purpose of this study, only the 1993 reform is considered to genuinely increase the length of compulsory schooling from 8 to 10 years. The earliest birth cohort affected by this reform is 1979, which was in eighth grade in the 1992/93 school year. Act 68 of 1999 amended the 1993 Public Education Act and extended compulsory schooling until the end of the school year in which a student turns

18. This applied to children who started primary school in the 1998/99 school year. The earliest affected birth cohort by this change is 1992.

Iceland: The first law introducing four years of compulsory schooling from the age of 10 to 14 was passed in 1907. In 1936, compulsory schooling was extended to seven years between the ages of 7 and 14. In 1946, compulsory schooling was further extended to eight years and the school leaving age raised to 15. The Compulsory School Act (No. 63) of 1974, stipulated nine years of compulsory schooling from the age of 7 to 16. However, the implementation of this provision was postponed and only fully achieved in 1984. The earliest birth cohort affected by this reform is 1968, provided that it applied to those in eighth grade in the 1982/83 school year. The Compulsory School Act (No. 49) of March 27, 1991 extended the length of compulsory schooling from 9 to 10 years, as of the 1991/92 school year. This was achieved by lowering the school starting age from 7 to 6, although parents had the right to enroll their children at the age of 6 already under the 1974 Act. The earliest birth cohort affected by this reform is 1985.

Ireland: The School Attendance Act of 1926 introduced eight years of compulsory schooling between the ages of 6 and 14. On April 12, 1972 a ministerial order modified this act and raised the minimum school leaving age by one year to 15, thereby increasing the length of compulsory schooling from 8 to 9 years. This order came into effect on July 1, 1972. The earliest fully affected birth cohort is 1958, which turned 14 during the course of 1972; among the 1957 cohort most had already turned 15 by the start of the 1972/73 school year. The Education (Welfare) Act of July 5, 2000 raised the minimum school leaving age by another year to 16 or until the completion of three years of post-primary education, whichever is later. The act came into effect two years after its passing on July 5, 2002. The earliest fully affected birth cohort is 1987, which turned 15 during the course of 2002; among the 1986 cohort most had already turned 16 by the start of the 2002/03 school year.

Italy: Law No. 1859 of December 31, 1962 extended the length of compulsory schooling from 5 to 8 years by requiring the attendance of the three-year long lower secondary school, but it maintained the school starting age at 6. This was pursuant to article 34 of the constitution of 1948, which called for eight years of compulsory schooling free of charge. The extension was implemented in the 1963/64 school year (Guglietti, 2013). The earliest affected birth cohort is 1952, which was in fifth grade in the 1962/63 school year.⁶¹ Law No. 9 of January 20, 1999 formally extended the length of compulsory schooling from 8 to 10 years, but noted that from the 1999/2000 school year only the extension from 8 to 9 years would be enforced. The earliest affected birth cohort is 1985, which was in eighth grade in the 1998/99 school year (Brilli and Tonello, 2018). Law No. 296 of December 27, 2006 extended the length of compulsory schooling from 9 to 10 years, as of the 2007/08

⁶¹Brandolini and Cipollone (2002) note that some students among the cohorts 1949-1951 might also have been affected in case they had to repeat any grades and did not leave school after the fifth grade. They also note that full compliance with the reform was not immediate, but rather took almost 15 years.

school year. The earliest affected birth cohort is 1992, which was in ninth grade in the 2006/07 school year.

Latvia: In the Republic of Latvia, six years of education starting at the age of 9 were compulsory between 1918 and 1940. In 1940, Latvia came under the rule of the Soviet Union and in 1941 of Nazi Germany before being taken back by the Soviet Union in late 1944. It is not well documented what the consequences for the education system in Latvia have been during WWII. In the Soviet Union, compulsory schooling had been four years in rural areas and seven years in urban areas since 1930, with schooling starting at the age of 7. When the Soviet Union regained control over Latvia in 1944, seven years of compulsory schooling starting at the age of 7 were introduced.⁶² The Act of December 24, 1958 extended compulsory schooling from 7 to 8 years starting from the 1959/60 school year. The earliest birth cohort affected by this reform is 1945, which was in seventh grade in the 1958/59 school year. Starting in 1970, compulsory secondary education was introduced. This extended the length of compulsory schooling from 8 to 10 years, but it took until around 1980 to implement this reform in the whole Soviet Union. However, in Latvia this extension resulted in an increase from 8 to 11 years, as the structure of (upper) secondary education in the Baltic states differed slightly from the Soviet model. The earliest birth cohort affected by this reform is 1955, provided that the change took effect in the 1970/71 school year, affecting those who were in eighth grade in the 1969/70 school year. Starting in the 1986/87 school year, a transition was formally initiated to lower the school starting age from 7 to 6 years and to extend the length of compulsory schooling from 11 to 12 years (from 10 to 11 years in the rest of the Soviet Union). It seems that in Latvia this transition was never completed. After Latvia's independence, the Education Law of June 19, 1991 abolished compulsory upper secondary education and introduced nine years of compulsory schooling starting at the age of 7. The earliest birth cohort affected by this change from 11 to 9 years of compulsory schooling is 1974, which could stop education at the end of the tenth grade in the 1990/91 school year.

Lithuania: In Lithuania, the 1922 Law on Compulsory Primary Education introduced compulsory school attendance from the age of 7 to 14. It was implemented between 1928 and 1931. In 1940, Lithuania came under the rule of the Soviet Union and in 1941 of Nazi Germany before being taken back by the Soviet Union in early 1945. It is not well documented what the consequences for the education system in Lithuania have been during WWII. In the Soviet Union, compulsory schooling had been four years in rural areas and seven years in urban areas since 1930, with schooling starting at the age of 7. When the Soviet Union regained control over Lithuania in 1945, seven years of compulsory schooling starting at the age of 7 were introduced.⁶³ The Act of December 24, 1958 extended com-

⁶²Some sources cite 1949 as the year when seven years of schooling were made compulsory, as this was the year when it was introduced throughout the whole Soviet Union. Due to the ambiguity of the exact date and details, I do not consider this reform in the analysis.

⁶³Some sources cite 1949 as the year when seven years of schooling were made compulsory, as this was the year when it was introduced throughout the whole Soviet Union. Due to the ambiguity of the exact

pulsory schooling from 7 to 8 years starting from the 1959/60 school year. The earliest birth cohort affected by this reform is 1945, which was in seventh grade in the 1958/59 school year. Starting in 1970, compulsory secondary education was introduced. This extended the length of compulsory schooling from 8 to 10 years, but it took until around 1980 to implement this reform in the whole Soviet Union. However, in Lithuania this extension resulted in an increase from 8 to 11 years, as the structure of (upper) secondary education in the Baltic states differed slightly from the Soviet model. The earliest birth cohort affected by this reform is 1955, provided that the change took effect in the 1970/71 school year, affecting those who were in eighth grade in the 1969/70 school year. Starting in the 1986/87 school year, a transition was formally initiated to lower the school starting age from 7 to 6 years and to extend the length of compulsory schooling from 11 to 12 years (from 10 to 11 years in the rest of the Soviet Union). It seems that in Lithuania this transition was never completed. After Lithuania's independence, the Education Law of June 25, 1991 abolished compulsory upper secondary education and introduced nine years of compulsory schooling starting at the age of 7. The earliest birth cohort affected by this change from 11 to 9 years of compulsory schooling is 1974, which could stop education at the end of the tenth grade in the 1990/91 school year. An amendment of the Education Law, passed on July 2, 1998, introduced a ten-grade basic school, which was implemented in the 1999/2000 school year. This increased the length of compulsory schooling principally from 9 to 10 years, but the law contains the clause that students can leave school upon turning 16, yet it also allows students to enroll either at the age of 6 or 7. Students who were in the ninth grade in the 1998/99 school year were offered to either stay in general education for one more year or complete the tenth year at a vocational school. This transitional provision affected students born in 1983, who started school at the age of 7 in the 1990/91 school year.

Luxembourg: An amendment of the Law on the Organization of Primary Education of August 10, 1912 was passed on May 25, 1945 and increased the length of compulsory schooling from 7 to 8 years, while maintaining school starting age at 6. However, the 1912 law allowed individual municipalities to introduce an eighth year of compulsory schooling, and the 1945 amendment allowed for a ninth year. The earliest birth cohort affected by this reform is 1932, provided that the change took effect in the 1945/46 school year, affecting those who were in seventh grade in the 1944/45 school year. Another amendment of the 1912 law, passed on August 5, 1963, extended the length of compulsory schooling from 8 to 9 years, while maintaining school starting age at 6. The earliest birth cohort affected by this reform is 1950, provided that the change took effect in the 1964/65 school year, affecting those who were in eighth grade in the 1963/64 school year. The law on Compulsory Education of February 6, 2009 extended compulsory schooling from 9 to 10 years, although students who enter an apprenticeship at the age of 15 can meet the requirement of the tenth year of compulsory schooling by attending concomitant vocational

date and details, I do not consider this reform in the analysis.

courses. Students born on or after September 1, 1993 were affected by this reform, as it took effect in the 2009/10 school year.⁶⁴

Malta: The Compulsory School Attendance Ordinance of 1924 made school attendance compulsory from the age of 6 to 12, and in 1928 it was extended from the age of 6 to 14. However, compulsory attendance only applied to children who were registered to attend school. The Compulsory Education Ordinance of 1946 introduced eight years of compulsory schooling for all children from the age of 6 to 14. The Education Act (No. XXXIX) of 1974 extended the length of compulsory schooling from 8 to 10 years and raised the school leaving age from 14 to 16. The earliest birth cohort affected by this reform is 1960, provided that the change took effect in the 1974/75 school year, affecting those who were in eighth grade in the 1973/74 school year. The Education Act (No. XXIV) of August 9, 1988 lowered the school starting age by one year to 5 and extended the length of compulsory schooling from 10 to 11 years until the age of 16. The earliest birth cohort affected by this reform is 1983, provided that the change took effect in the 1988/89 school year, affecting children who turned 5 in 1988.

Netherlands: The 1900 Law on Compulsory Education introduced six years of compulsory schooling from the age of 6 to 12. An amendment of the law extended the length of compulsory schooling to seven years as of January 1, 1922, but this was never enforced and the length was formally reversed to six years in 1924. On July 1, 1928 it was eventually extended to seven years. During the occupation by Nazi Germany, compulsory schooling was extended to eight years in 1942 in an attempt to promote learning of the German language, but due to resistance in the population, compliance with the law was very low (van Kippersluis et al., 2011). An amendment of the Law on Compulsory Education of April 18, 1947, due to be implemented on January 1, 1950, confirmed the length of compulsory schooling to be eight years, starting at the age of 6. The earliest birth cohort affected by this effective change from 7 to 8 years of compulsory schooling is 1937, which was in seventh grade in the 1949/50 school year. In 1968, the Secondary Education Act (also known as the Mammoth Act) profoundly changed the structure of the education system but not the length of compulsory schooling. The Law on Compulsory Education of May 30, 1968, extended compulsory schooling from 8 to 9 years. Although this law came into force on January 1, 1969, the extension was not enforced until August 1, 1971. An amendment of the law in 1971 also introduced one year of compulsory part-time education for those leaving school after compulsory full-time education. The earliest birth cohort affected by both of these reforms is 1957, which was in eighth grade in the 1970/71 school year. In 1975, compulsory full-time education was extended from 9 to 10 years, while maintaining school starting age at 6 and also one year of compulsory part-time education. According

⁶⁴Formally, the length of compulsory schooling is 12 years, as one year of compulsory pre-primary education starting at the age of 5 was introduced on October 22, 1976 and a second year of compulsory pre-primary education starting at the age of 4 on September 2, 1992. But there is no formal teaching in those years.

to Oosterbeek and Webbink (2007), the implementation of this reform started already in 1973. They note that students born in or after September 1959 were affected by the change, but because grade retention was fairly common among students who were mostly affected by the extension, it also affected some born in the year before this date. For the purpose of this study, the earliest affected birth cohort is 1959. In 1985, the compulsory school starting age was lowered from 6 to 5, and the length of compulsory full-time education extended from 10 to 12 years, while also maintaining one year of compulsory part-time education. This reform did not affect those who were already in school, as two grades in the beginning of primary school were added.⁶⁵ The earliest affected birth cohort is 1980, which had to start school in 1985, but it should be noted that most four-year and five-year olds already attended (pre-)school on a voluntary basis at that time. On August 1, 2007, the compulsory year of part-time education was abolished and compulsory full-time school attendance until the age of 18 was introduced, which corresponds to 13 years of schooling. Students born on or after August 1, 1990 were affected by this reform (Cabus and De Witte, 2011). For the purpose of this study, the earliest affected birth cohort is 1990.

Norway: In 1889, seven years of compulsory schooling starting at the age of 7 were introduced. The Law on the Primary School of April 10, 1959 confirmed that compulsory schooling lasts for at least seven years, starting in the calendar year in which a child turns 7. However, the law granted the municipal councils the right to introduce a nine-grade primary school and make its attendance compulsory for all children living in the municipality.⁶⁶ Pursuant to this law, many municipalities implemented this change, but full implementation was not achieved until the beginning of the 1970s. In the meantime, the Education Act of June 13, 1969 had formally extended compulsory schooling from 7 to 9 years. Aakvik et al. (2010) and Black et al. (2008) show that most municipalities switched to the new system in the years between 1965 and 1969. They also note that the timing of the implementation was unrelated to municipal characteristics. For the purpose of this study, the earliest affected birth cohort is 1951, which was in seventh grade in the 1964/65 school year and hence was affected by the implementation in 1965. Law No. 58 of September 9, 1994 lowered the school starting age from 7 to 6 and extended the length of compulsory schooling from 9 to 10 years. This reform came into force in the 1997/98 school year, and the law states that the 1991 birth cohort would be the first one to be affected.

Poland: The Decree on Compulsory Schooling of February 7, 1919 introduced seven years of compulsory schooling starting at the age of 7, but it exempted students from this

⁶⁵In terms of educational content, either only the first or both initial grades are sometimes classified as ISCED level 0, but usually as ISCED level 1.

⁶⁶According to Aakvik et al. (2010) and Black et al. (2008), the extension from 7 to 9 years of compulsory schooling had already started on a small and exploratory basis in the late 1950s, but applied to a negligible number of students because only three municipalities (of around 750), each with a small number of schools, were involved.

obligation if their home was more than 3 km away from the nearest school. The Decree on School Obligations of March 23, 1956 no longer contained this distance-dependent exemption. It obliged students to start school at the age of 7 and to stay in school until the completion of all seven grades of primary school or until the end of the school year in which they turn 16, whichever is earlier. But it also allowed for a drop-out at age 14 under certain circumstances. The Act on the Development of the Education System of July 15, 1961 established an eight-grade primary school, maintained school starting age at 7, and obliged students to stay in school until the completion of all eight grades of primary school or until the end of the school year in which they turn 16, whichever is earlier. This one-year extension in compulsory schooling was implemented in the 1966/67 school year (Jung-Miklaszewska, 2003; Liwiński, 2018a). The earliest affected birth cohort is 1952, which spent its seventh year in school in the 1965/66 school year. In the 1970s, there were unsuccessful attempts to extend primary school to ten grades, similar to the Soviet model. The Act on School Education of September 7, 1991 confirmed the provisions of the 1961 Act. The Act on Provisions Introducing a Reform of the School System of January 8, 1999 changed the structure of the school system and introduced a six-grade primary school and a three-grade lower secondary school. It maintained school starting age at 7 and obliged students to stay in school until the completion of all nine grades of primary school and lower secondary school or until they turn 18. It also obliged students who finished the first nine grades before turning 18 to continue in upper secondary school or vocational training offered by employers (i.e., part-time education) until they turn 18. The 1999 Act stipulated that its provisions affect all people younger than 18 on September 1, 1999. The earliest fully affected birth cohort is thus 1982⁶⁷, which completed all eight grades of the old primary school at the end of the 1996/97 school year (except for those who had to repeat classes) but then had to continue with at least part-time education until turning 18.

Portugal: Decree-Law No. 40964 of December 31, 1956 extended compulsory primary education from 3 to 4 years only for boys enrolling in the first grade in October 1957. The law did not change the provisions of Decree-Law No. 38968 of October 27, 1952 that stated that primary education is compulsory between the ages of 7 and 13 (upon completing three years according to the 1952 provisions or four years according to the 1956 provisions, students could leave school even before turning 13). The earliest affected male birth cohort is 1950, which was in the first grade in the 1957/58 school year. Decree-Law No. 42994 of May 28, 1960 introduced four years of compulsory primary education for students of both sexes between the ages of 7 and 13, as of the 1960/61 school year. Thus, it effectively extended the length of compulsory schooling for girls from 3 to 4 years, although the law noted that a large proportion of girls already used to stay in school voluntarily for a fourth year. The provision seems to have made it compulsory for girls who finished the third grade in spring 1960 to enroll in the fourth grade in fall 1960. The earliest affected female birth cohort is 1950, which means that the same cohort as for boys was affected

⁶⁷Liwiński (2018b) defines the 1986 cohort as the first one affected by the reform, as this was the first birth cohort that had to attend the new three-grade lower secondary school in the 1999/2000 school year.

by the one-year extension. Decree-Law No. 45810 of July 9, 1964 extended the length of compulsory schooling from 4 to 6 years for children (of both sexes) between the ages of 7 and 14 (upon completing six years, students could leave school even before turning 14). It stated that the two additional years would start to become compulsory for children enrolling in the first grade in the 1964/65 school year as well as children repeating the first grade in this school year. The earliest fully affected birth cohort is 1957, while children repeating the first grade⁶⁸ would be born in 1956. Law No. 5/1973 of July 25, 1973 intended to extend compulsory schooling from 6 to 8 years, but due to the revolution in 1974 it was never implemented. It also would have lowered school starting age from 7 to 6, but this was only achieved by Law No. 538/79 of 31 December 1979, which affected the 1974 birth cohort that started school in the 1980/81 school year. Law No. 46/1986 of October 14, 1986 extended the length of compulsory schooling from 6 to 9 years for children between the ages of 6 and 15. Students born on or after September 16, 1980 had to attend the first grade in the 1987/88 school year and were the first ones subject to the extension. For the purpose of this study, the earliest affected birth cohort is 1980. Law No. 85/2009 of August 27, 2009 extended the length of compulsory schooling from 9 to 12 years for children between the ages of 6 and 18. The earliest birth cohort affected by this reform is 1997, as the extension affected students enrolled in the seventh grade in the 2009/10 school year.

Romania: The Primary Education Law of 1924 introduced seven years of compulsory schooling. The Education Act of August 3, 1948 reduced the length of compulsory schooling from 7 to 4 years. The earliest birth cohort affected by this reform is 1935, which could stop education at the end of the sixth grade in the 1947/48 school year, provided that school starting age was 7. This reduction was reversed in the five-year plan of 1956-1960, which extended compulsory schooling from 4 to 7 years. The implementation of this reversal started in the 1956/57 school year and took until the 1961/62 school year. Malamud et al. (2018) note that especially Decision No. 1035/1958 to make the seven years of school attendance universal in villages and rural communities as of the 1958/59 school year was important. The earliest birth cohort affected by this decision is 1947, which was in fourth grade in the 1957/58 school year. In 1965, compulsory schooling was further extended from 7 to 8 years. The earliest birth cohort affected by this reform is 1951, provided that the change took effect in the 1965/66 school year, affecting those who were in seventh grade in the 1964/65 school year. The Education Act of May 13, 1968 extended the length of compulsory schooling from 8 to 10 years and also reduced the school starting age from 7 to 6. The gradual implementation of this reform started in the 1968/69 school year (Malamud and Pop-Eleches, 2010). The earliest birth cohort affected by the extended length is 1953, whereas the 1962 cohort was the first one subject to the lower school starting age. During the 1990/91 school year, compulsory schooling was reduced from 10 to 8 years. The earliest birth cohort affected by this reform is 1976, which could stop education while in ninth grade in 1990/91. The Education Act of July

⁶⁸Vieira (1999) notes that the failure rate was “quite high” in the first years of education, but does not define it in quantitative terms.

24, 1995 raised school starting age from 6 to 7, while maintaining eight years of compulsory schooling. The earliest birth cohort affected by this deferred school start is 1989. The Education Act of July 30, 1999 extended compulsory schooling from 8 to 9 years, as of the 1999/2000 school year. The earliest birth cohort affected by this reform is 1985, which still started school at age 6 and was in eighth grade in the 1998/99 school year. The Education Act of June 13, 2003 extended compulsory schooling from 9 to 10 years and lowered school starting age from 7 to 6, as of the 2003/04 school year. The earliest birth cohort affected by the extended length is 1988, which started school at age 6 in 1994 and was in ninth grade in the 2002/03 school year. The earliest birth cohort affected by the lower school starting age is 1997. The Education Act of 2011 extended compulsory schooling from 10 to 11 years by introducing a compulsory preparatory school year at the age of 6 and postponing the start of the first grade until the age of 7, as of the 2012/13 school year. The earliest birth cohort affected by this reform is 2006.

Serbia: After WWI, Serbia became part of Yugoslavia and education was compulsory for four years. Although the 1929 Law on Elementary Schools stipulated eight years of compulsory schooling, it was not enforced until the outbreak of WWII, and no new 8-year schools were opened nor any teaching plan or program drawn up for such a school (CIA, 1953; Tomich, 1963). A law passed on October 26, 1945 stipulated seven years of compulsory schooling, with schooling starting at the age of 7 (CIA, 1953; Tomich, 1963). The earliest birth cohort affected by this reform is 1935, provided that the change took effect in the 1946/47 school year, affecting those who were in fourth grade in the 1945/46 school year. In 1952⁶⁹, compulsory schooling was extended to eight years, while maintaining school starting age at 7. The earliest birth cohort affected by this reform is 1938, provided that the change took effect in the 1952/53 school year, affecting those who were in seventh grade in the 1951/52 school year. However, the aim of eight years of compulsory schooling in all of Yugoslavia was not fully achieved until the late 1950s, but the Serbian part, especially Vojvodina, might have reached it faster, as 6-year and 8-year primary schools existed there even before WWII (Tomich, 1963). The General Law on Education of June 25, 1958 established a uniform compulsory 8-year school of general education for children between the ages of 7 and 15 (Tomich, 1963; Zivojnović and Levi, 1959). There has been no change in the length of compulsory schooling or schooling starting age in Serbia since then.

Slovakia: After WWI, Czechoslovakia introduced eight years of compulsory schooling through the Small School Act of June 1922. The school starting age was six years and remained unchanged in all subsequent reforms. Act No. 95/1948 (passed in April) on the Basic Regulation of Comprehensive Education extended the length of compulsory schooling to nine years. The earliest birth cohort affected by this reform is 1934, provided that the change took effect in the 1948/49 school year, affecting those who were in eighth grade in the 1947/48 school year. Act No. 31/1953 on the Education System and Teacher Train-

⁶⁹There is conflicting information on the year of the extension. Contrary to Hörner et al. (2007), Tomich (1963) and Gabric (2000) cite 1950 and Domovic and Vizek Vidovic (2015) cite 1951.

ing reduced the length of compulsory schooling to eight years again. The earliest birth cohort affected by this reform is 1939, which could stop education after the eighth grade in the 1952/53 school year, provided that the change took effect in the 1953/54 school year. Act No. 186/1960 (passed in December) on the Education and Training System restored nine years of compulsory schooling. The earliest birth cohort affected by this reform is 1947, provided that the change took effect in the 1961/62 school year, affecting those who were in eighth grade in the 1960/61 school year. In 1976, the Communist Party initiated a reform on the Further Development of the Czechoslovak Education System, which entailed both a change in the structure of the primary and secondary education system and an extension of the length of compulsory schooling to ten years (consisting of eight grades in basic school and two grades in secondary school). A law in 1978 formalized these changes and they were gradually implemented starting around 1979. The earliest birth cohort affected by this reform is 1964, provided that the change took effect in the 1979/80 school year, affecting those who were in ninth grade in the 1978/79 school year. Act No. 29/1984 of March 22, 1984 on the System of Basic and Secondary Schools confirmed the new structure of the education system and the length of compulsory schooling. Act No. 171/1990 of May 3, 1990 amended the 1984 Act and reduced the length of compulsory schooling again to nine years. It stipulated that students in ninth grade in the 1989/1990 school year would complete compulsory school attendance by the end of this school year. This affected the student cohort born between September 1974 and August 1975. For the purpose of this study, the earliest affected birth cohort is 1975. After Slovakia's independence, Act No. 6/1998 of December 17, 1997 amended the 1984 Act again and extended compulsory schooling to ten years. It stipulated that students born before September 1, 1983 could still finish compulsory schooling within nine years. For the purpose of this study, the earliest affected birth cohort by this extension is 1983.

Slovenia: After WWI, Slovenia became part of Yugoslavia and education was compulsory for four years. This marked a decrease, as it was eight years when Slovenia still was part of the Austro-Hungarian Empire. Although the 1929 Law on Elementary Schools stipulated eight years of compulsory schooling, it was not enforced until the outbreak of WWII, but a majority of Slovenian students went to 6-year and 8-year primary school nonetheless (CIA, 1953; Tomich, 1963). A law passed on October 26, 1945 stipulated seven years of compulsory schooling, with schooling starting at the age of 7 (CIA, 1953; Tomich, 1963). The earliest birth cohort affected by this reform is 1935, provided that the change took effect in the 1946/47 school year, affecting those who were in fourth grade in the 1945/46 school year. In 1952⁷⁰, compulsory schooling was extended to eight years, while maintaining school starting age at 7. The earliest birth cohort affected by this reform is 1938, provided that the change took effect in the 1952/53 school year, affecting those who were in seventh grade in the 1951/52 school year. However, the aim of eight years of compulsory schooling in all of Yugoslavia was not fully achieved until the late

⁷⁰There is conflicting information on the year of the extension. Contrary to Hörner et al. (2007), Tomich (1963) and Gabric (2000) cite 1950 and Domovic and Vizek Vidovic (2015) cite 1951.

1950s, but Slovenia might have reached it faster, as 6-year and 8-year primary schools existed there even before WWII (Tomich, 1963). The General Law on Education of June 25, 1958 established a uniform compulsory 8-year school of general education for children between the ages of 7 and 15 (Tomich, 1963; Zivojnović and Levi, 1959). After Slovenia's independence, compulsory schooling was extended from 8 to 9 years and the school starting age lowered from 7 to 6 in 1999. The reform took effect in the 1999/2000 school year and was gradually implemented across the country until the 2002/03 school year (Ministry of Education, Science and Sport, 2001). The earliest birth cohort affected by this change was 1993, which had to start school at the age of 6 in the 1999/2000 school year.

Spain: The General Act on Education and Financing of the Educational Reform (Law 14/1970 of August 4, 1970) stipulated that basic education is compulsory and free of charge. Basic education was to last for eight years, starting at the age of 6 and lasting until turning 14. The 1970 Act initiated a complete overhaul of the structure of the education system, which was supposed to be implemented gradually over a period of ten years. Before this reform, children were placed into two separate branches, one providing primary education between the ages of 6 and 13, and one providing preparatory primary education from age 6 to 9 followed by secondary education from age 10 to 17. The 1970 Act seems to have led to an increase in the length of compulsory schooling from 7 to 8 years, due to the fact that students had to stay in school until turning 14 instead of 13.⁷¹ The earliest birth cohort affected by this reform is 1958, provided that the change took effect in the 1971/72 school year, affecting those who were in seventh grade in the 1970/71 school year. Note that 1971 is also the first year for which the 1970 Act provides an additional budget to cover the extra expenses for the reform's implementation. The Education Act 1/1990 of October 3, 1990 on the General Organization of the Education System increased the length of compulsory schooling from 8 to 10 years from the age of 6 to 16. It also entailed a new structure of the education system, whose implementation started in the 1991/92 school year and lasted until the 1998/99 school year. According to Felgueroso et al. (2014) and Robles-Zurita (2017), most schools switched to the new system in the 1996/97 school year. This affected the 1982 birth cohort, which was in eighth grade in the 1995/96 school year.

Sweden: In 1936, a law was passed which extended compulsory schooling from 6 to 7 years for children between the ages of 7 and 14. This reform was implemented at different times across the country's school districts, mostly between the 1936/37 and the 1948/49 school year, affecting students in sixth grade in the previous school year. The earliest

⁷¹Pons and Gonzalo (2002) state that this reform increased the minimum school leaving age and they define 1957 as the earliest birth cohort affected. However, they do not mention how large the increase was and provide no information related to the implementation of the reform that would motivate the choice of the 1957 cohort. All subsequent empirical papers relying on this reform directly or indirectly cite Pons and Gonzalo (2002) and state an increase from 6 to 8 years of compulsory schooling and an increase from 12 to 14 years in the minimum school leaving age. Only Murtin and Viarengo (2011) note that the reform implied an increase in compulsory schooling from 7 to 8 years.

birth cohort affected ranges from 1923 (if implemented in the 1936/37 school year) to 1935 (if implemented in the 1948/49 school year) (Fischer et al., 2016). School districts were also allowed to extend compulsory schooling to eight years upon approval by the king, but mostly only some city communities made use of this clause (Meghir and Palme, 2003). In 1962, a new law extended compulsory schooling from 7 (or 8) to 9 years for children between the ages of 7 and 16, and created a unified nine-grade school from the 1962/63 school year. This extension had already been in place on an experimental basis in certain municipalities across the country since the 1949/50 school year. By the 1961/62 school year, almost 40% of all municipalities had extended compulsory schooling to nine years. Meghir and Palme (2003) note that the timing of the implementation in the pre-reform period was unrelated to municipal characteristics. Whenever a municipality implemented the change, it was not immediate; it affected either students in the first grade or those in the fifth grade. This was also true in the remaining municipalities that had to implement the reform in the 1962/63 school year. In these remaining municipalities, the earliest birth cohort affected is 1955 (1951) if the change applied those in first (fifth) grade.

Switzerland: The constitution of 1874 enshrined compulsory schooling free of charge in primary school. The cantons were however free to determine the features of the education system. On October 29, 1970, the Swiss Conference of Cantonal Ministers of Education (EDK) proposed to harmonize certain features of the education system between the cantons, such as the length of compulsory schooling, the timing of the start of the school year, and the number of weeks of instruction. The proposal required cantons to implement at least nine years of compulsory schooling. But it was voluntary for the cantons to sign up for the proposal. After the quorum of ten cantons had signed up by June 1971, it formally came into force in the signing cantons. By the end of 1972, 20 out of 25 cantons had signed up for the proposal (the remaining ones did so after 1986) (Arnet, 2000). In 1970, nearly half of the cantons already fulfilled the requirement of nine years of compulsory schooling. The remaining cantons were required to implement this provision (mostly entailing an increase from 8 to 9 years, but in a few cantons it was from 7 to 9 years) “within a reasonable time frame”. Balestra and Backes-Gellner (2017) note that the by far most populous canton, Zürich, implemented the increase from 8 to 9 years in 1977, affecting those born in 1971 and later. For the purpose of this study, the earliest affected birth cohort is thus 1971.

United Kingdom - England and Wales: Educational matters in the UK have not been regulated uniformly across the country. In England and Wales, the 1944 Education Act extended compulsory schooling from 9 to 10 years by raising the minimum school leaving age from 14 to 15, while maintaining school starting age at 5. This provision was enforced as of April 1, 1947. Students born on or after April 1, 1933 were affected by this change (Clark and Royer, 2013). On March 22, 1972, the Raising of the School Leaving Age Order 1972, UK Statutory Instruments No. 444, was adopted in England and Wales.

It raised the minimum school leaving age from 15 to 16, thereby extending compulsory schooling from 10 to 11 years. This provision was enforced as of September 1, 1972. Students born on or after September 1, 1957 were affected by this change (Clark and Royer, 2013). For the purpose of this study, the earliest affected birth cohort is 1958. In England (but not in Wales), the 2008 Education and Skills Act stipulated that students have to stay in education or at least part-time training until the age of 17 (18) as of September 2013 (September 2015). Students born on or after September 1, 1996 (1997) were affected by this change.

United Kingdom - Northern Ireland: The Education (Northern Ireland) Act of 1947 closely mirrored the 1944 Act that applied to England and Wales. It extended compulsory schooling from 9 to 10 years by raising the minimum school leaving age from 14 to 15, while maintaining school starting age at 5. However, its enforcement was postponed due to political disputes. The Education (Amendment) Act (Northern Ireland) of 1953 determined its enforcement as of April 1, 1957. Students born on or after April 1, 1943 were affected by this change. In 1972, the minimum school leaving age was raised from 15 to 16 by the order of the Governor of Northern Ireland, thereby extending compulsory schooling from 10 to 11 years. This provision seems to have been enforced as of September 1, 1972, in line with the other parts of the UK. Students born on or after September 1, 1957 were affected by this change. For the purpose of this study, the earliest affected birth cohort is 1958. The Education Reform (Northern Ireland) Order of 1989 extended compulsory schooling from 11 to 12 years by lowering the school starting age from 5 to 4.⁷² The Education Reform (1989 Order) (Commencement No. 1) Order (Northern Ireland) 1990 put the enforcement date of this provision to July 1, 1990. Students born on or after September 1, 1985 were affected by this change.

United Kingdom - Scotland: The Education (Scotland) Act of 1945 closely mirrored the 1944 Act that applied to England and Wales. It extended compulsory schooling from 9 to 10 years by raising the minimum school leaving age from 14 to 15, while maintaining school starting age at 5. As in England and Wales, this provision was enforced as of April 1, 1947, hence affecting students born on or after April 1, 1933. On January 20, 1972, the Raising of the School Leaving Age (Scotland) Regulations 1972, Statutory Instruments No. 59, was adopted. It raised the minimum school leaving age from 15 to 16, thereby extending compulsory schooling from 10 to 11 years. As in England and Wales, this provision was enforced as of September 1, 1972, hence affecting students born on or after September 1, 1957. For the purpose of this study, the earliest affected birth cohort is 1958.

⁷²In terms of educational content, all grades starting at the age of four are usually classified as ISCED level 1.