Research Article

The Demographic Echo of War and educational attainment in Soviet Russia

Gordey Yastrebov

Contents

The Demographic Echo of War and educational attainment in Soviet Russia

Gordey Yastrebov[1]

Abstract

BACKGROUND
Research on Western countries has shown that birth cohort size is negatively related to educational attainment. It has offered complementary interpretations of this association – optimal schooling choices versus cohort overcrowding effects – that are difficult to resolve empirically.

OBJECTIVE
To investigate birth cohort size effects on educational attainment taking shape primarily in the context of a socialist society that does not lend itself well to "optimal schooling" interpretations.

METHODS
I exploit birth cohort size variation generated by the Second World War, a phenomenon known as the Demographic War Echo. Using the Education and Employment Survey for Russia and growth curve modeling, I analyze educational trajectories between ages 18 and 35 among Russian men and women born 1950–1987.

RESULTS
Larger cohorts attained less schooling and advanced more slowly in their educational careers. They could partly make up for the disadvantage by studying longer and retreating to part-time education. The disadvantage was larger for women because for men it was partly compensated through a decreased probability of military conscription.

CONCLUSIONS
Larger birth cohort size disadvantaged young Russians in the process of educational attainment. Given the context, this can be attributed entirely to cohort overcrowding effects.

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CONTRIBUTION

This is the first examination of birth cohort size effects on educational attainment in a state socialist context. It is also the first to model these effects on educational trajectories rather than simply attainment and to explore the moderating role of part-time education.

1. Introduction

Cycles of baby booms and baby busts are characteristic of many countries' demography after the Second World War (WW2). Following Richard Easterlin's seminal work (1980), several studies have shown that birth into either a baby boom or a baby bust cohort can influence individual fortunes (e.g., Macunovich and Easterlin 2008; Pampel and Peters 1995). Research shows that larger birth cohort size can negatively affect enrollment rates in secondary and tertiary education (Ahlburg 1982; Wachter and Wascher 1984; Macunovich 1996; Card and Lemieux 2000 in the United States) and the levels of schooling overall (Falaris and Peters 1991, 1992; Card and Lemieux 2000; Stapleton and Young 1988; Bound and Turner 2007 in the United States; Fertig, Schmidt, and Sinning 2009 in Germany; Jeon and Berger 1996 in South Korea; Saavedra 2012 in Colombia).[2] Two complementary sets of explanations exist. The first one builds on the simple intuition that individuals in larger birth cohorts suffer more from the limited supply of educational resources and opportunities, which makes progression to higher levels of education more difficult, costly, and risky. The second one claims that these individuals could be less incentivized to undertake more schooling because they face smaller returns on education. Although difficult to disentangle empirically, both explanations seem appropriate in the context of Western countries, which are overrepresented in existing research. No comparable research, however, has addressed the relationship between birth cohort size and educational attainment in the context of socialist societies.

Socialist societies are a potentially interesting frame of reference because the institutional context of such societies does not lend itself well to explanations emphasizing labor market mechanisms (i.e., changing educational returns) due to the practice of centralized wage setting and equalization policies. In other words, these societies can be taken as an environment in which cohort overcrowding effects stemming from the restricted supply of educational opportunities are unconfounded by possible overcrowding effects on educational returns. In that sense, they provide a clearer test of whether overcrowding is effectively dampened by educational policy responses aiming to expand educational opportunities. In this study I address the gap by focusing on Russia,

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[2] The single exception is the study by Reiling (2016) in Norway, which counterintuitively identifies a positive relationship.

where in addition to the socialist context specifics, birth cohort sizes oscillated considerably as a result of WW2 in a phenomenon known among Russian demographers as the Demographic Echo of War (DEW) (Vishnevsky 2017).[3] In particular, I focus on the generations of Russians born in the Soviet Union whose educational careers took shape primarily during the Soviet era – i.e., in the context of the socialist educational system and employment relations.

Apart from focusing on the socialist context, the study makes two other important contributions, first by exploring birth cohort size effects on educational trajectories rather than simply on the level of attainment and second by exploring the moderating role of part-time education. My analysis shows that Russians born into larger cohorts were indeed disadvantaged. The disadvantage was particularly strong in full-time education, although it could be partly overcome through part-time study after initiating employment. In any case, the option of part-time education implied longer educational spells and the need to combine work with studies. I also find that the disadvantage was not gender-neutral. It was less pronounced for men, for whom it was offset by the lower likelihood of conscription, which in turn extended and interrupted educational careers. The study thus shows that the negative relationship between birth cohort size and educational attainment was not unique to Western societies. It also highlights that birth cohort size effects on educational attainment can manifest in ways underrecognized in earlier research – i.e., by affecting the timing of education and/or forcing people to consider alternative educational options.

The article is structured as follows. In section 2, I introduce the DEW, which serves as a major source of birth cohort size variation in post-WW2 Russia. In section 3, I outline the theoretical mechanisms that relate birth cohort size to educational attainment and deliberate on their relevance to the context in question. In section 4, I provide more details on the Russian educational system and deliberate on more context-specific hypotheses. In section 5, I expose my data and inference methods and discuss possible limitations to the causal interpretation of my findings. Section 6 presents the results. Finally, in the concluding section 7, I discuss my findings and the limitations and implications of this study.

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[3] Although its effects on the educational system are well recognized in the Russian literature (Shubkin 1979; Gorshkov and Sheregi 2010; Cherednichenko 2016), the discussion rarely extends beyond the rudimentary analysis of aggregate statistics on period-specific enrollment and graduation rates. This is the first study to use micro-level evidence and life-course data.

2. Russia's Demographic Echo of War

WW2 left deep and long-lasting scars in Russia's demography. In addition to ending millions of lives of Soviet citizens and the devastating effects on the health of surviving generations, the war had a major impact on birth rates (Brainerd 2016). Figure 1 illustrates this by plotting the change in the total number of live births in Russia since 1937. The total number of births dropped dramatically during the war (1941–1945) but, fueled by postponed fertility, quickly rebounded at the end of the 1940s. This led to the heaping of birth cohorts at the end of the 1940s to the beginning of the 1950s – i.e., Russia's postwar baby boom. From then on, birthrates in Russia evolved largely as a result of two independent forces: (1) the second demographic transition, causing a gradual secular decline in cohort fertility rates (the long dashed line in Figure 1), and (2) the sheer logic of numbers, whereby a larger generation reproduced a larger generation and a smaller generation reproduced a smaller generation, which the small changes in cohort fertility rates could not offset[4] (Vishnevsky 2017). In particular, it is the second mechanism that underpins the recognizable repetitive pattern in Figure 1: The first echo of WW2 resonated in the 1960s – roughly the years when the war children (children born during WW2) were entering childbearing age (approximately 26 years old, judging from the mean age at birth – the short dashed line in Figure 1). The rebound in the 1970s marked the coming of age of baby boomers' children. Yet another echo in the late 1980s and the 1990s, reinforced by the difficulties of the market transition (Grogan 2006), was brought on by the fewer war children's grandchildren and so on. Although it would be unfair to claim that these fluctuations remained completely uninfluenced by various demographic policies (e.g., the abortion ban of 1936–1954, divorce liberalization in the 1960s, family support measures in the 1980s; for an overview see Vishnevsky 2006; Zakharov 2008), they do not seem to have achieved much in breaking down the cyclical nature of this pattern.

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[4] In fact, in Russia, cohort fertility rates worked toward amplifying the magnitude of demographic cycles, because the birth size of cohorts was positively correlated to fertility rates (a correlation of 0.693 based on data presented in Figure 1). This is very different from what was documented for the United States and some other Western countries – the phenomenon known as the Easterlin effect – suggesting a negative correlation (e.g., Macunovich 1998).

Figure 1:   Cohort size at birth in Russia, 1937–2018
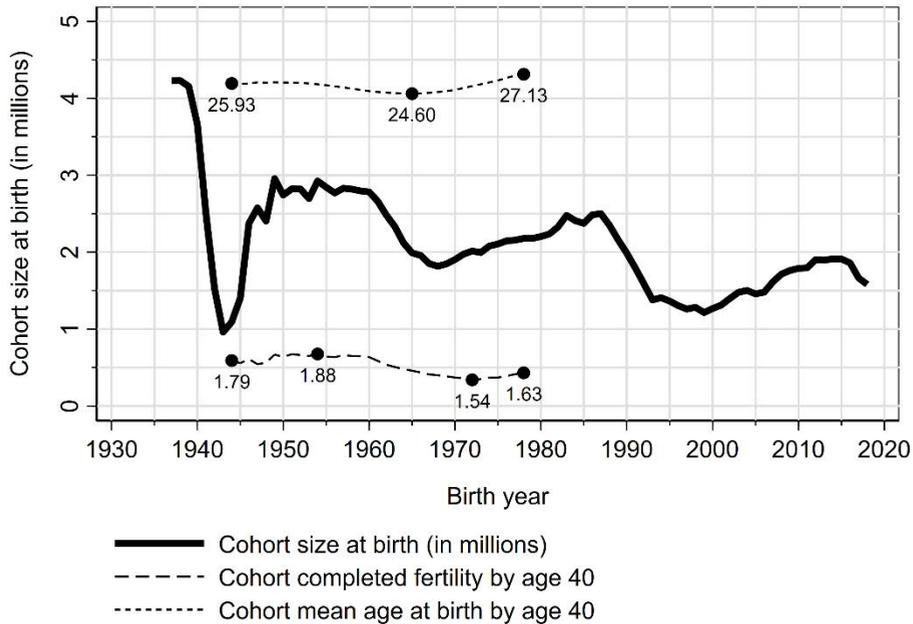
To acknowledge its origins, Russian demographers termed the pattern the Demographic Echo of War. They knew it could have major repercussions for different generations. Below is a characteristic quote:

> *Demographic waves make social and economic life difficult. The passing of large cohorts after small ones always creates additional tension in society, as well as impacts on the fortunes of generations themselves. When fewer in number, generations have an easy social life: they enjoy less populated maternity hospitals, kindergartens, and schools; they face less competition in access to higher education institutions and enjoy more favorable prospects in professional careers as well as marriage markets. However, the social institutions that have adjusted to accommodate those cohorts soon become insufficiently developed, and the channels of social mobility become too narrow for*

>   *the larger generations that follow.* (Vishnevsky 2006: 491; translated from Russian)[5]

Some relevant DEW effects were indeed documented in the Russian educational system, where the chances of admission and graduation in secondary and tertiary education in various periods were shown to correlate with birth cohort size (Shubkin 1979; Gerber and Hout 1995; Gerber 2000; Gorshkov and Sheregi 2010; Cherednichenko 2016). However, all such conclusions were based on the examination of period changes in aggregate admission, enrollment, and graduation rates[6] at specific stages of the educational system, some of which do exhibit the anticipated wavelike patterns.

In Figure 2, I reproduce a similar empirical intuition. The figure contains four panels, three of which illustrate period trends in absolute admission and graduation numbers in different segments of the Russian educational system: (A) the school system, providing general lower and upper secondary education;[7] (B) the system of secondary specialized educational institutions[8] (SSEI), providing lower tertiary education; and (C) the system of higher educational institutions[9] (HEI), providing upper tertiary education. I discuss the specifics of the educational system in more detail in section 4.1. Here it is sufficient to acknowledge that access to tertiary education in SSEIs and HEIs required *at least* lower and upper general secondary education, respectively. Of the three systems described in Figure 2, it is only in the school system that the output roughly mirrors cohort size variation, suggesting that the system of secondary education was more or less able to accommodate the dramatically changing numbers of students. In contrast, the intake and output of the SSEI and HEI systems followed more secular trends (relative to the magnitude of the demographic swings), suggesting that larger cohorts must have been more deprived of tertiary education. The last panel (D) brings everything together, matching school graduation numbers and the number of tertiary education admissions to the size of potentially corresponding[10] birth cohorts. The ratios in panel D thus provide a rough estimate of the probability of graduating from or being admitted to a specific level of education for an average birth cohort member. Accordingly, these probabilities (especially regarding admissions to tertiary education) turn out quite favorably for the war children and the DEW cohorts (i.e., those born from the 1960s to the mid-1970s) and less favorably for the local baby boomer cohorts surrounding them.

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[5] For a similar-minded quote citing Canadian economist Scott Gordon, see Easterlin (1980: 31–32).

[6] The number of admissions/enrollments/graduations relative to the size of relevant age groups in a given period.

[7] By lower and upper secondary education, I mean incomplete and complete secondary education, accordingly. The terms are literal translations of *nepolno'*e and *polno'e sredne'e obrazovani'e*. The term *incomplete* is easy to confuse with *dropout*, but it was in fact a recognized stage in the Soviet educational system.

[8] This is a literal translation of *sredne'e spetsialno'e uchebno'e zavedeni'e.*

[9] This is a literal translation of *vysshe'e uchebno'e zavedeni'e.*

[10] Assuming a typical school starting age of 7 and an average duration of general lower and upper secondary education of eight and ten years, accordingly.

Figure 2: **The Demographic Echo of War in admission and graduation numbers in the Russian educational system**

A. SCHOOL SYSTEM

------- Number of lower secondary school graduates
———— Number of upper secondary school graduates

B. SSEI SYSTEM

— — — Number of SSEI admissions
------- Number of SSEI graduates
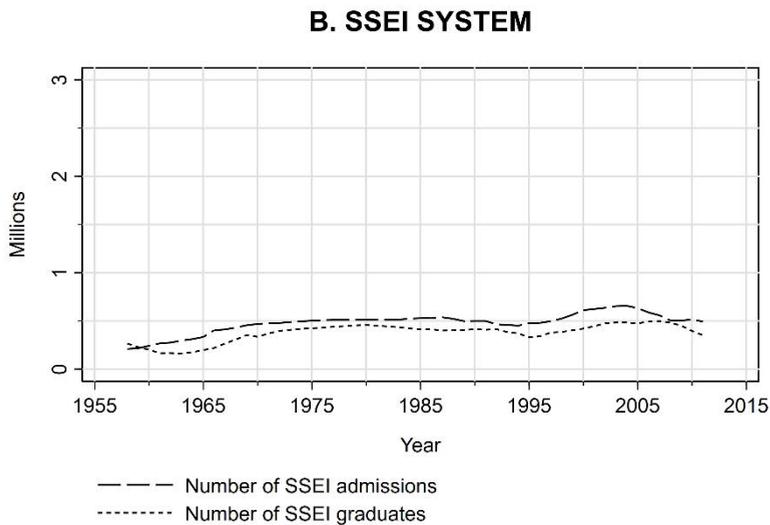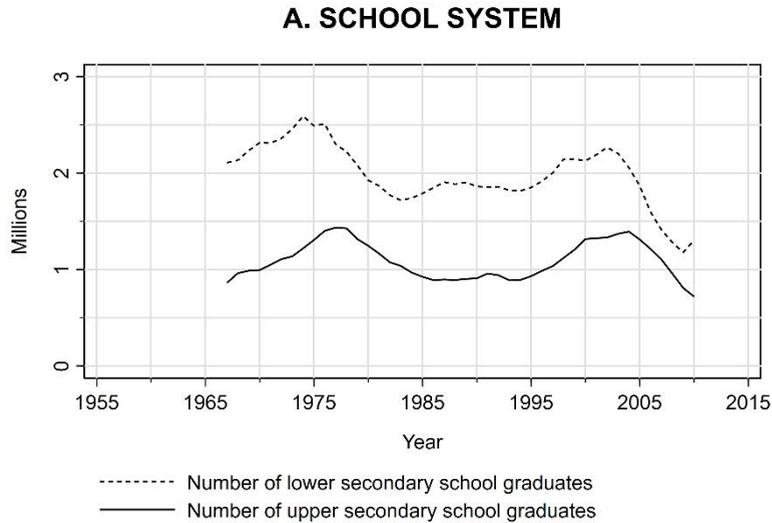
Figure 2: **(Continued)**

C. HEI SYSTEM

Number of HEI admissions
Number of HEI graduates

D. BIRTH COHORT RATIOS
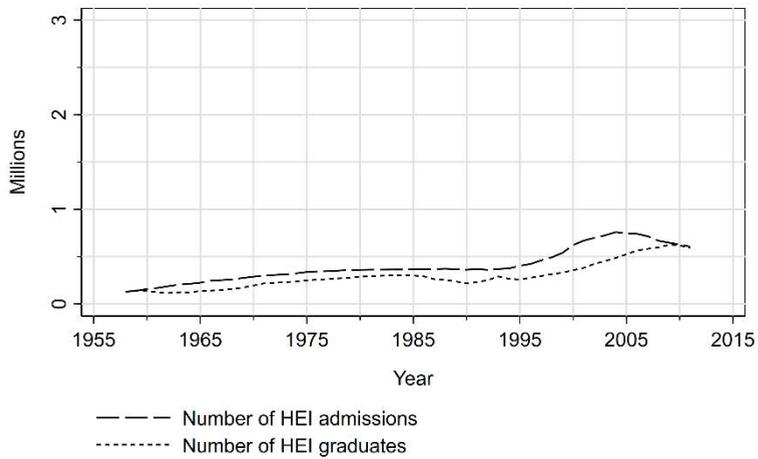
Birth cohort size (BCS)
Number of lower secondary school graduates by age 15 / BCS
Number of upper secondary school graduates by age 17 / BCS
Number of SSEI admissions by age 15 / BCS
Number of HEI asmissions by age 17 / BCS
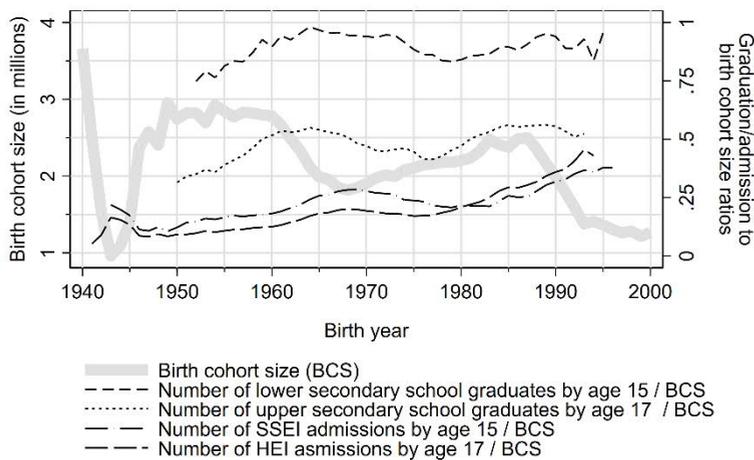
Sources: Cohort size at birth as in Figure 1; education statistics were combined from several sources: National Economy of RSFSR 1958–1990; *Russian Statistical Yearbooks* 1992–2015.
Note: Admission and graduation numbers refer to public, full-time education.

The empirical arguments of the kind above, however, are not necessarily telling of the cohorts' true educational fortunes, because graduation and admission numbers in a given period may include members of different cohorts. It is also possible that larger birth cohort size forces one to postpone rather than completely forego advanced education. In that case, cohort size effects based on period indicators might be overstated.[11] In this study, I overcome these analytical limitations and attend more directly to cohort-specific patterns of the educational attainment process to uncover the DEW's effects on both the timing and the level of education.

3. Theoretical mechanisms and the case for the socialist context

Two complementary sets of arguments connecting birth cohort size to educational attainment can be found in the relevant literature. The first one corresponds to the intuition outlined in the previous section. It suggests that a larger birth cohort size can depress educational attainment because it leads to the overcrowding of the educational system and the dilution of educational resources and opportunities. Larger cohorts might have to be packed into larger classes and enjoy less instructional time, which could negatively affect their academic achievement (Bound and Turner 2007; Babcock, Bedard, and Schulte 2012). This could in turn decrease their chances of being promoted to (or successfully completing) higher levels of education. Larger cohorts might also face greater competition for slots available at higher levels of education, potentially meaning that a greater proportion of them are not accommodated due to capacity constraints (Saavedra 2012). These overcrowding effects, however, hinge on two key assumptions: (1) that the supply of educational resources and opportunities is either constant or does not adapt well to the changes in demand prompted by the demographic change, and (2) that there are no significant economies of scale in the use of educational resources (Reiling 2016).

The second set of arguments proposes that the educational attainment of cohorts can additionally be shaped via differential educational returns. Several subtle varieties of this argument exist (Freeman 1979; Welch 1979; Wachter and Wascher 1984; Connelly 1986; Stapleton and Young 1988; Falaris and Peters 1991, 1992), but they share in common the observation that educational returns (i.e., earnings) tend to be depressed in larger cohorts, hence there are fewer incentives for the members of such cohorts to invest in more schooling. The theoretical explanation behind this is that in highly skilled occupations, the substitutability between young and old workers is much lower than in low-skilled

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[11] The reason is that those born to large cohorts are more likely to submit applications and get admitted to SSEIs and HEIs later. Accordingly, the number of admissions attributed to the smaller birth cohorts potentially includes admissions of those who were born to large cohorts.

occupations. It is thus the highly skilled workers who are more susceptible to changes in labor market demography (e.g., Stapleton and Young 1988). However, this assumes the existence of a more or less competitive labor market, whereby the price for labor of different quality is determined by its scarcity/abundance relative to the demand.

Both sets of arguments entail roughly similar implications for the empirical relationship between birth cohort size and educational attainment (i.e., a negative correlation), making them hard to disentangle. However, it is possible to argue that the effects that work through schooling decisions and differential returns to education have only limited application in the socialist context. There was no competitive labor market because of the reliance on the planned distribution of the workforce, which guaranteed job placement after education, and because it was the state rather than the supply and demand forces that determined wages (e.g., Hayek 1988; Kornai 1992; Katz 2001). It is not that socialist societies did not seek to reward highly skilled workers. Rather, the associated premiums were much less susceptible to shifts in supply and demand of workers than they were to socialist wage equalization policies. Unfortunately, little hard evidence on the changes in returns on schooling in socialist societies exists. The few available studies tend to disagree on the direction and magnitude of these changes (Münich, Svejnar, and Terrell 2005; Klesment 2013). However, there seems to be a much stronger consensus in the literature that the returns were much smaller compared to those in Western countries (Katz 1999).

In contrast, explanations that build on the educational system overcrowding idea retain their relevance even in nonmarket contexts. Guided by this framework, in the next section, I provide a brief overview of the Russian educational system and the evolution of its policies in the postwar period, and I deliberate on more specific hypotheses pertinent to the context in question.

4. Birth cohort size effects and the Russian educational system

4.1 Russian educational system

Relevant to the selection of cohorts afforded in my analyses (see section 5.1), I describe the system as it crystallized in Khrushchev's era – the late 1950s to the mid-1960s – and as it survived, largely intact, until the early 2000s.

All education in Soviet Russia was public and procured by the state.[12] The flipside of the system, concordant with the spirit of Soviet politics and planned economy, was its high level of centralization. The state allocated the resources and also administered

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[12] Tuition fees for upper secondary education and beyond were reinstituted during Stalin's era, but Khrushchev abolished them in 1956.

educational institutions, teaching programs, and admission procedures. Although some greater management autonomy was allowed in the 1990s, with Russia's market transition, the state did not withdraw from the commitment to provide education publicly, but funding responsibilities were shifted from the federal to regional and local levels (Zajda 2003; Eklof, Holmes, and Kaplan 2005).

The first stage of the system was primary school, which started at age 7. The stage lasted three years (changed to four years in the late 1980s; see next section). Primary education was followed by lower secondary education, lasting another five years and opening several options afterward. The first was lower-grade vocational education, comprising programs of different quality and duration (one to three years). It was offered in vocational-technical schools[13] and was designed to teach manual skills. A limited number of programs of upper-grade vocational education, offered in SSEIs and ranging three to four years, were also available to lower secondary graduates. Some of these programs even provided a separate pathway to higher education.[14] The last option was advancing to upper secondary education, lasting two additional years and granting access to tertiary education in either SSEIs (offering lower tertiary, or upper-grade vocational, education) or HEIs (offering upper tertiary, or higher, education). Lower tertiary education could last two to three years and trained students for technical, lower-grade professional occupations. Upper tertiary lasted five years and was essential for many higher-grade professional and managerial positions. Admission to higher-level educational programs (e.g., in SSEIs and HEIs) in Soviet Russia was quite selective and intense, with selection based on educational achievement (most often revealed through admission exams). A display of adequate academic merit was also essential for the successful completion of such programs.

Much of the formal education was provided full-time, meaning students had to devote most of their time to studies and were not allowed to work. However, part-time education, extending to secondary and tertiary education and allowing the combination of study and work, was a prominent feature of the Soviet educational system starting with Stalin. Part-time study's main advantages were that it allowed (1) combining education with employment and (2) allowed returning to education practically at any stage of one's career. It thus theoretically provided an additional opportunity to those who were deprived of education otherwise (e.g., older people and working-class students). Still, part-time education was inferior to full-time education for several reasons: (1) the combination of work and study was generally stressful (dropout rates were higher than in full-time education); (2) students had to accept a reduction in pay in cases of reduced workloads; (3) the choice of specializations was restricted (particularly in tertiary

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[13] This is a literal translation of *professinal'no'e technichesko'e uchilische*.
[14] Some SSEI programs provided upper secondary education. Their graduates were eligible for higher education after three years of production experience.

education); and (4) the education was of generally lower quality and prestige due to its chronic underfunding and understaffing (Matthews 2012: 135–141). The returns on part-time education were also most likely lower than the returns on full-time education. Although reliable evidence for the Soviet period does not exist, Gerber and Schaefer (2004) have shown this evidence for the post-Soviet period.

4.2 Educational policies, reform, and enrollments

Throughout its history, Soviet Russia remained deeply committed to educating its citizens, with many of its successes in educational expansion recognized widely (Szekely 1986; Matthews 2012). However, the dramatic demographic changes caused by WW2 were bound to remain a source of both fortune and concern in keeping up with these commitments.

The goal of universal lower secondary education, proclaimed by Khrushchev in 1958, was well timed, as the secondary system was just then absorbing the thin generation of war children. An easy target in terms of cost and effort, the goal allowed Khrushchev to channel resources into major experimentation with school curriculum,[15] vocational training, and the democratization of access to tertiary education. The entire reform was set to marry "school with life" by educating students better in technical sciences, increasing the practical component, favoring part-time study wherever possible, and rendering work experience as an advantage in admission to tertiary education. Although the reform may have temporarily contributed to rising enrollments in upper secondary and tertiary education, it caused much resistance in the system and was abandoned with Khrushchev's removal in 1964 (Boiter 1959; Matthews 2012).

From the late 1960s to the early 1970s, Brezhnev confronted a far more challenging context, with the bulk of baby boom cohorts overcrowding secondary schools, making it a lot harder to keep up with Khrushchev's commitments, as rising enrollments prompted more teaching hours and school construction. Nevertheless, breaking with many of Khrushchev's experiments (albeit staying true to the egalitarian spirit of his reforms), the system seems to have managed reasonably well without sacrificing much in terms of either capital construction or teaching staff. In addition, some innovative solutions were found. These included accommodating primary and secondary education in the same buildings and making institutions run in second-shift mode to cope with overcrowding. There were also reports that teachers, although proportionately increasing in numbers, had to accept workloads that could exceed 50 hours a week (Matthews 2012: 62). In

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[15] Upper secondary school was extended from two to three years for the reform period, but this affected only cohorts graduating from lower secondary school before 1964 (i.e., those born before 1949).

comparison, tertiary education did not entertain much change with Brezhnev's reform (Matthews 2012).

In the mid-1980s, Gorbachev inherited a system that was then taking a short break from the baby boomers, especially in tertiary education, which at the moment was just processing the DEW cohorts. However, Soviet planners certainly had to plan for the gradual arrival of baby boomers' children, born throughout the 1970s and 1980s, which prompted new targets of school construction and an increasing number of pupil places. Moreover, additional commitments were made to extend compulsory education from eight to nine years by adding one more year in primary education in 1986.[16] But the demographic realities put off the complete implementation of these plans until 1989 (Szekely 1986; Long 1990).
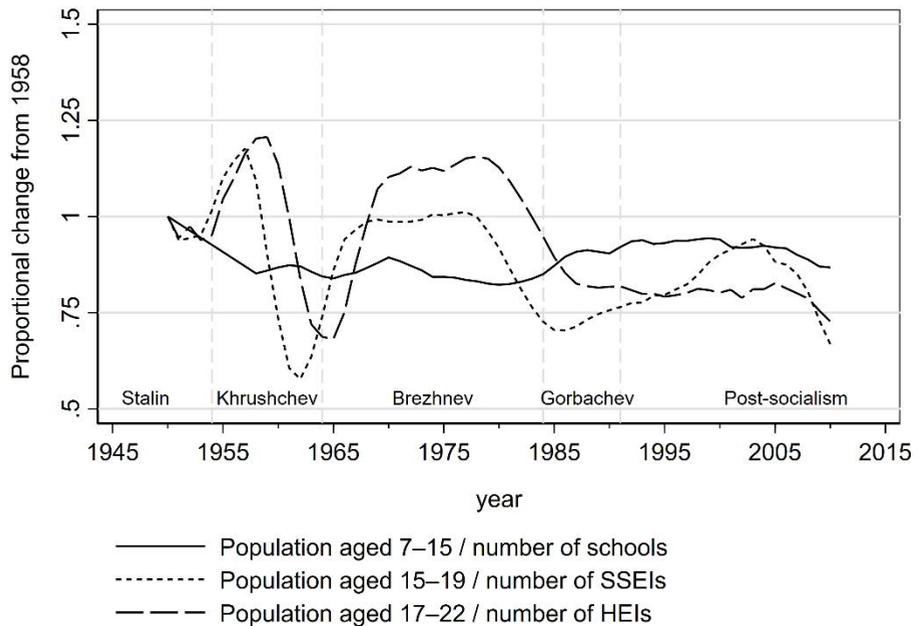
The collapse of the USSR in 1991 did not bring much change in terms of the structure of the system. The major change concerned the move toward greater autonomy for educational institutions in the matters of management, program content, and teaching methods, and the shifting of funding responsibility from the federal to regional and local levels (Eklof, Holmes, and Kaplan 2005). However, many of these commitments could not be fulfilled due to the socioeconomic turmoil of the 1990s and the crisis of 1998 depleting both private and public budgets (Zajda 2003). These underfunding problems were stacked with yet another overcrowding cycle, which phased in on primary and secondary education. For the same reason, the expansion of commercial private education, particularly higher education, did not gain momentum until the second half of the 1990s.

Although comparable and reliable data on total education spending in Soviet Russia are hardly available (as is the case, unfortunately, with many other data), a general sense of how educational policies responded to the demographic challenges is provided in Figures 3 and 4. Figure 3 shows the relative changes in the ratio of the total eligible population for a given level of education to the number of corresponding educational institutions. Figure 4 zooms in on the school system providing primary and secondary education to reflect the situation with student-per-teacher ratios. Both figures confirm that the secondary school system coped reasonably well not just by adapting its capacity to the changing student numbers but also by keeping up with the commitment to improve teacher quality. In contrast, the system of tertiary education remained much more inert, leaving it much more susceptible to overcrowding and restricted in its ability to accommodate changing student numbers.

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[16] Parents could choose to send their children to primary school at age 6 instead of age 7 to enroll their children in four-year educational programs.

Figure 3: **Age-relevant population compared to the number of educational institutions, relative changes from 1958**

Figure 4: **Student-per-teacher ratios in primary and secondary education**
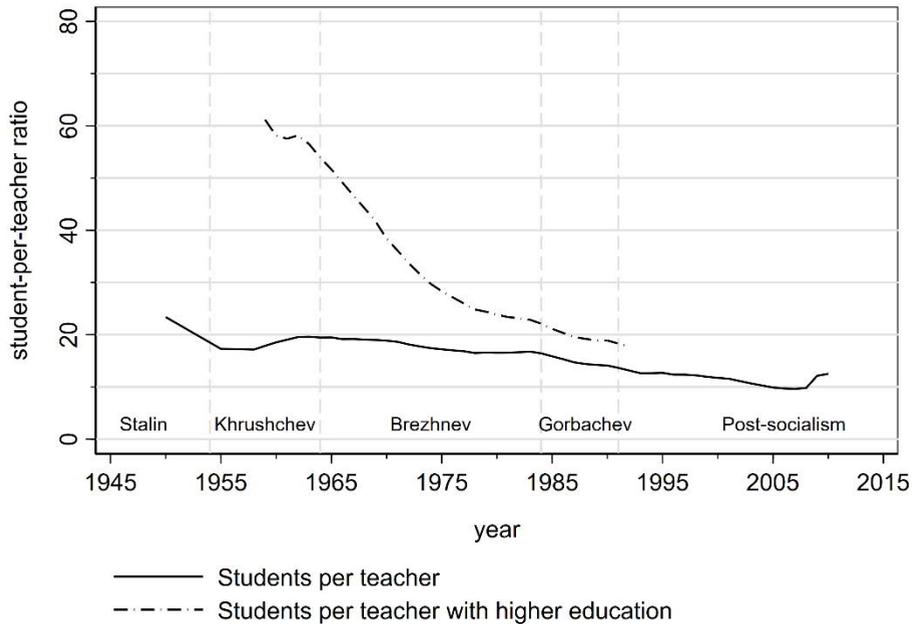
4.3 Hypotheses

From the preceding discussion, I hypothesize that the inability of the Russian educational system to adjust to changing student numbers, particularly in tertiary education, must have rendered birth cohort size a factor in educational attainment. Accordingly I generally expect that:

> *H1*: Individuals born to larger cohorts attained less schooling compared to individuals born to smaller cohorts.

Nevertheless, I recognize that the Russian educational system provided individuals with an opportunity to maneuver around the periods of overcrowding (and, possibly,

failure in advancing to higher stages of education) via part-time education. If that is the case, I would expect that:

> *H2*: Larger birth cohort size is more consequential in the more rigid and age-structured system of full-time education.

In addition, the temporal aspect of the educational attainment process is important in itself. A larger birth cohort size does not necessarily condemn individuals to lower levels of schooling – it may simply delay or postpone certain types of educational transitions. For instance, a secondary school graduate aspiring to continue in higher education might fail in admission to HEI immediately after graduation but undertake a second, more successful attempt the next year. Therefore I further expect that:

> *H3*: Individuals born to larger cohorts attained comparable levels of schooling at a later age than individuals born to smaller cohorts.

Finally, I consider a particular aspect of the Russian educational system that can moderate the effects of birth cohort size on educational attainment by gender. Young men in Russia were liable to military service. Most were conscripted immediately after graduating from secondary school (but no earlier than at age 18), provided they were in good health and did not immediately obtain admission to full-time higher education. (Part-time education did not grant such opportunity.) In reality, however, some men intentionally evaded military service, and the army did not seek to enroll everyone eligible; rather it sought to maintain a certain contingent (Odom 1998). Therefore men born to smaller cohorts were probably more likely to be drafted than men in larger cohorts because the former faced more exacting conscription campaigns. In turn, military service, which could last from two to four years (depending on the type of military force entered), implied an interruption in educational careers for those recruited after secondary school. While conscription did not formally block further schooling, it certainly disadvantaged the conscripted by consuming the time they could devote to preparation for admission exams. Thus, while potentially representing an advantage for men in the educational system, a smaller birth cohort size might also have increased their conscription risk and, through it, had a countervailing effect on educational attainment. No such offsetting mechanisms existed for women.[17] Therefore I expect that:

> *H4*: The negative association between birth cohort size and educational attainment should be stronger for women.

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[17] If anything, some women must have been doubly disadvantaged. Those choosing to have children before completing formal education probably also had to reckon with some overcrowding of child care facilities.

H5: The smaller negative association between birth cohort size and educational attainment for men is partly due to the conscription mechanism.

5. Data and methods

5.1 Data

For my analyses, I employ data from the first wave of the Generations and Gender Survey[18] (GGS) combined with data from the Education and Employment Survey for Russia[19] (EES). GGS sampled national Russian-speaking residents aged 18–79 in 2004 (N = 11,261). EES was a follow-up survey of a subsample of GGS targeting respondents aged 18–55 (N = 6,455) – i.e., covering cohorts born from 1950 to 1987.[20] In addition to the rich sociological and demographic data, the greatest advantage of the combined dataset is the detailed retrospective information on the course of respondents' educational attainment since January of the year they turned 17 (contained in the EES module). In particular, this information includes the date of enrollment and graduation, the form of studies (part-time or full-time), and outcome (successful completion or dropping out). Additionally, it contains data on whether men were drafted into military service, which is relevant for the test of *H5*.

5.2 Modeling framework

A comprehensive test of my hypotheses (especially *H3*) invites modeling educational attainment as a dynamic process. One option is to employ multistate event history models (Cook and Lawless 2018). However, I endorse growth curve modeling (GCM) (Halaby 2003; Steele 2008) because (1) it allows for a more intuitive presentation of results (i.e., growth curve visualizations), and (2) the use of multistate event history models for analyzing educational transitions in GGS+EES is not feasible because risk sets for a large proportion of educational transitions cannot be clearly defined.

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[18] Complete survey documentation is available at https://www.ggp-i.org/.

[19] The survey was conducted by the Max Planck Institute for Demographic Research (Rostock, Germany), the Independent Institute of Social Policy (Moscow), and the Demoscope Independent Research Center (Moscow). The merged GGS+EES data file is distributed by the Max Planck Institute for Demographic Research. More details about the dataset are provided in Soroko and Konietzka (2006) and Kreyenfeld and Konietzka (2012). For EES survey instruments, see Bühler et al. (2007).

[20] In reality, the EES sample features a small number of individuals who fall beyond the targeted age group. This extends birth cohort coverage to 1948–1988. They are included in my analyses.

To model the growth curve – i.e., the process of educational attainment as a function of time – I opt for a multilevel random-effects (RE) model. Despite the advantages of the fixed-effects (FE) specification (tighter control of the unobserved heterogeneity), RE is my only feasible option given that the key independent variable of interest – cohort size at birth – is a time-constant variable. After considering various specifications for age effects,[21] I chose to use five splines with nodes at 20, 23, 26, and 30 years of age. Accordingly, the baseline model can be written as follows:

$$Edu_{it} = \alpha_0 + \sum_{s=1}^{5} \alpha_s Age_{its} + \sum_{s=1}^{5} \alpha_{s+5} Age_{its} \times CS_i + \alpha_{11} CS_i + \boldsymbol{\beta} \times \mathbb{Z}_i + \mu_i + \epsilon_{it},$$
$$(1)$$

where Edu_{it} stands for the educational attainment of individual i at time t (see section 5.4), Age_{its} are the spline components, CS_i is the individual's birth cohort size (see section 5.5), $\mathbb{Z}$ is a vector of control variables (see section 5.6), and, finally, μ_i and ϵ_{it} are the time-invariant and idiosyncratic components of the person-specific error term, respectively. The interaction of the cohort size component with age splines allows the entire curve shape to vary as a function of cohort size. Accordingly, α- and β-parameters are to be estimated from the data.

To employ GCM, I restructure GGS+EES data (i.e., episodes and spells) into cross-sectional time series of person-year observations. To maintain a reasonable balance of observational spans and to focus on the most dynamic phases of people's educational careers, I cap the resulting sample at 35 years of age.

5.3 Analytical strategy

I estimate and explore a total of six GCMs. The first two are gender-specific models for education counting both part-time and full-time schooling. The second two are gender-specific models for education counting only full-time schooling. And the last two are models for men (one for each of the dependent variables) in which specifics of the drafting procedure are controlled away. In the discussion of these models, I focus on how educational attainment progress (i.e., the curve shape) varies as a function of cohort size (to address *H1* and *H3*) and how the association between educational attainment and cohort size differs in the relevant comparisons (to address *H2, H4,* and *H5*).

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[21] This includes various polynomial and alternative spline specifications. The five splines at selected nodes provide a reasonable degree of flexibility to the curve, at the same time keeping the model parsimonious: The four shorter segments are intended to dissect the most dynamic phase of educational careers (ages 18–26) and the last one, after which fewer changes are to be expected (ages 27–35).

5.4 Dependent variables

To model educational attainment using GCM, I construct continuous measures expressing education in symbolic years of schooling. Consistent with the analytical strategy, I construct two such measures – one for education counting both forms of schooling and one for education counting just full-time schooling.[22] Table 1 specifies the imputation procedure. The imputation is based on the standard duration of corresponding educational programs in Russia. In cases of uncertainty, I consulted survey data directly and took the average duration of study for a given level of education, rounding it to 0.5 years.

I emphasize that the resulting scale may not completely correspond to the actual years spent in education by certain individuals. Rather it approximates the minimum amount of time needed to reach a given level of education without any interruptions in an educational career. Thus it serves merely as a measure of convenience to differentiate between qualitatively different levels of education. The exact amount of time taken to reach a specific level of attainment is modeled using GCM.

Table 1: Classification of education and imputed years of schooling

Level of education as reported in GGS+EES	Imputed years of schooling
1. below lower secondary school	6
2. general lower secondary school	8.5
3. general upper secondary school	10
4. general lower secondary school + vocational training	10.5
5. general upper secondary school + vocational training	12.5
6. secondary specialized education	13.5
7. higher education	15
8. post–higher education (e.g., doctoral degree)	18

5.5 Key independent variable

For my key independent variable of interest – *cohort size at birth* – I use data on yearly total live births in Russia from the Human Mortality Database (HMD). One could raise the concern that the number of total live births is an inadequate measure of birth cohort size because of the varying definition of what constituted a live birth in Russia over time (e.g., Velkoff and Miller 1995; Andreev and Kvasha 2002). However, I have replicated

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[22] For some individuals in EES, it was impossible to identify the educational spells as either full-time or part-time. For such individuals, the variable that counts only full-time educational spells was coded as missing. To keep the analytical samples identical for both of my dependent variables, I accordingly recoded the remaining dependent variable as missing.

the analyses with cohort size measured at various ages up to 7 (i.e., school-starting age), and it does not affect the substantive findings.

I match these data to individuals in the GGS+EES using respondents' reported year of birth. To account for small inaccuracies in the matching procedure,[23] as well as the possibility of spill-over competition between proximate cohorts,[24] I further recode the original values into three-year moving averages (i.e., total births in an individual's year of birth + cohort sizes of the two neighboring cohorts / 3).

Consistent with uses in the more recent literature (Card and Lemieux 2000; Bound and Turner 2007; Saavedra 2012) and the intuition that relative cohort size differences matter more in educational attainment than absolute differences, I log-transform the variable for birth cohort size in my analyses.

5.6 Potential sources of confounding and controls

The RE model described in section 5.2 provides a reasonable way of getting at cohort size effects on educational attainment under only specific assumptions. One is that cohort size at birth is uncorrelated with the individual error term ($\mu_i + \epsilon_{it}$). Individual variation in cohort size at birth can be considered plausibly exogenous because (1) individuals do not choose their birth cohort and because (2), particularly in the Russian context, cohort size fluctuations were largely caused exogenously by WW2. However, in a finite sample of cohorts, cohort size can correlate with birth year. In the GGS+EES sample of cohorts, the correlation between birth year and the logged cohort size at birth amounts to a nontrivial –0.554. This opens several potential sources of confounding.

The first is the possible secular trend of increasing demand for education pushed by modernization and the gradual upgrading of social structure over time (Craig 1981; Schofer and Meyer 2005). This process implies a positive correlation between year of birth and educational attainment. I deal with this type of confounding by directly controlling for individuals' social background characteristics, in particular parents' highest occupational status[25] and the area of respondents' residence at birth.[26] Additionally, I control for a respondent's birth year, using a simple linear specification,

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[23] Example: Individuals born in December 1949 and January 1950 are intuitively in the same cohort but would formally be assigned different cohort sizes at birth since HMD data is reported per entire calendar year.

[24] Example: Individuals born in 1950 and starting school at age 7 might be competing with individuals born in 1951 and starting school at age 6.

[25] The status was measured using the International Socioeconomic Index for occupations (ISEI) developed by Ganzeboom, De Graaf, and Treiman (1992). Including parents' occupational characteristics in the analysis slightly reduces the effective sample size due to missing cases (4.8%).

[26] This discriminates between a village, town, or major city. To deal with an extremely high percentage of missing cases (15.5%), these were coded as a separate category and included in the analysis.

to account for any residual relationship between the year of birth and educational attainment (such as that possibly driven by technological progress and/or occupational upgrading in the Soviet economy pushing up the demand for a skilled workforce).[27]

The second source is possible endogenous selection on the outcome (e.g., Elwert and Winship 2014) due to socioeconomic differentials in life expectancy (also reported for Russia: Bessudnov, McKee, and Stuckler 2012; Shkolnikov et al. 1998). In a cross-sectional sample, this can generate a (spurious) positive relationship between birth year and educational attainment because more highly educated people tend to live longer and are thus overrepresented at later ages. However, this survivorship bias is minimized in my analyses because GGS+EES samples only individuals between 18 and 55 years old (omitting age groups particularly susceptible to the bias).[28]

Additional controls enhance the model, as described in section 5.2. In all my models, I include a binary variable to differentiate between cohorts born before and after 1979 to account for the extension of primary school from three to four years per the reform of 1989 (see section 4.2), which affected those who by September 1989 had not yet completed primary education.[29] Another binary is included to identify the post-socialist period to account for the confounding possibly due to the liberalization of the post-Soviet educational market (Gerber 2000; Kyui 2016).[30] I also include a control for the number of a respondent's siblings.[31] Although this is conditionally unrelated to birth cohort size (partial correlation accounting for birth year is 0.017; also see section 2 and Figure 1), including it as a control can improve estimation efficiency because it is a strong correlate of educational attainment (e.g., Steelman et al. 2002).

Finally, a set of specific controls is used to control away the specifics of the drafting procedure to address *H4* and *H5*. The first is binary differentiating between those who reported being conscripted and those who were not. The second is an additional binary for cohorts born between 1960 and 1970, when the conscription campaigns in Russia may have intensified due to the Soviet-Afghan War of 1979–1989 (McMichael 2002). The

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[27] This control does not affect the direction of birth cohort size effects, but it shrinks the naive estimates by no more than 30%.

[28] We can get a distant idea that survivorship bias is a possibility from Shkolnikov et al. (2006), who estimate life expectancy for different educational groups at age 30 for the years 1988–1989 and 1999. In 1988–1989, for more highly educated men, this amounted to 43.30 years, versus 35.52 years for less educated men. For women it amounted to 51.71 versus 46.17 years, respectively. In 1999 the respective figures were 44.50 versus 31.42 and 53.10 versus 42.89, indicating slightly increased educational differentials. However, life expectancy alone is not sufficient to estimate the amount of the bias. For this, one would need to know cohort survival functions for different educational groups, which are unfortunately not available for Soviet Russia.

[29] Cohorts precisely affected are hard to identify due to possible differences in school starting age, inconsistent implementation of the reform across educational institutions, and so on. Using other possible cutoffs (1988, 1987, 1986) does not affect substantive findings.

[30] This control does not have any serious effects on the key findings.

[31] I transform the variable by adding one to the number of siblings and taking the natural logarithm of the sum, which proves a better specification.

reason for including this control is the possibility that it can confound the relationship between birth cohort size and the likelihood of draft, because cohorts affected include the bulk of DEW cohorts.[32]

6. Results

I provide full models and summary statistics in Appendix A (Tables A-1 and A-2, correspondingly). However, the model components involving age splines and their interactions with (log) birth cohort size are not very intuitive to interpret and require certain math[33] to arrive at meaningful comparisons. Here I present key findings in the form of actual growth curves (Figure 5) and in the form of average marginal effects (Table 2) calculated from the models in Table A-1 for the more specific and intuitive contrasts. Figure 5 presents schooling growth curves simulated for two fictitious cohorts – one roughly corresponding to the DEW birth cohort of 1965 (2 million = $e^{0.7}$) and the other corresponding to the baby boom birth cohort of 1949 (3 million = $e^{1.1}$). Table 2 communicates roughly the same information in the form of average differences in schooling at specific ages associated with a 50% difference in birth cohort size.

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[32] The Soviet-Afghan campaign could thus have had the same suppressing effect on the relationship between birth cohort size and schooling, as described in section 4.3. Indeed, controlling for the relevant cohorts reveals that it suppresses the relationship in question by an additional 14%.

[33] For example, to know how a one-unit change in log cohort size affects years of schooling by age 20, we would have to calculate $\alpha_{11} + 20\alpha_6$. (Refer to equation (1) for parameter descriptions and Table A-1 for their empirical estimates.) Accordingly, arriving at the effect by age 30 would require calculating $\alpha_{11} + 20\alpha_6 + 3\alpha_7 + 3\alpha_8 + 4\alpha_9$. Besides, a one-unit change in log cohort size is not itself intuitive and corresponds to a 272% increase in actual cohort size.

Figure 5:   **Schooling growth curves**

A. SCHOOLING (ALL FORMS), *WOMEN*
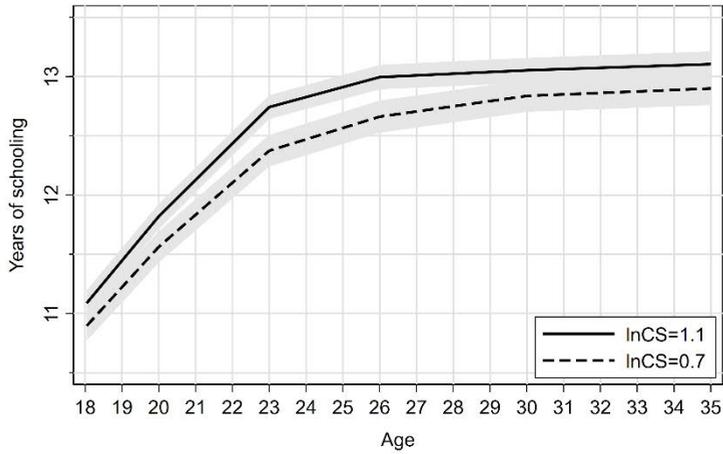
B. SCHOOLING (FULL-TIME), *WOMEN*
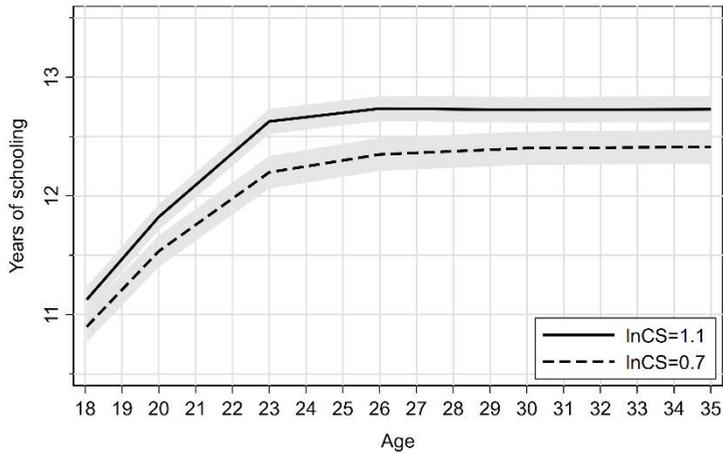
Figure 5:   **(Continued)**

C. SCHOOLING (ALL FORMS), *MEN*
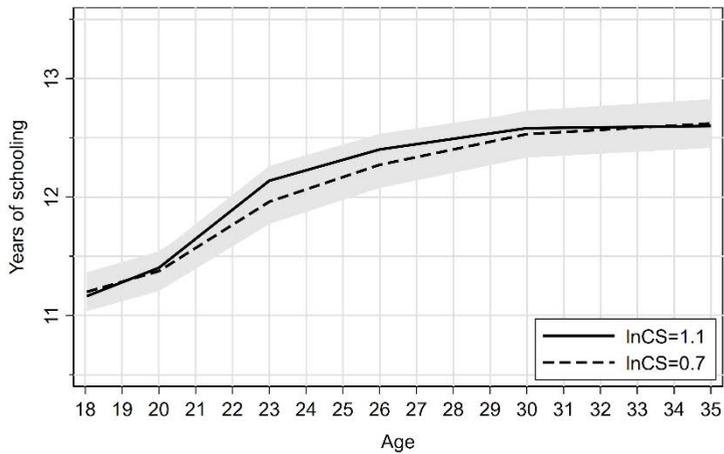
D. SCHOOLING (FULL-TIME), *MEN*
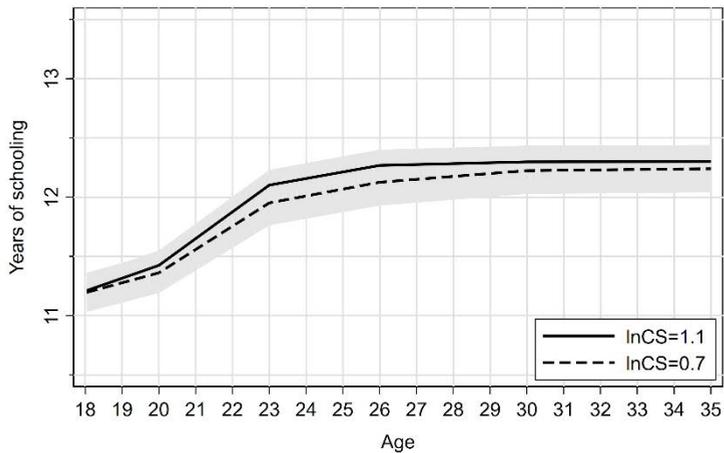
Figure 5: **(Continued)**

E. **SCHOOLING (ALL FORMS)**, *MEN**
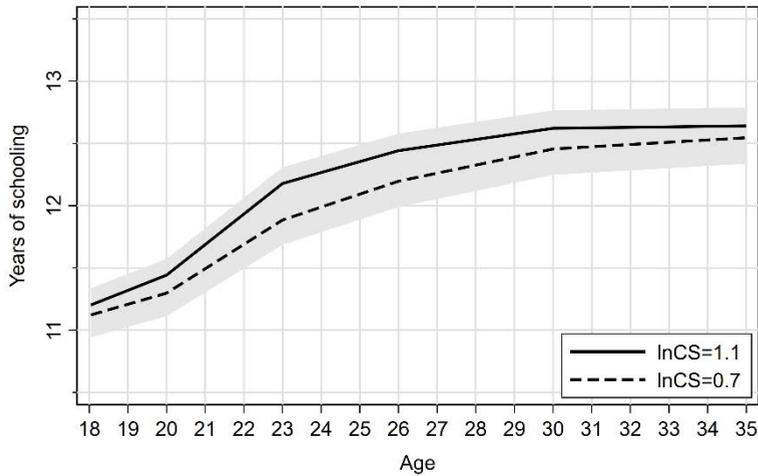
F. **SCHOOLING (FULL-TIME)**, *MEN**
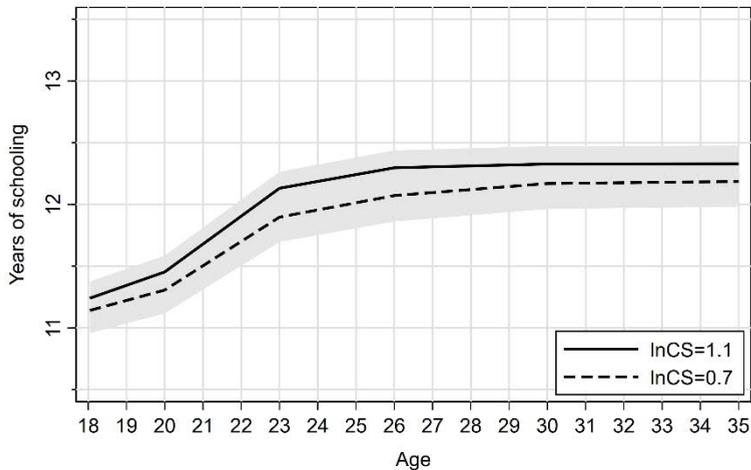
Source: GGS+EES data (EES subsample) and my own calculations. Source model estimates are in Appendix A, Table A-1.
Note: Solid and dashed lines correspond to growth curves estimated for birth cohort sizes of roughly 2 ($e^{0.7}$) and 3 ($e^{1.1}$) million, respectively. Shaded areas correspond to 95% confidence intervals.

Table 2: **Age-specific average marginal differences in schooling associated with a 50% increase in birth cohort size**

Age	Schooling (all forms)			Schooling (full-time)		
	Women	*Men*	*Men**	*Women*	*Men*	*Men**
at 18	**−0.194**	**0.037**	**−0.081**	**−0.231**	**−0.015**	**−0.100**
	(0.106)	(0.131)	(0.142)	(0.109)	(0.133)	(0.146)
at 20	**−0.261**	**−0.029**	**−0.147**	**−0.292**	**−0.064**	**−0.149**
	(0.108)	(0.132)	(0.143)	(0.110)	(0.134)	(0.148)
at 23	**−0.373**	**−0.179**	**−0.297**	**−0.435**	**−0.152**	**−0.237**
	(0.105)	(0.140)	(0.149)	(0.109)	(0.142)	(0.154)
at 26	**−0.338**	**−0.131**	**−0.249**	**−0.392**	**−0.144**	**−0.229**
	(0.107)	(0.145)	(0.157)	(0.110)	(0.147)	(0.160)
at 30	**−0.219**	**−0.050**	**−0.168**	**−0.327**	**−0.075**	**−0.160**
	(0.107)	(0.146)	(0.157)	(0.111)	(0.147)	(0.159)
at 35	**−0.208**	**0.022**	**−0.096**	**−0.323**	**−0.061**	**−0.146**
	(0.109)	(0.149)	(0.156)	(0.113)	(0.149)	(0.158)

Source: GGS+EES data (EES subsample) and my own calculations. Source model estimates are in Appendix A, Table A-1.
Notes: Models marked with an * account for military draft specifics. Robust standard errors are in parentheses.

Growth curves in Figure 5 reveal some intuitive general patterns: Schooling advances with age, steeply before the mid-20s, after which any substantial improvements become less likely. The growth curves also reveal subtle gender differences: Men tend to accumulate less education overall and advance to their highest level of attainment more slowly, reflecting the impact of military service. (Mind the slowdown around age 18–20.) Finally, the amount of schooling accumulated only in full-time education is smaller than the amount accumulated via both forms of education.

What of the differences associated with birth cohort size? *H1* looks partially corroborated, with the growth curves for larger birth cohorts lying somewhat above the growth curves for the smaller cohorts. The association between birth cohort size and schooling is negative across the range of age distribution and in all model specifications. However, the patterns are nuanced. The difference is most prominent if we consider women in full-time schooling (Figure 5B). It becomes largest around ages 23–26, amounting to 0.392–0.435 years of schooling per 50% difference in birth cohort size (Table 2), but narrows down to 0.327 by age 30 and remains stable afterward (0.323). If we count part-time schooling (cf. Figure 5A), the difference gets smaller, with comparable estimates amounting to 0.338–0.373, 0.219, and 0.208 years of schooling, respectively (Table 2). At least for women, this is in line with *H2*, suggesting more

prominent effects of birth cohort size in full-time education (and the compensatory effect of part-time education, respectively), and *H3*, suggesting the association to weaken with age.

Turning to men, the patterns look largely similar, albeit the differences associated with a comparable difference in birth cohort size are much smaller (and subject to greater statistical uncertainty, judging by the size of standard errors in Table 2 and the overlapping confidence intervals in Figures 5C and 5D). This is consistent with *H4*. The largest gaps, also situated around ages 23–26, amount to just 0.152 (both forms of education) and 0.179 (full-time) years of schooling (consistent with *H2*) and converge toward practically zero (the absolute difference of just 0.022 and 0.061) by the mid-30s (consistent with *H3*).

Does the fact that birth cohort size differences are less consequential for schooling among men have to do with military draft specifics as outlined in section 4.3? In the last set of models (marked with an * in Table 2 and Figure 5), I control for the conscription mechanism and find that the schooling differences associated with birth cohort size are at least partly suppressed by it – point estimates grow somewhat larger than they would be without the control. (Evidence of the negative effect of birth cohort size and conscription probability is presented in Table A-3 and Figure A-1 in Appendix A.) In the case of schooling, counting both forms of education, the difference is suppressed by 40% at age 23 (cf. 0.297 against 0.179 in the models not controlling for conscription) and even more so if one considers later ages (up to the point where the small positive estimate at age 35 flips to negative). In the case of full-time schooling only, the difference is suppressed to a comparable 36% (cf. 0.237 against 0.152). Nevertheless, even after controlling for draft specifics, birth cohort size disadvantage for men remains lower than a comparable disadvantage for women (about 50% for the latest estimates at age 35), suggesting that it does not completely explain away the gender difference in birth cohort size effects on educational attainment.

Finally, one might notice that the models controlling for draft appear somewhat at odds with *H2*. In particular, birth cohort size effects are similar (if not slightly smaller) for full-time education compared to education comprising both forms of schooling around the age range of 23–30 (see Table 2). However, it is not intuitive why the logic underpinning *H2 should* apply to the case when the conscription mechanism is controlled for. Unlike full-time education, part-time education does not make one eligible for draft deferment. Thus controlling for the draft (which is also tantamount to averaging birth cohort size effects for those who get drafted and those who do not) in the models in which both forms of schooling are counted endows birth cohort size effects with a slightly different meaning. Specifically, when the draft is controlled for, these effects increasingly apply to those who willingly decide to study part-time early in educational careers (and thus automatically submit to being drafted) rather than to those who are forced to retreat

to part-time education to make up for the failure in full-time education (which *H2* is all about). Unfortunately, it is impossible to test empirically whether this is the case because GGS+EES does not contain data on educational preferences and aspirations. However, one piece of indirect evidence might be that this "inconsistency" is observable early but not later in educational careers.

7. Discussion and conclusions

The results presented above largely corroborate the intuition that birth cohort size in Russia was a force to reckon with in the educational attainment process. Those lucky to be born in the times of declining birthrates – e.g., the DEW cohorts – found it easier to advance their level of education, unlike the large cohorts of baby boomers (and, eventually, their numerous children). More specifically, birth cohort size affected educational careers in several respects: In addition to the overall level of schooling, it affected the speed of human capital accumulation and the willingness of people to consider alternatives to full-time schooling, such as part-time education. The former is an important nuance because it suggests that the disadvantage due to larger birth cohort size was not entirely irreversible. While particularly pronounced at the most dynamic phase of young people's educational careers – their mid-20s – this disadvantage tended to decline slightly over time, revealing that people were indeed not just willing but also successful in making up for it. The study also revealed a peculiar institutional compensatory mechanism whereby birth cohort size in Russia was not as consequential for men's educational attainment as it was for women's levels of education. This was the mechanism of military conscription, which men in large cohorts were more likely to avoid and thus they expended more time and energy on their educational careers.

But how big were the disadvantages? As an example, taken at their face value, my estimates suggest that by age 35, a 50% increase in birth cohort size was associated with an average possible loss of 0.2 years of schooling for women. Given the standard five-year duration of a full-time higher education program, this is roughly equivalent to one in every 25 women missing out on attaining a higher degree. On its own, this might look like a small and inconsequential difference judged against the dramatic change in birth cohort size to which it is attributed. However, to put this finding in context, in a US study featuring the most readily comparable estimates, a similar birth cohort size increment was associated with an estimated loss of roughly 0.07–0.11 years of schooling[34] (Card and

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[34] Specifically, Card and Lemieux report that "a .1 increase in log cohort size [implies] a .04–.06 reduction in total years of completed education" (Card and Lemieux 2000: 31). This is average for both men and women. A 0.1 unit increase in log cohort size is equivalent to a 10.5% increase in absolute cohort size ($0.1 = \ln CS_2 - CS_1 = \ln(CS_2/CS_1) = \ln(1.105)$). To arrive at effects roughly comparable to those reported in Table 3, the

Lemieux 2000) – i.e., the difference was roughly twice as small. Although the figures might not be directly comparable for several reasons,[35] this naive comparison might not be unmeaningful, potentially suggesting the moderating role of an institutional context. One theoretical possibility is that in the United States, market forces and educational policies may have been more efficient in reducing shortages of educational opportunity. (For example, US universities have many part-time faculty who enter and leave the academic labor market, making supply more elastic.) The elasticity of educational supply in the United States is a well-known feature (Walters 2000), and this has to be the case to warrant the conclusion that baby boomers' lower level of schooling was more a matter of their pessimistic outlook regarding educational returns (Freeman 1979; Welch 1979; Wachter and Wascher 1984; Connelly 1986; Stapleton and Young 1988; Falaris and Peters 1991, 1992). In turn, this motivates the question of whether market-based educational systems indeed cope with cohort overcrowding more effectively than do state-regulated systems, which future research can address.

The gender difference is also motivating. Even though the conscription mechanism partly suppresses the negative association between birth cohort size and schooling for men, it does not entirely explain why women remain more disadvantaged. One possible explanation is that in larger cohorts, women choosing to have children before completing formal education may have to reckon with the overcrowding of child care facilities, forcing them to accept the burden of child care, which can make further education more difficult. However, this conjecture is not supported by the data.[36] Another possibility is that in the presence of significant gender segregation by discipline, the total cohort size is potentially a less accurate proxy for competition than is gender-specific cohort size, but this too does not explain the difference.[37] Perhaps a more plausible explanation, and one that is more consistent with the data,[38] is that women were slightly overrepresented in tertiary education in the Soviet Union after WW2 (e.g., Ofer and Vinokur 1985), which was particularly vulnerable to overcrowding effects, as discussed in sections 2 and 4.2.

To conclude, the study shows that the negative relationship between birth cohort size and educational attainment was not unique to Western societies and was a feature of socialist countries too. It also corroborates the judgments of scholars (Shubkin 1979; Gerber and Hout 1995; Gorshkov and Sheregi 2010; Matthews 2012; Cherednichenko 2016) who also express the view that Soviet educational policies were not perfectly

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estimates reported by Card and Lemieux need to be multiplied by 1.76 ($0.176 = \ln(1.5)$). This yields roughly 0.07–0.11 years of schooling.

[35] Primarily because of the differences in educational systems (i.e., the comparability of educational attainment measures) and estimation strategies.

[36] Controlling for the number of children in the models slightly increases the negative association between birth cohort size and schooling by roughly the same amount for both women *and* men.

[37] In fact, the estimates presented in this paper barely change (data available upon request).

[38] I ran a simple test by ignoring tertiary education in the calculation of schooling as per Table 1. This yields birth cohort size effects for women and men (net of conscription) that differ by no more than 10%.

responsive to the demographic challenges induced by the long-lasting impact of WW2. Finally, my findings highlight that birth cohort size effects on schooling can extend beyond the highest level of educational attainment and manifest in ways underrecognized in earlier research (Ahlburg, Crimmins, and Easterlin 1981; Wachter and Wascher 1984; Dooley 1986; Stapleton and Young 1988; Flinn 1993; Macunovich 1996; Jeon and Berger 1996; Bound and Turner 2007; Fertig, Schmidt, and Sinning 2009; Saavedra 2012; Babcock, Bedard, and Schulte 2012). In particular, one has to consider the timing of education and/or the pressure people may experience to consider alternative educational options, such as part-time education.

This study is not free from limitations, and the major concern is the identification of the primary causal effect of interest. Even though cohort size fluctuations in Russia were largely caused by an exogenous shock (WW2), these fluctuations unfolded very slowly, making it likely that they coincided with some other important cohort or period effects potentially affecting education.[39] If the sample of cohorts had been sufficiently large, this would not have been a problem. However, the cohorts represented in GGS+EES cover just one and a half demographic cycles: two peaks separated by a single trough. To the extent possible, I have tried to deal with this problem in my modeling approach by accommodating various assumptions about the most likely confounding factors (as discussed in section 5.6). Also, in Appendix B, I provide a supplementary analysis using GGS that helps slightly extend the span of cohorts and corroborates the main findings. However, in an observational study like this, causal claims cannot be warranted completely; the causal interpretation of findings hinges to a great extent on the plausibility of the identification assumptions.

Yet another important limitation is that my study cannot directly probe the role of migration (e.g., between Soviet republics), which can be viewed as a mechanism potentially offsetting some of the DEW effects on student demography in Soviet Russia. However, I would speculate that migration had a limited impact because many Soviet republics were not immune to similar demographic challenges. Also, to my knowledge, the data on the national composition of enrollments (or specific age groups) in Soviet Russia are available for only a few particular years, making such endeavor somewhat complicated.

Finally, while the study claims to control away the demand-side explanations by focusing on the Soviet institutional context, it cannot directly evaluate the extent to which the correlation between cohort size and educational attainment is due to decisions versus constraints. The fact that larger cohorts partly succeeded in making up for lower levels

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[39] Although, strictly speaking, the specific contemporaneous changes in educational and occupational structure invoked through policy measures in response to demographic shifts are not a concern as long as the research interest remains in identifying the total (rather than direct) impact of changes in population age structure on individual educational/occupational outcomes. (In that sense, finding a zero effect of cohort size on educational attainment would indicate that such policies were effective in counteracting the demographic changes.)

of schooling by retreating to part-time education and/or taking more time to attain it suggests that their educational aspirations were not that much different from the aspirations of smaller cohorts. However, a proper study distinguishing the demand- and supply-side explanations must ideally attend to the difference between aspirations and actual attainment. This seems particularly appropriate in market contexts, where the difference might be especially useful for the more effective targeting of policies concerned with human capital accumulation.

8. Acknowledgments

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Appendix A

Table A-1:   RE growth curve models of years of schooling

	Schooling (all forms)			Schooling (full-time)		
	Women	*Men*	*Men**	*Women*	*Men*	*Men**
Cohort size (logged)	1.033	1.582	1.295	0.816	1.068	0.861
	(2.153)	(1.991)	(1.994)	(2.087)	(1.929)	(1.933)
Age splines[1]						
18–20 y.o.	0.433	0.180	0.181	0.410	0.151	0.152
	(0.099)	(0.090)	(0.090)	(0.096)	(0.087)	(0.087)
20–23 y.o.	0.372	0.332	0.332	0.350	0.277	0.277
	(0.066)	(0.079)	(0.079)	(0.063)	(0.077)	(0.077)
23–26 y.o.	0.064	0.060	0.060	0.012	0.051	0.050
	(0.038)	(0.052)	(0.052)	(0.030)	(0.044)	(0.044)
26–30 y.o.	−0.037	0.010	0.010	−0.031	−0.022	−0.022
	(0.018)	(0.032)	(0.032)	(0.011)	(0.017)	(0.017)
30–35 y.o.	0.007	−0.021	−0.021	−0.000	−0.005	−0.004
	(0.015)	(0.022)	(0.022)	(0.010)	(0.014)	(0.014)
Age splines[1] × cohort size						
18–20 y.o.	−0.084	−0.083	−0.083	−0.077	−0.061	−0.061
	(0.113)	(0.104)	(0.104)	(0.109)	(0.100)	(0.100)
20–23 y.o.	−0.092	−0.124	−0.124	−0.117	−0.073	−0.072
	(0.075)	(0.091)	(0.091)	(0.071)	(0.089)	(0.089)
23–26 y.o.	0.029	0.040	0.040	0.035	0.007	0.007
	(0.044)	(0.059)	(0.059)	(0.034)	(0.050)	(0.050)
26–30 y.o.	0.073	0.050	0.050	0.040	0.042	0.042
	(0.020)	(0.037)	(0.037)	(0.012)	(0.021)	(0.021)
30–35 y.o.	0.005	0.036	0.035	0.002	0.007	0.007
	(0.017)	(0.025)	(0.025)	(0.011)	(0.017)	(0.017)
Year of birth	0.007	0.016	0.009	0.005	0.014	0.007
	(0.005)	(0.007)	(0.007)	(0.005)	(0.007)	(0.007)
Born after 1979	−0.282	−0.313	−0.446	−0.252	−0.272	−0.403
	(0.098)	(0.127)	(0.128)	(0.104)	(0.132)	(0.134)
Post-Soviet period	−0.061	−0.079	−0.080	−0.028	−0.044	−0.044
	(0.032)	(0.047)	(0.048)	(0.027)	(0.039)	(0.040)
Parents' highest occupational status	0.016	0.010	0.008	0.014	0.008	0.006
(ISEI)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Number of siblings[2]	−0.135	−0.155	−0.154	−0.104	−0.161	−0.157
	(0.049)	(0.066)	(0.066)	(0.052)	(0.069)	(0.068)
Place of birth (ref: village)						
Town	0.064	0.456	0.419	−0.017	0.467	0.431
	(0.057)	(0.078)	(0.077)	(0.060)	(0.080)	(0.079)
City	0.120	0.351	0.309	−0.045	0.310	0.267
	(0.068)	(0.094)	(0.093)	(0.073)	(0.097)	(0.096)
Not available	0.035	0.222	0.182	−0.085	0.205	0.162
	(0.072)	(0.102)	(0.100)	(0.076)	(0.105)	(0.103)
Drafted			−0.521			−0.539
			(0.077)			(0.081)
Born 1960–1970			−0.039			0.016
			(0.077)			(0.079)
Intercept	−10.174	−24.494	−8.703	−5.894	−19.049	−4.662
	(9.449)	(13.174)	(13.216)	(10.066)	(13.517)	(13.806)

Table A-1:   (Continued)

	Schooling (all forms)			Schooling (full-time)		
	Women	*Men*	*Men**	*Women*	*Men*	*Men**
R^2 between	0.135	0.108	0.132	0.096	0.086	0.111
R^2 within	0.278	0.202	0.202	0.222	0.161	0.161
R^2 overall	0.165	0.124	0.148	0.115	0.093	0.121
ρ (ICC)	0.657	0.675	0.666	0.731	0.742	0.734
Wald χ^2	2653.8	869.6	889.3	1741.3	613.5	627.4
df	19	19	21	19	19	21
N persons	3204	1881	1881	3204	1881	1881
N person-years	46156	25779	25779	46156	25779	25779

Source: GGS+EES data (EES subsample) and my own calculations.
Notes: Models marked with * control for the military draft. Robust standard errors are in parentheses.
[1] Marginal effects of age at given age intervals.
[2] Number of siblings plus one, logged.

Table A-2:   Summary statistics

Variables	Mean		SD		Min		Max		N	
Years of schooling by age 35[1] (all forms)	12.7	(12.8)	1.75	(1.74)	6	(6)	18	(18)	5680	(5085)
Years of schooling by age 35[1] (full-time)	12.4	(12.4)	1.72	(1.72)	6	(6)	18	(18)	5468	(5085)
Cohort size (in millions)	2.37	(2.37)	0.335	(0.336)	1.79	(1.79)	2.87	(2.87)	6455	(5085)
Drafted	0.243	(0.234)	0.429	(0.424)	0	(0)	1	(1)	6455	(5085)
Male	0.381	(0.37)	0.486	(0.483)	0	(0)	1	(1)	6455	(5085)
Parents' highest occupational status (ISEI)	43.8	(44.8)	17.7	(17.9)	16	(16)	90	(90)	6147	(5085)
Place of birth										
Village	0.35	(0.351)	0.477	(0.477)	0	(0)	1	(1)	6455	(5085)
Town	0.308	(0.31)	0.462	(0.463)	0	(0)	1	(1)	6455	(5085)
City	0.187	(0.187)	0.39	(0.39)	0	(0)	1	(1)	6455	(5085)
Not available	0.155	(0.152)	0.362	(0.359)	0	(0)	1	(1)	6455	(5085)
Number of siblings	1.77	(1.67)	1.66	(1.53)	0	(0)	16	(16)	6276	(5085)
Year of birth	1966	(1966)	10.5	(10.3)	1948	(1948)	1988	(1986)	6455	(5085)
Born after 1979	0.116	(0.118)	0.32	(0.323)	0	(0)	1	(1)	6455	(5085)
Born 1960–1970	0.168	(0.162)	0.374	(0.369)	0	(0)	1	(1)	6455	(5085)

Source: GGS+EES data (EES subsample) and my own calculations.
Notes: EES complete sample size is 6,455. Main statistics are derived from valid observations per variable. The statistics in brackets refer to complete observations.
[1] Calculated from reported education, as per Table 1.

**Table A-3:   Logistic regression model of being drafted before age 27**

Cohort size (in millions)	−1.447	(0.222)
Parents' highest occupational status (ISEI)	−0.018	(0.003)
Number of siblings	0.013	(0.035)
Place of birth (ref: village)		
Town	−0.262	(0.129)
City	−0.406	(0.147)
Not available	−0.310	(0.158)
Year of birth	−0.104	(0.007)
Born 1960–1970	0.352	(0.127)
Intercept	208.715	(14.583)
Pseudo R^2	0.179	
Likelihood ratio χ^2	530.2	
df	8	
N	2268	

Source: GGS+EES data (EES subsample) and my own calculations.
Note: Standard errors in parentheses.
[1] Number of siblings plus one, logged.

Figure A-1:   Predicted probability of being drafted before age 27 by birth cohort size
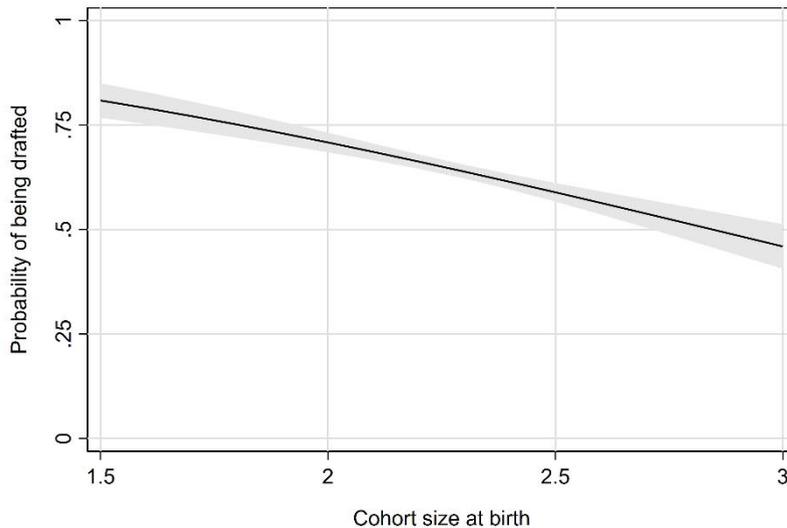
Source: GGS+EES data (EES subsample) and my own calculations. Source model estimates in Table A-3.
Note: Shaded area corresponds to 95% confidence intervals.

Appendix B

Supplementary analyses using GGS

Here, I employ GGS data to test whether key findings reported in section 6 hold if one considers a broader range of cohorts than those featured in EES. GGS includes cohorts born as far back as 1923, but reliable data on birth cohort size in Russia exists only for cohorts born in 1935 and later (a restriction of *Demoscope Weekly* time series). Therefore only these cohorts could be included. Even with this restriction, the cohorts born before, during, and shortly after WW2 enter the analysis. However, it is worth mentioning why GGS data is inferior to EES. First, it does not contain information on educational careers over time and does not allow modeling the educational attainment process as a function of age (essential for disentangling age from cohort effects). Second, the educational attainment variable in GGS is based on crude ISCED mapping and does not discriminate between part-time and full-time education.

Using GGS I estimate two kinds of models for men and women separately: (1) models regressing the highest reported educational attainment expressed in years of schooling on birth cohort size (logged) plus the same set of controls as in EES analyses (ISCED codes 0–6 recoded into 0, 4, 9, 11, 12, 15, and 21 years of schooling, respectively – this recoding is a compromise between the original UNESCO ISCED 1997 classification for Russia and more accurate correspondence in Table 1); and (2) the models regressing age at the highest reported level of education (contained in GGS) plus the same set of covariates *and* educational attainment as an additional control.

Table B-1 contains the models. In general, it corroborates the key findings in section 5. I find a negative association between birth cohort size and educational attainment for both men and women, and it is weaker for men. The estimates are also not substantially different from those previously reported: e.g., for women, a 50% increase in birth cohort size amounts to $\ln(1.5) * (-0.573) = -0.232$ years of schooling (cf. –0.208 at age 35, reported in Table 3). The second set of models is also consistent with the intuition that a larger birth cohort size implies slightly longer educational spells (although standard errors suggest that the estimates are much less precise).

Still, it is important to note that the estimates between EES and GGS are only weakly comparable given the definitions of educational attainment and modeling strategies. For instance, the correlation between EES and GGS measures for the highest years of schooling amounts to only 0.591 in the overlapping sample. Besides, the GGS sample of cohorts is much more prone to the mortality selection bias discussed in section 5.6.

Table B-1:   OLS models of years of schooling using GGS data

	Years of schooling				Age when education attained			
	Women		*Men*		*Women*		*Men*	
Cohort size (in millions logged)	−0.573	(0.171)	−0.263	(0.277)	0.405	(0.381)	0.198	(0.623)
Education attained (ref: ISCED 1)								
ISCED 2					−2.825	(2.096)	−0.730	(1.304)
ISCED 3					−3.700	(2.023)	−1.649	(1.238)
ISCED 4					−3.676	(2.018)	−0.805	(1.246)
ISCED 5					−0.232	(2.018)	3.128	(1.243)
ISCED 6					4.889	(2.442)	6.332	(2.079)
Parents' highest occupational status (ISEI)	0.039	(0.002)	0.036	(0.002)	0.000	(0.004)	0.004	(0.006)
Place of birth (ref: village)								
Town	0.113	(0.081)	0.422	(0.109)	0.449	(0.183)	−0.102	(0.228)
City	0.224	(0.091)	0.496	(0.118)	0.931	(0.202)	0.459	(0.259)
Not available	0.337	(0.096)	0.661	(0.128)	0.715	(0.244)	−0.041	(0.264)
Number of siblings[1]	−0.513	(0.064)	−0.328	(0.091)	0.033	(0.157)	0.109	(0.182)
Year of birth	0.006	(0.004)	−0.010	(0.006)	−0.097	(0.008)	−0.100	(0.012)
Born after 1979	−0.728	(0.122)	−0.480	(0.150)	0.119	(0.183)	0.177	(0.248)
Intercept	0.070	(7.460)	29.806	(11.240)	211.883	(16.110)	215.952	(22.970)
R^2	0.151		0.118		0.219		0.302	
F	106.8		49.1		90.0		85.3	
df	8		8		13		13	
N	5488		3366		4180		2602	

Source: GGS data; my own calculations.
Notes: Standard errors in parentheses.
[1] Number of siblings plus one, logged.