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The Long Shadow of Short-Term Schooling Disruption

Analysis of Kuwait's Civil Service Payroll Data

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Abstract

This paper estimates the long-term impacts of schooling disruptions on private returns to schooling in Kuwait. It applies an instrumental variables approach to estimate the private returns to schooling, using unique civil service payroll data, with Kuwaiti students' exposure to the Gulf War (1990–91) as the instrument. The Gulf War is a suitable instrument because it profoundly affected Kuwaiti students' schooling at the time and is unlikely to be correlated with many potentially problematic omitted variables, such as students' ability. The analysis finds that (i) people who were of schooling age during the Gulf War tend to have lower educational attainment than people who were of schooling age after the Gulf War; (ii) men who were of schooling age at the time of the Gulf War earn on average 5.6 percent less for each year of schooling lost, and women earn correspondingly 6.8 percent less for each year of schooling lost; (iii) students who were in lower grades during the Gulf War tend to suffer a greater percentage wage loss for each year of lost schooling.

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1. Introduction

This paper estimates the long-term impacts of disruptions to education on private returns to schooling in Kuwait. We do so using unique cross-sectional data and a natural experiment of the Gulf War (1990-91), which disrupted schooling for students in Kuwait. We apply an instrumental variables approach to estimate the private returns to schooling, using Kuwaiti students' exposure to the Gulf War as the instrument. The approach, exemplified by Angrist and Krueger (1991), addresses the omitted variable bias and has been used in numerous studies as documented in Card's literature reviews (1999, 2001). In what amounts to a more novel part of the investigation, we examine the long-term impacts of war-induced schooling shocks for students at various stages of their education cycle, including at the individual grade level.

The analysis thus advances the existing literature in two respects: (i) it contributes to the work that has been done on the long-term impacts of conflicts on education outcomes and private returns to schooling; and (ii) it contributes to previous studies that have estimated returns to schooling in Kuwait (see Table 1). The negative impacts of conflicts on schooling are found in various contexts, for example, Shemyakina (2011) documents the impact of the 1992-98 armed conflict in Tajikistan; Kesternich et al. (2014) report long-term consequences in World War II affected countries, and Weldeegzie (2017) shows the effect of the Ethiopia-Eritrea conflict of 1998-2000 (see also Chamarbagwala and Moran 2011; Leon 2012; and Poirier 2012).[1] The effect

[1] Dang et al. (2020) discuss an interesting case of the First Indochina War (1946–1954) associated with an

of conflicts on wages has been explored by Galdo (2013), who shows that early childhood exposure to violence during the civil war in Peru led to lower earnings in adulthood, and by Akbulut-Yuksel (2014), who finds that exposure to World War II destruction in Germany had a negative long-term impact on the earnings of males from disadvantaged families. Other works take the analysis one step further to connect conflict-related schooling loss with change in earnings, allowing them to estimate private returns to the affected students' schooling. Ichino and Winter-Ebmer (2004) identify World War II's long-run adverse effects on the schooling of Austrian and German children who were ten years old during the conflict. Using the instrumental variable approach, they also estimate the respective private returns to schooling. In a similar analysis, Islam et al. (2016) use the impact of Cambodia's 1970s civil war on primary school-age children to estimate private returns to schooling.

We are not aware of previous studies assessing the effects of the Gulf War on labor market outcomes in Kuwait; however, as we already suggested, our contribution brings more than just geographic diversity to the literature. In contrast to Ichino and Winter-Ebmer (2004) and Islam et al. (2016), who are closest to our approach, we do not rely on survey data. Instead, we use unique government payroll data from the Kuwait Civil Services Commission. Using this data means that we can include almost two-thirds of employed Kuwaitis in the analysis, and unlike in many other studies, we are not using a sample but the population of civil servants. The size and quality of the data set allows us to estimate narrower disaggregation than in other studies.

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increase in girls' education outcomes in areas controlled by the Democratic Republic of Vietnam. However, the positive association results from the education policies in the areas, not the war itself.

We also contribute to the studies that estimate returns to schooling in Kuwait as summarized in Table 1 (Hosni and Al-Qudsi 1988, Al-Qudsi 1989, Alqattan, Stergioulas, and Al-Zayer 2012). However, unlike previous estimates, this paper is—to our knowledge—the first to use the instrumental variable approach in the Kuwaiti context. While the other contributions estimate correlations between schooling and labor market outcomes, we estimate the causal relationship between the two variables.

Table 1: Previous estimates of private returns to schooling in Kuwait

Author(s)	Data source (Year)	Sample size	Additional information	Dependent variable	Schooling coefficient (OLS)
Hosni and Al-Qudsi (1988)	Survey by the Central Statistical Office (1983)	2,332	Kuwaiti males (public & private sectors)	Monthly earnings, natural log	0.052
Hosne and Al-Qudsi (1988)	Survey by the Central Statistical Office (1983)	535	Kuwaiti females (public & private sectors)	Monthly earnings, natural log	0.082
Al-Qudsi (1989)	Survey by the Central Statistical Office (1983)	2,792	Kuwaiti males & females (public sector)	Monthly earnings, natural log	0.064
Al-Qudsi (1989)	Survey by the Central Statistical Office (1983)	100	Kuwaiti males & females (private sector)	Monthly earnings, natural log	0.058
Alqattan et al. (2012)	Kuwait Civil Services Commission	63,051	Kuwaiti males (public—civil service)	Monthly earnings, natural log	0.055
Alqattan et al. (2012)	Kuwait Civil Services Commission	83,448	Kuwaiti females (public—civil service)	Monthly earnings, natural log	0.067

Our findings show that schooling disruptions during the Gulf War have had a significant adverse effect on labor market outcomes, even almost 30 years after the war. Furthermore, we

find that students in the lower grades during the Gulf War tend to suffer from a higher percentage wage loss for each lost year of schooling.

The remainder of the paper is organized as follows. Section 2 presents the Gulf War's historical context and its disruptive effects on education in Kuwait. Section 3 describes Kuwait's education system and the civil service. Section 4 presents a description of the unique data set used in this study together with the methodology. The penultimate section presents the results; and we conclude with an assessment of some implications of this work, including the applicability of the findings to assess the COVID-19 shock on labor market outcomes in Kuwait.

2. Effects of the Gulf War on schooling in Kuwait

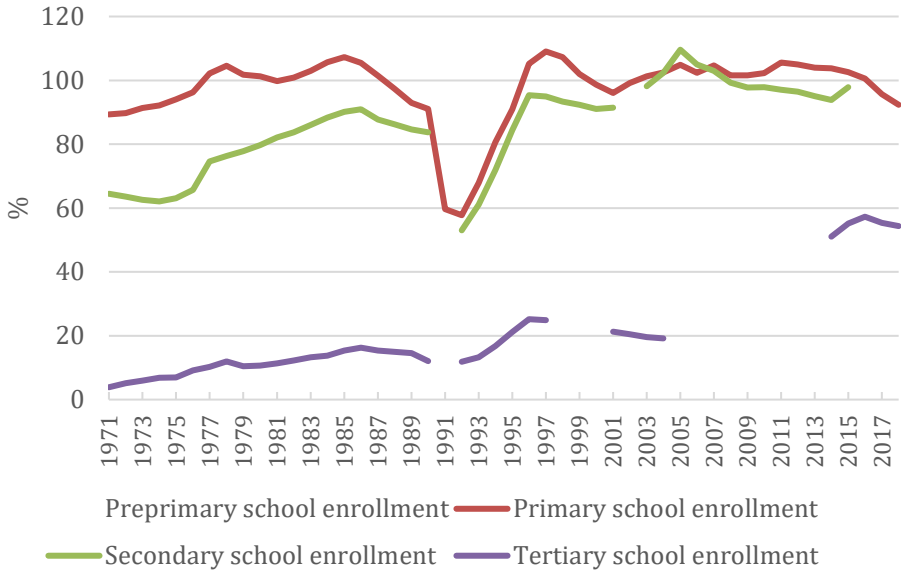
The Iraqi armed forces invaded Kuwait on August 2, 1990, intending to exploit its oil wealth and incorporate it as Iraq's 19th governorate (Sassoon and Walter 2017: 607–9). The invasion, and the ensuing occupation, lasted seven months, until February 26, 1991. It brought "chronic insecurity, fear of violent crime or arbitrary arrest, controlled movement due to curfews and checkpoints, scarcity of food and essential resources, crippled health care services, a shuttered school system, looted houses, and boarded-up shops" (Sassoon and Walter 2017: 607, 614). The substantial adverse effects of the invasion on students had at least two channels: (i) suspension of formal schooling and cannibalization of schooling infrastructure; (ii) the physical and psychological damage to students.

2.1 Suspending formal schooling and cannibalizing its infrastructure

Gross enrollment rates in Kuwait paint a negative picture of the Gulf War's impact on

schooling. Despite some missing observations, the data shows that the Gulf War led to a steep fall in gross enrollment rates, and afterwards there was a lag before gross enrollment rates returned to rates seen before the invasion.

Figure 1: Gross school enrolments in Kuwait (%)



Source: World Bank, World Development Indicators

An easily identifiable reason for the long-term impact on enrollments is the Gulf War-related damage to the education infrastructure. Sassoon and Walter (2017: 617) report an Iraqi order to "state-sponsored pillaging" dated September 1990 "to take all of the equipment, furniture, and electronics from Kuwaiti schools and send them to Baghdad." As a result, the Kuwaiti government had to spend considerable resources on replacing the destroyed schools and equipment after the war. The US Army Corps of Engineers supervised the repairs of 147 schools, which included "removing debris, ammunition and vehicles, and repairing and replacing windows,

doors, airconditioners [sic], plumbing and electrical fixtures, and water systems." The British Education Consortium for Kuwait assisted the Kuwaiti government with "procurement and installation of about $68 million worth of equipment at more than 200 schools" (Middle East Economic Digest 1991), to put this in context: there had been a total of 642 schools in Kuwait in 1988/89 Manatt and Manatt (1996: 371).

Families made varying decisions about schooling for their children during the Gulf War, most of which were heavily influenced by location. Students who remained in Kuwait experienced disruptions when schools closed (Manatt and Manatt 1996: 373; Sassoon and Walter 2017: 616). In contrast, many Kuwaiti students who happened to be abroad during the invasion enrolled in schools in the countries they were visiting[2] and were able to complete the academic year (Safwat 1993: 18). The Kuwaiti embassy in London for example, gave Kuwaitis regular stipends and covered education tuition costs (La Ganga 1991) and the Egyptian government allowed the Kuwaiti government to open five schools with the Kuwaiti curriculum in the Arab Republic of Egypt (Safwat 1993 :18). Unfortunately, official data on the full extent of the Kuwaiti student population studying abroad are not available.

When the occupation ended, the Kuwaiti government designed policies for public schools to make up some of the lost schooling and to prevent further human capital losses. As part of this effort, teachers returned to public schools as early as August 3, 1991 (The Kuwaiti Educational

[2] The invasion began during the summer break of 1990/1991. Many families had already left the country for their summer vacation and decided to stay there as the invasion was unraveling. By one account "more than half the population, expats and citizens alike, were out of the country" (Manatt and Manatt 1996: 368).

Center in Cairo 1991). The first post-occupation academic year for public schools[3] began on August 24, 1991, and ended on July 18, 1992, lasting 2 months longer than the usual academic year (The Kuwaiti Teachers Association 1991). The Ministry of Education extended the academic year to allow students in public schools to make up for lost schooling time and counted one academic year (1991/1992) as two (Safwat 1993 :18). This decision was intended to keep the students from losing any time on their academic paths. As part of the effort, student performance was not graded (Alsarraf et al. 1993: 18), and other changes were adopted, for example music classes were dropped, and physical education and home economics classes were reduced (The Kuwaiti Educational Center in Cairo 1991). Interestingly, the students who had kept up with their education abroad in 1990/91 ended up being ahead in their schooling and were able to re-enter public schools only in February 1992 where they left off (ibid.). Manatt and Manatt (1996: 373) reflect with some hindsight that during "the first postwar school year, a double-up effort was made and most students are continuing to complete high school with their age cohorts." Public institutions for higher education, including Kuwait University (KU) and the Public Authority for Applied Education and Training (PAAET), also offered make-up classes to counter the impacts of the occupation, similar to public schools (Safwat 1993 :18).

Private schools, in contrast, did not compress two academic years into one like public

[3] Our sources do not state whether private schools followed suit, however, private schools at the time served a smaller, although substantive, percentage of students in Kuwait. In 1991/92, 245,800 students were studying at pre-tertiary public schools, including kindergartens (Central Statistical Bureau 2000: 311). In comparison, there were 74,784 students attending private schools. The data include Kuwaitis and non-Kuwaitis as we were not able to find comparable data disaggregated by nationality. Al-Qudsi (1989: 266) notes that 99% of Kuwaiti nationals were attending public pre-tertiary level education but does not provide a specific source for the information.

schools, as many of the private school students had studied abroad during the invasion. Students who were not abroad received additional tutoring and continued with the 1991/1992 academic year as planned before the invasion ("The Beginning of the Construction Process" 1991). It is important to note however, that private schools were a smaller player in Kuwait's overall education system at that time. Manatt and Manatt (1996: 371) refer to it as "thriving, but small," and Al-Qudsi (1989: 266) notes that 99% of Kuwaiti nationals attended public pre-university education.

In addition to the disruption discussed above, Kuwait significantly reduced the size of its civil service following the occupation, including its cadre of public-school teachers, which likely hampered the government's ability to restore services to pre-war levels.[4]

2.2 Physical and psychological impacts on students

Students, unsurprisingly, also faced invasion-related physical and psychological pain. The physical effects included impaired senses and lost limbs caused by explosions, shortness of breath, blood and intestinal disorders, skin conditions, arrhythmia, dizziness, physical weakness, and headaches (Kuwait Society for the Advancement of Arab Children 1994). In terms of general psychological and behavioral effects, children became more prone to anxiety, sleeping disorders, bedwetting, slurred speech, and loss of trust (Al-Sahl 1993; Kuwait Society for the Advancement

[4] In the report from August 1991, the Kuwaiti government decided to dismiss 110,000 civil servants, mostly Palestinians, which led to recruitment drives, including those for teachers. The dismissals happened partly because of the perceived collaboration of the foreign workers with the Iraqi regime. The dismissals of the Palestinians were also "a retaliation for the Palestine Liberation Organisation's support for Iraq" during the war (Isa 1991).

of Arab Children 1994). Students became more inclined to disobey rules, and were more prone to absenteeism, vandalism, cursing, and aggressive behavior. Their overall view of the future was marked with fear and insecurity (Kuwaiti Studies and Research Center 2002). Academic performance decreased in line with the challenges described above according to a 1992 study by The Psychological Service Department at the Ministry of Education in Kuwait summarized in (ibid.). The study assesses elementary school students' academic problems and finds that 63 percent of students did not complete their homework on a regular basis; 68 percent did not participate effectively in class; 62 percent were inattentive in class; 70 percent reported not having good relationships with teachers; and 74 percent did not ask questions or participate in discussions. A 1994 study by the Social Development Office summarized in (ibid.) also documents post-war declines in academic performance among elementary school students.

3. Context of Kuwait's education system and its civil service

The section describes Kuwait's education system during the period after 1954 and briefly presents the key characteristics of Kuwait's civil service.

3.1 The education system in Kuwait

Primary, intermediate, and secondary pre-university education in Kuwait is offered in public, private, and religious schools (Safwat 1993). The Kuwaiti government provides public education under the auspices of the Ministry of Education (UNESCO-IBE 2012). There are two types of private schools; both supervised by the Ministry of Education: Arabic private schools use the Ministry of Education's curriculum, and private foreign schools, like the American, British, or

Indian schools use their own curricula (UNESCO-IBE 2007).

Students can enroll in the first grade of primary public school if they are at least five years and six months old at the beginning of the school year, on September 15 (Alqattan et al. 2012: 4; Registration in Public Schools n.d.).[5] [6] Education is compulsory, starting at the age of six and ending at the age of fourteen if one does not graduate from elementary level by then. Once attending intermediate level, the compulsory schooling ends when students complete intermediate level or turn sixteen (UNESCO-IBE 2007). The current structure of the education system established in academic year 2004/2005 is "5-4-3" as it allocates five grades to primary school, four to middle school, and three to high school. Prior to 2004/2005, the system was "4-4-4" (Ministry of Education 2008: 20; UNESCO-IBE 2007, 2012) and all people included in our instrumental variable analysis studied under the older "4-4-4" system.

The Ministry of Higher Education supervises Kuwait's post-secondary education, the two main public education institutions being Kuwait University and the Public Authority for Applied Education and Training (PAAET) (UNESCO-IBE 2007, 2012). Other public institutions include Saad Al Abdullah Academy for Security Sciences, the Higher Institute of Dramatic Arts, and the Higher Institute of Musical Arts (UNESCO-IBE 2007). Several private universities operate in Kuwait, including the Gulf University for Science and Technology (GUST), the American University in Kuwait (AUK), and the American University of the Middle East (AUM).

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[5] Note that while, generally, there should be a correspondence between a student's age and the grade in which this student enrolls, it does not have to be the case. For details, see Appendix 3 for the age ranges for each grade level.

[6] Different rules might apply to private schools. At the private American School of Kuwait, first-year elementary students, for example, have to be six years old by December 31 (Admissions Requirements n.d.).

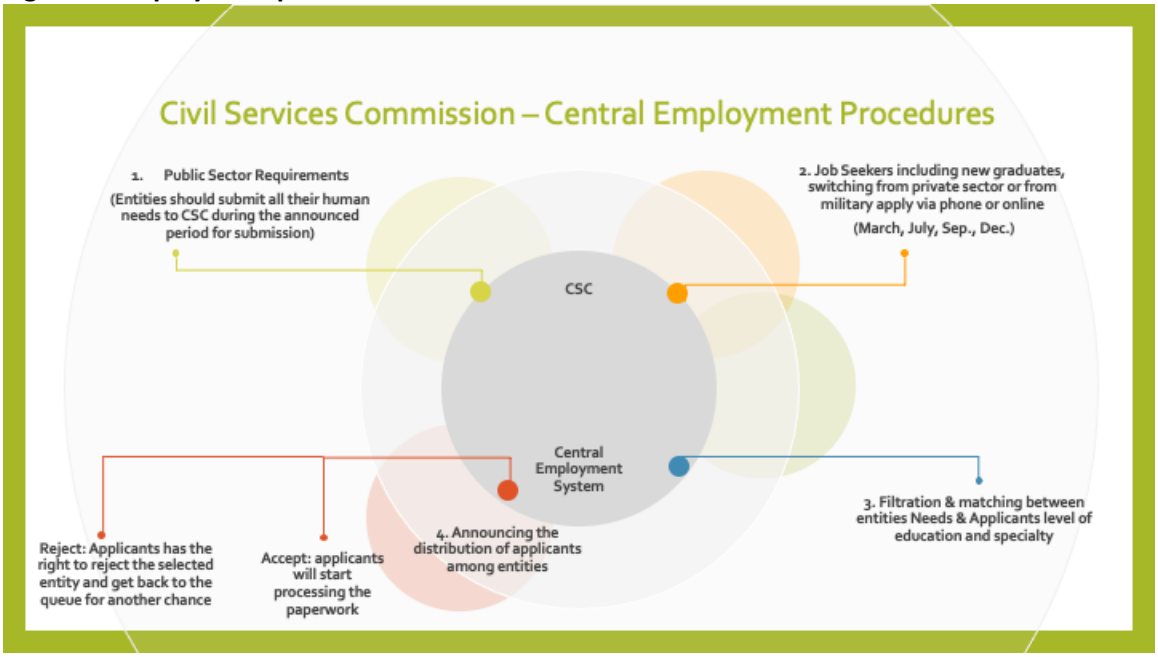
Diploma-awarding post-secondary programs in Kuwait usually take two years. The standard length of study for a bachelor's degree is four years (eight semesters), except for engineering (four and a half to five years) and medicine (seven years). Master's programs take one to two years in addition to a bachelor's degree, and doctoral programs take a minimum of three years (UNESCO-IBE 2007, 2012). We use the information in Appendix 1 to map years of schooling to people's highest achieved degree.

3.2 Civil service in Kuwait

After completing their schooling, most Kuwaitis who join the labor force find employment in the public sector. According to the Public Authority of Civil Information (PACI), 85 percent of the labor force of Kuwaiti nationals work for the public sector as of December 2019. AlHumaidan (2019: 18) reports that Kuwaitis prefer jobs in the public sector because of the "shorter working hours, higher wages and job security." The preferable working conditions are—at least to some extent—related to the commitment of the Kuwaiti government to provide employment to all its citizens (AlHumaidan 2019: 20-21).

To secure a public sector job, Kuwaitis generally apply through the Civil Services Commission (CSC), except for jobs in the National Guard, the Military, state-owned enterprises, and some positions at Kuwait University and PAAET. Figure 2 illustrates the job application process, in which the CSC matches available job openings to qualified candidates. AlHumaidan (2019: 21), in this context, notes that applicants sometimes wait for up to three years before accepting a position, as they hold out for a more attractive positions across ministries.

Figure 2: Employment process at Kuwait's Civil Services Commission



Source: Authors' own research

In the Kuwaiti public sector, the following characteristics determine compensation, and apply equally to men and women: (i) educational level; (ii) field of study; and (iii) years of experience (AlHumaidan 2019: 22). Two other compensation components apply unequally to men and women: (i) social allowances, and (ii) children's allowances. The social allowance component has two categories: "married" and "unmarried. All women, regardless of their marital status, receive the "unmarried" social allowance, the more generous "married" social allowance is reserved for married male workers. Children's allowance is generally paid to fathers, rarely to mothers. The children's allowance is 50 Kuwaiti dinars[7] per child for up to seven children per

[7] 1 Kuwaiti dinar was equivalent to US$3.33 on April 6, 2021.

family. The allowance stops when: a child is 24 years old; a child finds employment; or a female child gets married (Alansari 2018: 65–66).

The retirement age requirement in Kuwait has gone through several changes over time. Until 2007, the Kuwaiti government gave women the option of early retirement after only 15 years of work and men after 20 years (Garrison 2015). The government modified the law in 2007 and imposed a timetable detailing increases to the minimum retirement age, we summarize in Appendix 2. As of January 2020, starting at age 55, Kuwaiti men may retire after 30 years of service without losing any retirement benefits and women, may retire after 25 years of service, starting at age 50 (PIFSS 2019).

4. Data and methodology

We use unique proprietary data from the Kuwait Civil Services Commission. This 2019 cross-section provides anonymized individual-level information on civil service employees in Kuwait. Variables include age, tenure, salary, gender, nationality, and education level attained. Categorical values of variables in Arabic are computer-translated to English. The data set is unique, and it is ideal for the analysis for two reasons: (i) the size of the data set is bigger than most household or labor force surveys and large enough to carry out very disaggregate analysis; (ii) the wage information in this data set is more accurate than wage data collected by most household or labor force surveys.[8]

[8] Wage data in household and labor force surveys are often underreported and suffer from measurement errors.

The data set contains 341,522 individuals who were members of the Kuwaiti civil service in June/July 2019. As part of initial data-cleaning, we exclude around 8,000 observations because of perfect duplicates, individuals with non-standardized descriptions of education, and unrealistic ages. We also exclude around 70,000 observations that contain information for non-Kuwaiti citizens. Keeping these entries would likely bias our estimates because we do not know in which country the non-Kuwaitis studied and whether the Gulf War impacted them. [9] [10] The data-cleaning leaves our analysis with 262,771 observations of Kuwaiti nationals, representing about 64 percent of all Kuwaiti workers in Kuwait. [11]

The size and scale of the data is noteworthy; however, the data includes only public sector workers, which limits the interpretation of our results below. It would be unwise to generalize the results of the analysis, for example with respect to returns to schooling in the private sector. Given the large size and the extent to which the public sector affects salaries of Kuwaiti nationals, public sector workers might often be unable to find equivalent salaries in the private sector. The two

[9] One can make similar objections for those listed as Kuwaiti nationals. Some may have been living outside Kuwait before the Gulf War, and their lives might have been disrupted only minimally by the war. Although we do not have the exact number of such nationals, and as there are likely very few, the absence of the information would be unlikely to substantially bias the results.

[10] One might object to not utilizing the non-Kuwaiti segment of the data as it might serve as a control group when analyzing the Gulf War's impact. While it is true that the schooling of many non-Kuwaitis was likely unaffected by the war, they also represent a heterogeneous population that might substantially differ from Kuwaitis. An interpretation of a comparison of the two might then be difficult because the differences might not amount to the effects of the war but rather to the underlying differences between Kuwaitis and non-Kuwaitis.

[11] There were 408,205 employed Kuwaitis in Kuwait in December 2019, of which 344,937 were working in the public sector according to PACI (2019). Keeping in mind that our data was collected about 6 months earlier than PACI's, the data covers approximately 76% of all Kuwaiti public sector workers and 64% of all Kuwaiti workers. Note that the data we use does not represent all public sector employees as the Civil Services Commission does not hire all public sector workers in Kuwait.

sectors then likely have two different returns to schooling, making generalizations based on results from the public sector ill-advised.[12]

4.1 Validity of the Gulf War as an instrument

We use the data to estimate the private returns to schooling of Kuwaitis working in the civil service. Such estimation commonly faces a potential omitted variable bias; this means that estimates of returns to schooling are almost always carried out without including variables such as the individual ability. This omission can bias the returns to schooling estimate because schooling and ability are likely strongly correlated.

To overcome the omitted variable bias, we exploit an experiment-like event, or instrument, that changed the amount of schooling attained by individuals but that was uncorrelated with other omitted variables. The Gulf War is a suitable candidate for such an experiment and hence a suitable instrument because it profoundly affected Kuwaiti students' schooling at the time. The war is further unlikely correlated with many potentially problematic omitted variables, such as students' ability.

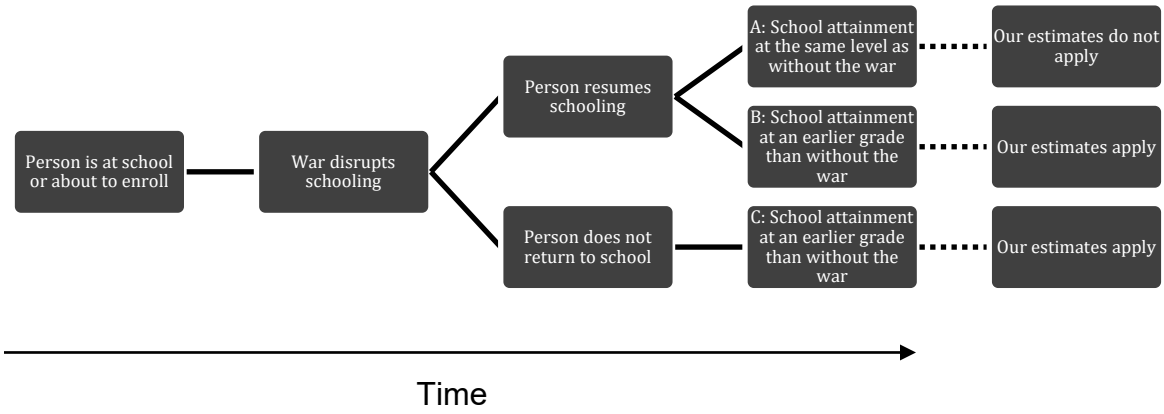
One of the difficulties of this type of analysis is the likely heterogeneity of private returns to schooling across students (Ichino and Wither-Ember 2004: 70). The heterogeneity affects the

[12] Public and private sectors are connected through a wage arbitrage; however, public sector compensations have the "upper hand" here. The public sector's appealing compensations and a tendency to employ the excess supply of Kuwaiti nationals, both discussed earlier, have the tendency to function as a price floor for the private sector. The floor's mechanism then tends to distance a Kuwaiti national's public sector salary from the corresponding marginal product of labor and wage that this person would make in the private sector.

interpretability of results, but our instrumental variable estimates allow us to follow the local average treatment effect (LATE) interpretation as proposed by Imbens and Angrist (1994), Angrist and Pischke (2008: ch. 4), and that Ichino and Wither-Ember (2004) use in a setting similar to ours. Under this interpretation, the estimated schooling coefficient represents the average private returns to an additional year of schooling of those students that ended up with less schooling because of the war. Figure 3 illustrates the limited applicability of the results. Our estimates of private returns to schooling do not apply in case A, when schooling was unaffected by the war, but they do apply to cases B and C.[13]

[13] For example, one can imagine a setting with two students, A and B. Let's say that without a war, student A would achieve 16 years of schooling and student B 18 years. Assume further that with the war, student B ends up with 14 years of schooling, and A still ends up with the same 16 years. In this case, a LATE approach allows estimating only private returns to the schooling of student B—a student whose outcome changes because of the war.

Figure 3: The LATE interpretation implies that estimates of private returns to schooling apply only to people whose schooling decreased because of the war (students B and C)



To interpret our results as a LATE, however, we must meet four assumptions: independence, exclusion restriction, first-stage, and monotonicity (Angrist and Pischke 2008: ch.4).[14]

The independence assumption means that the instrument is as if it was random with respect to the outcomes and treatment assignment. Our instrument identifies whether someone was of schooling age during the war or not, which for our purposes means the person was between 5.5 and 27.5 years old because it includes all levels of schooling. In this case, the independence assumption would be invalid if one's belonging to the war-time schooling age group was changed by anticipation of: (i) the war or (ii) future income. In other words, parents would have to change their child's birth in anticipation of (i) or (ii), thereby changing the child's schooling timeline. As each of the two anticipations would require unrealistic predictive abilities,

[14] The following discussion of the assumptions adopts Angrist and Pischke (2008: ch.4).

the independence assumption likely holds.

The exclusion restriction assumption means that the instrument affects the outcome variable through a single channel. Our instrument, which distinguishes people of certain birthdates, should then affect people's incomes only through its effect on their years of schooling. We find two possible problems with the assumption in our context.

First, the assumption implies that the war impacts the earnings of those who were of schooling age during the war only through their years of schooling. One can certainly think of a counterexample: the physical and psychological damage of the war could have impacted incomes through channels other than schooling. On this issue, we follow Ichino and Wither-Ember (2004: 75), who argue that such other effects are likely unimportant in the long run after a war.[15]

Second, the instrument might be capturing effects other than those of the war. The most important candidate is in this regard a secular growth of average years of schooling. When using the instrument, we compare people who were of schooling age during the war and people who reached schooling age only after the war. With the secular growth in schooling, the difference in average years of schooling between the two groups would have been caused not only by the war itself. The younger people would have more schooling also because of better access to schooling or its higher desirability in their age group. Unfortunately, given the available data, it is impossible to distinguish between the secular trend in years of schooling and the effect of the war.

To support the validity of the exclusion restriction for our instrument, one can argue that,

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[15] Kesternich et al. (2014) find negative long-term physical and psychological health effects in people exposed to World War II. One can still argue, however, that these effects did not have substantial consequences on long-run labor market outcomes.

given our historical narrative, it is reasonable to conclude that the war was a once-in-a-lifetime event with overwhelming influence over anything else happening in Kuwait at the time. Other events may have impacted people's years of schooling; however, the importance of such events, including that of the trend, was relatively small. In an alternative defense of the exclusion restriction validity, one can focus on the disaggregate version of our results and view them with varying confidence, depending on the age of the war-affected treatment group. One can argue that the potential effect of a secular trend in average years of schooling is smaller for the younger students affected by the war: these students will be closer in age, and likely more similar, to the people in the control group who enrolled only after the war. Correspondingly, one can view the computed private returns to schooling for the younger students with relatively higher confidence.

The first-stage assumption states the existence of the first-stage in the two-stage least squares estimation. In our case this means that being of schooling age during the war tends to affect people's years of schooling. Table 4 suggests this might be the case, reporting a highly statistically significant negative correlation between the two. In addition, Stock and Yogo tests that we report with our two-stage least squares estimates reject the hypothesis of weak instruments.

The monotonicity assumption means that the instrument affects all people in the same direction, or monotonically. Translated into our setting, if being of schooling age during the war affects one's years of schooling, the effect can only be negative. This is not a testable assumption; however, the historical narrative makes a case for its reasonability. The Gulf War, no doubt, was disruptive to Kuwaitis' schooling at all schooling levels, decreasing schooling opportunities and making it more difficult to reach one's full schooling potential.

4.2 The data in light of demographic and educational parameters

This section focuses of the data in light of Kuwait's educational and demographic parameters. First, we use the design of the education system to generate a variable for years of schooling. Second, we use the retirement rules to eliminate observations that would likely bias our results.

We use Table 2 to assign to each current employee an approximate school grade at the time of the Gulf War. This mapping reflects the earlier discussion of Kuwait's education system, particularly that children have to be at least five-and-a-half-years-old at the beginning of the school year (September 15), to enroll in first grade, and that the school system at the time was still "4-4-4."[16]

Table 2: Gulf War (GW) education-level age groups in Kuwait

Group in 1990	Oldest born on Mar-16	Youngest born on Mar-15	Age on Sep-15-1990 (years)	Age on Sep-15-2019 (years)
Enrolled after GW	1985	--	Less than 5.5	Less than 34.5
Elementary school	1981	1985	<5.5, 9.5>	<34.5, 38.5>
Middle school	1977	1981	<9.5, 13.5>	<38.5, 42.5>
High school	1973	1977	<13.5, 17.5>	<42.5, 46.5>
College	1969	1973	<17.5, 21.5>	<46.5, 50.5>
Graduate school	1963	1969	<21.5, 27.5>	<50.5, 56.5>
Working age	--	1963	Older than 27.5	Older than 56.5

Source: Authors' calculations
Note: Sep-15 is traditionally the first day of school

In the next step, we use Kuwait's retirement system rules to identify age groups we can

[16]Four years for primary school, four years for middle school, and four years for high school.

analyze. We exclude observations for groups that had already reached retirement age when the data was collected. Some people in these groups could be retired, thereby possibly distorting the average schooling achievement for the groups: specifically, these are women born before 1971 and men born before 1966, see Appendix 2.

Next, we identify each person's years of schooling, using the education level and the corresponding table in Appendix 1. Unfortunately, we do not have the individual-level information on lost schooling during the war and cannot account for it. When counting the years of schooling, we therefore take the achieved education levels at their face values.[17] Table 3 presents the new variable for the years of schooling and gives an overall sense of the schooling that may have been lost because of the war.

Utilizing the computed years of schooling, the group born between March 16, 1963 and March 15, 1985 is the starting point in identifying our treatment group as it represents those who were most likely to be at school during the war. We identify the group only by people's age, which means that not all people in the group—in fact—were at school. They were just more likely to do so given their age at the time. Within the group, we then highlight the subgroups not affected by the minimum retirement age. The treatment group for women then includes those born between

[17] In other words, we do not subtract the schooling time missed during the Gulf War from one's overall years of schooling. For example, if a person finished high school and had one year off during the war, we still count it as 12 years of education—the same as any high school graduate—and not 12 years minus the time lost. We would subtract the missed time in an ideal case, but we do not have enough individual-level information. For example, if someone is a high school graduate and studied during the war, it can mean two things. First, he could have missed schooling because of the war. Second, he could have been studying abroad during the war, enrolling in a private school after the war, missing no schooling, and having 12 years of education. Unfortunately, we do not know which of the two applies in the case of a particular person. In other words, the lost schooling that we estimate in the paper is happening only after the war.

January 01, 1971 and March 15, 1985. The corresponding group for men includes those born between January 1, 1966 and March 15, 1985.

We identify the group born between March 16, 1985 and March 15, 1992 as the most appropriate comparison group to those with schooling affected by the war. We exclude those born after March 15, 1992 as they may not have completed their education before the data was collected.[18] Comparing the war-affected group not subject to retirement and the control group suggests a possible effect of the war-induced schooling when comparing average years of schooling of the two. Men born between January 1, 1966 and March 15, 1985 completed an average of 0.61 year less schooling than those born between March 16, 1985 and March 15, 1992. Women born between January 1, 1971 and March 15, 1985 completed an average of 0.59 year less schooling than those born between March 16, 1985 and March 15, 1992.[19]

[18] Someone born on March 16, 1992 likely enrolled in first grade in September 1997, at the age of 5 and a half. If this person eventually decided to get a PhD, the person would have graduated in 2019, after 22 years of schooling that we assume it to take in Appendix 1. It seems possible but not likely that under such circumstances, the person would be already hired by the civil service and thereby reflected in our data set from June/July 2019. All the people younger than March 16, 1992 are even less likely to have graduated, and therefore less likely to be included in our data set of active civil service employees, skewing the average years of schooling for the younger group downward.

[19] Using data from Table 3 for men: 13.38−13.99 = −0.61. Using the same source for women: 14.18−14.77 = −0.59.

Table 3: Kuwaiti civil servants' average years of schooling by birthyear and gender

Group born	Male (# observations)	Female (# observations)
Before Mar/16/1963	15.44 years (1,678 obs.)	14.22 years (1,668 obs.)
Mar/16/1963–Dec/31/1965	14.18 years (1,680 obs.)	--
Mar/16/1963–Dec/31/1970	--	13.61 years (11,267 obs.)
Jan/01/1966–Mar/15/1985	13.38 (49,540 obs.)	--
Jan/01/1971–Mar/15/1985	--	14.18 years (71,617 obs.)
Mar/16/1985–Mar/15/1992	13.99 (29,837 obs.)	14.77 years (52,288 obs.)
Mar/16/1992 and later	14.04 (15,190 obs.)	15.1 years (28,005 obs.)

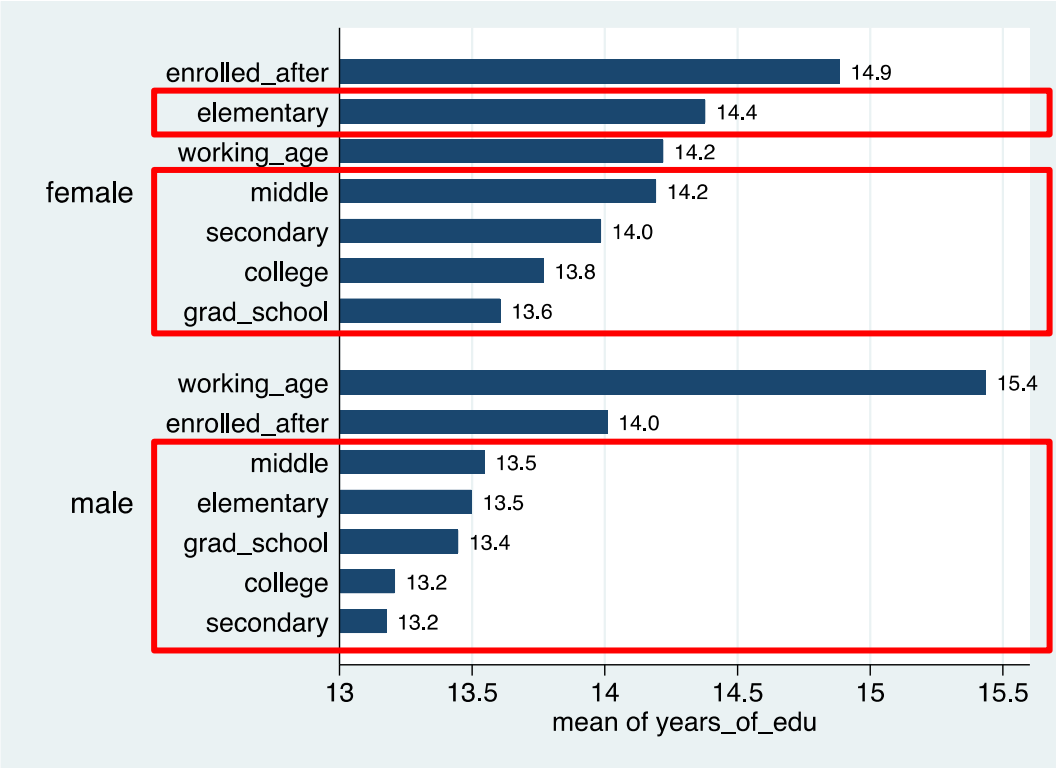
Source: Kuwait Civil Services Commission 2019, authors' calculations

Notes: People born between March 16, 1963 and March 15, 1985 are assumed to have been at school during the war, and their education disrupted.

The table reflects male and female treatment groups that are not subject to retirement. The treatment group for women represents those born between January 01, 1971 and March 15, 1985. The group for men represents those born between January 1, 1966 and March 15, 1985.

To complement Table 3, we present years of schooling in a more disaggregated way also in graphs. Figure 4 shows the average years of schooling for corresponding schooling groups.

Figure 4: Kuwaiti civil servants' average years of schooling in 2019, grouped by their estimated education group in 1990



Source: Kuwait Civil Services Commission 2019, authors' calculations

Notes: "working_age": people who were of working age during the war, "enrolled_after" people of school age only after the war, "elementary", "middle", "secondary", "college," and "grad_school" refers to the level of education in which respective age groups may have been enrolled during the war.

The red rectangles indicate groups of people that may have been planning to be at school during the war.

We estimate an OLS regression of the data represented in Figure 4 with years of schooling as the dependent variable and independent categorical variables representing the various schooling groups. The results in Table 4 confirm that the average years of schooling differ significantly between students who enrolled after the Gulf War and those of schooling age during the war.

Table 4: OLS estimates of cohorts' average years of schooling by gender (base=enrolled after the Gulf War)

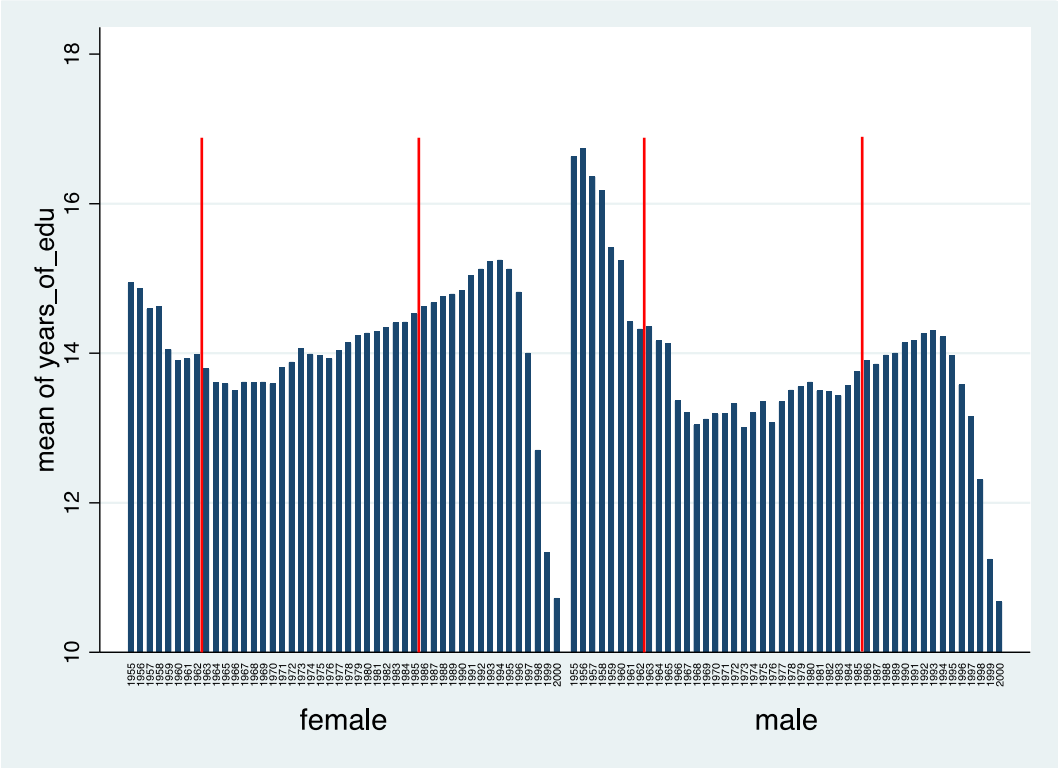
	(1)	(2)	(3)	(4)
	Women (full sample)	Women (control & treatment)	Men (full sample)	Men (control & treatment)
Elementary school	-0.507***	-0.393***	-0.511***	-0.496***
	(0.0176)	(0.0187)	(0.0316)	(0.0345)
Middle school	-0.692***	-0.578***	-0.463***	-0.448***
	(0.0189)	(0.0199)	(0.0337)	(0.0366)
Secondary school	-0.899***	-0.786***	-0.833***	-0.818***
	(0.0211)	(0.0219)	(0.0362)	(0.0390)
College	-1.116***	-0.899***	-0.800***	-0.785***
	(0.0256)	(0.0325)	(0.0400)	(0.0427)
Graduate school	-1.278***		-0.562***	-0.816***
	(0.0308)		(0.0445)	(0.0539)
Working age	-0.665***		1.426***	
	(0.0615)		(0.0821)	
Enrolled after	Base	Base	Base	Base
Constant	14.89***	14.77***	14.01***	13.99***
	(0.00877)	(0.0108)	(0.0156)	(0.0197)
Observations	164845	123905	97925	79377
R-squared	0.0289	0.0165	0.0142	0.00939
F-statistic	816.9	521.1	234.9	150.5

Notes: Standard errors are in parentheses.
Full sample regressions (1) and (3) includes all Kuwaiti observations for the given gender. Regression (2) includes observations for women born between January 01, 1971 and March 15, 1992. Regression (4) includes observations for men born between January 1, 1966 and March 15, 1992.
Dependent variable is years of schooling, independent variables are categorical.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The estimates in Table 4 and the information in Figure 4 point to two further insights. First, unlike men, women's working age group is qualitatively similar to the groups studying during the Gulf War. This likely results from the policy and cultural changes, that have made female education more accessible over time. Second, the average years of schooling of the working age

male group are substantially above all the other groups. Figure 5 shows that these results are driven by older males, suggesting the average years of schooling might be biased by the retirement of older and less educated male workers. This is plausible, given the Kuwaiti civil service retirement policies we discussed above. These two insights support our decision to exclude from the further analysis those people who finished their schooling before the Gulf War. The difference in years of schooling between this older group and younger groups is likely driven by causes other than exposure to the Gulf War. Since our analysis builds on the primary causal importance of the Gulf War in causing such differences, the inclusion of the older groups is not suitable for the analysis.

Figure 5: Kuwaiti civil servants' average years of schooling. Grouped by year of birth (1955-2000)



Source: Kuwait Civil Services Commission 2019, authors' calculations

Note: The area between the two red lines approximates students of schooling age during the war

Figure 5 also supports our decision to exclude people who are too young from the analysis. Male and female birthyear cohorts born after mid-1990s have declining average years of schooling, suggesting some members of these younger cohorts are yet to get more schooling. In other words, some of the prospective employees in the younger cohorts are still at school and will become Kuwaiti civil servants only in the future.

5. Results

We divide our results into five parts, progressively addressing the question of the effect of educational attainment on labor market outcomes in more detail. First, we run Mincer-style OLS regressions to get a benchmark for the remaining results. Second, we estimate the private returns to a year of schooling using an instrumental variables technique, with the Gulf War as the instrument. Third and fourth, we estimate private returns to a year of schooling for war-induced schooling shocks at different education stages and grades. Lastly, we provide robustness checks.

5.1 OLS results

We follow a standard earnings function—or Mincerian—method of estimating returns to education, dating back to Mincer (1974) and more recently discussed by Patrinos and Psacharopoulos (2020: 55). Our dependent variable of interest is the natural logarithm of net

take-home monthly compensation, $ln(NetW_i)$.[20] We estimate Mincer-style OLS regressions for men and women separately because, as we discussed earlier, men and women in the civil service face different reward structures. In addition to the standard variables included in Mincerian regressions such as: (i) years of schooling ($School_i$), (ii) years of service (Exp_i),[21] and (iii) squared years of service (Exp_i^2); we also include the number of children for which employees receive benefits included in their compensation ($Child_{ij}$),[22] and the marital status for men ($Married_i$). We also include a categorical variable to distinguish between people who were of schooling age during the war (δ=1) and the remaining observations (δ=0).

The first regression in each of the two sets comprises the full data set of Kuwaiti civil service employees of the given gender, including the potentially biased age groups we drop in the instrumental variable analysis. The remaining five regressions provide a sense of the subsets of the data that we later use for a more detailed analysis of the impact based on the various education levels. We estimate each of the five regressions on the subset of students born between March 16,1985 and March 15, 1992, who were too young to be at school during the Gulf War, combined with one of the five groups of people who were of schooling age during the war and did not reach the minimum retirement age when the data was collected: elementary school, middle school, high school, college, post-graduate (only for males). The exercise allows us to

[20] While Kuwait does not impose income taxes, employees are subject to a social security deduction. The net wages are gross wages minus the deduction.
[21] Years of service are measured as years of work for Kuwait's civil service.
[22] This means that the number of children is nonzero only when the person receives children benefits. Since the benefits are usually collected by men on behalf of the family, most women have number of children listed as zero.

assess whether the five groups show substantive differences in the average relationship between the measured years of schooling and compensation. The respective regression models we use for women (model 1) and men (model 2) reflect the gender differences in compensation as discussed above. Model 2 therefore includes a marriage dummy because married men receive additional payment with their salaries.

$$\ln(NetW_i) = \alpha + \beta_1 \delta School_i + \beta_2 Exp_i + \beta_3 Exp_i^2 + \sum_{j=1}^{n} \gamma_j \, Child_{ij} + \varepsilon_i \qquad (1)$$

$$\ln(NetW_i) = \alpha + \beta_1 \delta School_i + \beta_2 Exp_i + \beta_3 Exp_i^2 + \beta_4 Married_i + \sum_{j=1}^{n} \gamma_j \, Child_{ij} + v_i \qquad (2)$$

The results below suggest a relative consistency across the groups for each gender, as can be seen from the coefficients of the "years of education" variable for the respective Gulf War groups (1) and the non-Gulf War group (0). The consistency indicates that the compensation for years of schooling is similar across the groups, allowing for analysis based on comparisons across the groups.

Table 5: OLS Mincer regressions: Full sample and by segments of female Kuwait civil service employees

	(1)	(2)	(3)	(4)	(5)
	Full sample	Elementary school	Middle school	Secondary school	College
Schooling age GW=0 # Years of schooling	0.0859***	0.0956***	0.0933***	0.0906***	0.0932***
	(0.000330)	(0.000509)	(0.000511)	(0.000540)	(0.000647)
Schooling age GW=1 # Years of schooling	0.0884***	0.0960***	0.0949***	0.0939***	0.0976***
	(0.000351)	(0.000542)	(0.000552)	(0.000613)	(0.000798)

Years of service	0.0149***	0.0101***	0.00943***	0.0134***	0.0165***
	(0.000388)	(0.000632)	(0.000624)	(0.000550)	(0.000595)
Years of service squared	0.000341***	0.000629***	0.000616***	0.000376***	0.000279***
	(0.0000151)	(0.0000365)	(0.0000326)	(0.0000256)	(0.0000298)
Constant	5.523***	5.397***	5.437***	5.465***	5.409***
	(0.00517)	(0.00818)	(0.00806)	(0.00836)	(0.00997)
Controlling for number of children	Yes	Yes	Yes	Yes	Yes
Observations	164845	78684	74181	69117	58787
R-squared	0.658	0.564	0.588	0.614	0.591
R-squared adj	0.657	0.564	0.588	0.614	0.591

Notes: Robust standard errors are in parentheses.
Dependent variable is the natural log of net wages.
Schooling age GW=1 indicates people of schooling age in the fall 1990.
Number of children is nonzero only when the person receives children benefits (much more common for men).
Each of the regressions on the subset of students includes those born between March 16,1985 and March 15, 1992, combined with one of the groups of people who were of schooling age during the war.
* p < 0.05, ** p < 0.01, *** p < 0.001

Table 6: OLS Mincer regressions: Full sample and by segments of male Kuwait civil service employees

	(1)	(2)	(3)	(4)	(5)	(6)
	Full sample	Elementary school	Middle school	Secondary school	College	Graduate school
Schooling age GW=0 # Years of schooling	0.0661***	0.0633***	0.0646***	0.0646***	0.0643***	0.0636***
	(0.000271)	(0.000364)	(0.000373)	(0.000402)	(0.000420)	(0.000457)
Schooling age GW=1 # Years of schooling	0.0660***	0.0625***	0.0634***	0.0639***	0.0665***	0.0687***
	(0.000267)	(0.000399)	(0.000419)	(0.000519)	(0.000583)	(0.000760)
Years of service	0.0250***	0.0119***	0.0166***	0.0225***	0.0267***	0.0304***
	(0.000386)	(0.000757)	(0.000675)	(0.000691)	(0.000647)	(0.000657)

Years of service squared	-0.000086***	0.000694***	0.000356***	-0.0000400	-0.000216***	-0.000303***
	(0.0000111)	(0.0000370)	(0.0000291)	(0.0000270)	(0.0000227)	(0.0000228)
Constant	5.905***	5.989***	5.958***	5.941***	5.930***	5.922***
	(0.00446)	(0.00655)	(0.00650)	(0.00704)	(0.00713)	(0.00756)
Controlling for number of children	Yes	Yes	Yes	Yes	Yes	Yes
Controlling for the marital status	Yes	Yes	Yes	Yes	Yes	Yes
Observations	97925	44277	42025	40090	37892	34441
R-squared	0.651	0.538	0.576	0.574	0.590	0.577
R-squared adj	0.651	0.537	0.576	0.574	0.589	0.577

Notes: Robust standard errors are in parentheses.
Dependent variable is the natural log of net wages.
Schooling age GW=1 indicates people of schooling age in the fall 1990.
Number of children is nonzero only when the person receives children benefits (much more common for men).
Each of the regressions on the subset of students includes those born between March 16,1985 and March 15, 1992, combined with one of the groups of people who were of schooling age during the war.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The estimates of private returns to a year of schooling indicate that one additional year of schooling corresponds to an increase in female net take-home compensation by 8.6–9.8 percent and to an increase in male net take-home compensation by 6.3–6.9 percent, depending on the subset of civil service employees. Besides the relative stability of each gender's coefficient of years of schooling, it is also noteworthy that the estimates of private returns to a year of schooling are higher for women than men—consistent with the previous estimates for Kuwait by Hosni and Al-Qudsi (1988) and Alqattan, Stergioulas, and Al-Zayer (2012) that follow similar

methodology. The result is also broadly consistent with Psacharopoulos and Patrinos' (2018) review of the literature on returns to education. They find that the global average private rate of return to schooling is about 9 percent, and that female private returns to education exceed male returns (452-3).

5.2 Using Gulf War exposure as the instrumental variable

We use the Gulf War indicator as our instrument for the two-stage least squares (2SLS) estimate of schooling's effect on Kuwaiti civil service compensation. We deploy the instrument in two ways, as well as separately for men and women. First, we instrument the years of education with a single instrumental variable, indicating whether the person was of schooling age during the Gulf War and has not reached minimum retirement age yet (birthdates January 1, 1966 to March 15, 1985 for men and January 1, 1971 to March 15, 1985 for women). Second, we use multiple instrumental variables for years of schooling, where each variable indicates a specific group of schooling grade levels during the war. The results below show that the choice of the more granular set of instruments does not substantively change the results.

Table 7: 2SLS estimates of returns to schooling, instrumented by schooling age during the Gulf War

	(1)	(2)	(3)	(4)
	Women (single instrument)	Women (multiple instruments)	Men (single instrument)	Men (multiple instruments)
Years of schooling	0.0683***	0.0680***	0.0504***	0.0564***
	(0.000974)	(0.000880)	(0.00237)	(0.00175)
Years of service	0.00985***	0.00989***	0.0201***	0.0202***
	(0.000463)	(0.000466)	(0.000404)	(0.000402)

Years of service squared	0.000655***	0.000654***	0.0000441***	0.0000343**
	(0.0000188)	(0.0000189)	(0.0000131)	(0.0000128)
Constant	5.800***	5.804***	6.149***	6.068***
	(0.0130)	(0.0117)	(0.0324)	(0.0240)
Controlling for number of children	Yes	Yes	Yes	Yes
Controlling for the marital status	No	No	Yes	Yes
Observations	123905	123905	79377	79377
R-squared	0.617	0.617	0.604	0.614
First stage instruments				
Of schooling age during the war	-1.602***		-1.046***	
	(0.0193)		(0 .0346)	
Of elementary school age during the war		1.905***		1.460***
		(0.0483)		(0 .0650753)
Of middle school age during the war		1.145***		1.238***
		(0. 0456)		(0 .063)
Of secondary school age during the war		0.428***		0.417***
		(0.0431)		(0.0605)
Enrolled after the war		3.0424***		2.231***
		(0.0501)		(0.0677)
Of college age during the war		Base		Base
Of graduate school age during the war				-0.474***
				(0.0768)

Post-estimation diagnostics				
Robust Durbin-Wu-Hausmann test	500.375***	650.781***	42.657***	28.6724***
Stock and Yogo test	6859.99	2041.73	913.804	314.881
Hansen-Sargan test		8.96587**		108.018***

Notes: Using the models from section 5.1, we estimate model (1) for women and model (2) for men, instrumenting for "Years of schooling."
Robust standard errors are in parentheses.
Dependent variable is the natural log of net wages.
Number of children is nonzero only when the person receives children benefits (much more common for men).
The single instrument regressions instrument the years of schooling with a single variable, indicating whether the person was of schooling age during the Gulf War. The multiple instrument regressions instrument years of schooling with multiple instruments indicating schooling grade levels during the war (Elementary school, Middle school, Secondary school, College, Graduate school)
Robust Durbin-Wu-Hausmann test is testing the null of exogeneity of the years of schooling variable.
Stock and Yogo test is testing the null hypothesis of weak instruments. The following critical values represent the maximum rejection rate of a Wald test at the 5% level. For regressions (1) and (3): 16.38 (10%), 8.96 (15%), 6.66 (20%), 5.53 (25%). For regression (2): 24.58 (10%), 13.96 (15%), 10.26 (20%), 8.31 (25%). For regression (4): 26.87 (10%), 15.09 (15%), 10.98 (20%), 8.84 (25%).
Hansen-Sargan test is testing the null hypothesis of validity of the overidentifying restriction.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results differ from the original OLS estimates for men and women, suggesting a possible omitted variable bias. The measured bias goes in the same direction for males and females, and the 2SLS estimates of the wage effects of an additional year of schooling for both are lower than their OLS counterparts. In other words, schooling attainment is positively correlated with ability (which is omitted) for both genders.

Post-estimation diagnostic tests suggest endogeneity of the years of schooling variable (Robust Durbin-Wu-Hausmann test) and reject the hypothesis of our instruments' weakness

(Stock and Yogo test), thereby giving credibility to our methodological approach. The Hansen-Sargan tests also indicate that our multi-instrument models for males and females are overidentified. One explanation could be that the loss of an academic year of education has heterogeneous effects on students across grade levels during the war. We show how this is the case in the following subsection.

5.3 Using Gulf War exposure as the instrumental variable: Disaggregating by education levels

We explore the heterogeneity of the wage effects of an additional year of schooling. We run five 2SLS estimations on the subset of students who were too young to study during the invasion (born between March 16, 1985 and March 15, 1992), combined with one of the five groups of people who were of schooling age during the war—elementary school, middle school, high school, college, post-graduate (men only). Again, we select the people in the five groups to avoid the bias resulting from retirement rules, keeping only men born between January 1, 1966 and March 15, 1985, and women born between January 1, 1971 and March 15, 1985. The age restriction means there are no remaining observations for women in the post-graduate schooling group. In each of the resulting estimations, we use only one instrument indicating whether a person belongs to a Gulf War schooling cohort or not.

The estimated years of schooling coefficients confirm the heterogeneity in the case of men and women and do so with a strikingly similar pattern. The groups affected by the Gulf War in the earlier stage of their education, such as elementary school and middle school, tend to have higher private returns to schooling. We interpret the results using the LATE framework, which acknowledges the increased likelihood of the heterogeneous effect of schooling on wages even

within each group. Given the heterogeneity, the estimated schooling coefficient represents the average wage effect to an additional year of schooling of those students that lost schooling because of the war. In other words, students who lost schooling because they experienced the war early on in their studies fared, on average, worse than older students in terms of their labor market outcome. To put things differently, our results suggest the younger students who lost schooling because of the war, would have benefited from an additional year of schooling more in terms of the additional income. In case of men, the younger-older divide is looser when compared to women, because the estimated private returns to schooling peak in the middle school.[23] Table 10 summarizes the percentage income losses from a lost year of schooling for Gulf War schooling groups as we estimate them in Table 8 and Table 9.

Table 8: 2SLS estimates of returns to schooling for females, by Gulf War schooling groups

	(1)	(2)	(3)	(4)
	Elementary school	Middle school	Secondary school	College
Years of schooling	0.0858***	0.0745***	0.0655***	0.0645***
	(0.00183)	(0.00161)	(0.00130)	(0.00176)
Years of service	0.0104***	0.0113***	0.0160***	0.0183***
	(0.000638)	(0.000688)	(0.000603)	(0.000612)
Years of service squared	0.000677***	0.000634***	0.000415***	0.000360***
	(0.0000347)	(0.0000321)	(0.0000247)	(0.0000249)
Constant	5.537***	5.700***	5.813***	5.815***

[23] Again, all post-estimation diagnostic tests reject the exogeneity of the years of education variable and reject the hypothesis of our instruments' weakness, thereby giving credibility to our methodological approach.

	(0.0258)	(0.0222)	(0.0179)	(0.0246)
Controlling for number of children	Yes	Yes	Yes	Yes
Observations	78684	74181	69117	58787
R-squared	0.560	0.572	0.587	0.558
First stage instruments				
Of schooling age during the war	-1.043***	-1.667***	-2.512***	-2.968***
	(0.0222)	(0.0349)	(0.0457)	(0.0724)
Post-estimation diagnostics				
Robust Durbin-Wu-Hausmann test	28.9774***	147.574***	403.092***	257.152***
Stock and Yogo test	2206.26	2280.44	3019.71	1682.47

Notes: Using the models from section 5.1, we estimate model (1), instrumenting for "Years of schooling."
Robust standard errors are in parentheses.
Dependent variable is the natural log of net wages.
Number of children is nonzero only when the person receives children benefits (much more common for men).
Each of the regressions includes those born between March 16,1985 and March 15, 1992, combined with one of the groups of people who were of schooling age during the war.
Each regression instruments the years of schooling with a single variable, indicating whether or not the person was of schooling grade level during the war (Elementary school, Middle school, Secondary school, College)
Robust Durbin-Wu-Hausmann test is testing the null of exogeneity of the years of schooling variable.
Stock and Yogo test is testing the null hypothesis of weak instruments. The following critical values represent the maximum rejection rate of a Wald test at the 5% level: 16.38 (10%), 8.96 (15%), 6.66 (20%), 5.53 (25%).
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: 2SLS estimates of returns to schooling for males, by Gulf War schooling groups

	(1)	(2)	(3)	(4)	(5)
	Elementary school	Middle school	Secondary school	College	Graduate school

Years of schooling	0.0876***	0.0941***	0.0733***	0.0545***	0.0280***
	(0.00600)	(0.00553)	(0.00314)	(0.00331)	(0.00585)
Years of service	0.0172***	0.0209***	0.0234***	0.0260***	0.0287***
	(0.00153)	(0.00111)	(0.000764)	(0.000676)	(0.000722)
Years of service squared	0.000385***	0.000104*	-0.0000913**	-0.000157***	-0.000186***
	(0.0000797)	(0.0000518)	(0.0000289)	(0.0000223)	(0.0000215)
Constant	5.631***	5.532***	5.816***	6.069***	6.427***
	(0.0882)	(0.0802)	(0.0451)	(0.0473)	(0.0830)
Controlling for number of children	Yes	Yes	Yes	Yes	Yes
Controlling for the marital status	Yes	Yes	Yes	Yes	Yes
Observations	44277	42025	40090	37892	34441
R-squared	0.495	0.517	0.568	0.582	0.495
First stage instruments					
Of schooling age during the war	-0.5169***	-0.7561***	-1.686***	-2.033***	-1.818***
	(0.040)	(0.0561)	(0.0792)	(0.0990)	(0.137)
Post-estimation diagnostics					
Robust Durbin-Wu-Hausmann test	18.7306***	34.8082***	8.28516***	10.1253***	51.702***
Stock and Yogo test	170.668	181.935	453.899	421.285	176.872

Notes: Using the models from section 5.1, we estimate model (2), instrumenting for "Years of schooling."
Robust standard errors are in parentheses.
Dependent variable is the natural log of net wages.

Number of children is nonzero only when the person receives children benefits (much more common for men).
Each of the regressions includes those born between March 16,1985 and March 15, 1992, combined with one of the groups of people who were of schooling age during the war.
Each regression instruments the years of schooling with a single variable, indicating whether or not the person was of schooling grade level during the war (Elementary school, Middle school, Secondary school, College, Graduate school)
Robust Durbin-Wu-Hausmann test is testing the null of exogeneity of the years of schooling variable.
Stock and Yogo test is testing the null hypothesis of weak instruments. The following critical values represent the maximum rejection rate of a Wald test at the 5% level: 16.38 (10%), 8.96 (15%), 6.66 (20%), 5.53 (25%).
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: How estimates of private returns to schooling translate into a loss of income

	Gulf War schooling group	**Lost year of schooling leads to a salary decrease by**
Men	Elementary school	8.8%
	Middle school	9.4%
	Secondary school	7.3%
	College	5.5%
	Graduate School	2.8%
Women	Elementary school	8.6%
	Middle school	7.5%
	Secondary school	6.6%
	College	6.5%

5.4 Using Gulf War exposure as the instrumental variable: Disaggregating by individual grades

The results in the previous section suggest a relationship between private returns to schooling and the timing of the shock regarding one's stage of schooling. This raises the question of whether the results are merely artifacts of grouping students into particular stages or whether the heterogeneity we found holds more generally. To explore the heterogeneity, we revisit the

analysis from the previous section grade by grade. As before with the schooling stages, we use our understanding of the Kuwaiti schooling system to map each person's grade during the Gulf War according to the person's age. We then do 2SLS estimations on the subset of students who were too young to study during the invasion combined with one of the identified grades; we repeat the process for each grade. Again, we use only one instrument, indicating whether a person belongs to a Gulf War schooling cohort or not. Given the large number of resulting grade-by-grade estimates of private returns to schooling, all of which are significant at the 1 percent level, we plot the value of the coefficient for the years of schooling in Figure 6.

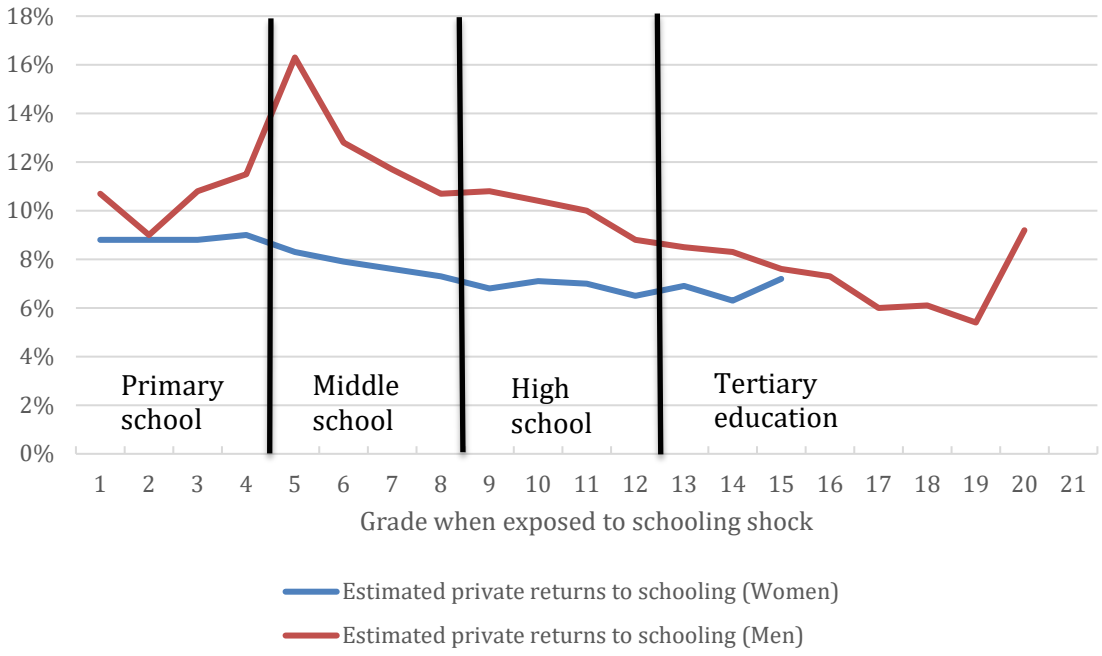
The results are generally consistent with the previous analysis: a lost year of schooling among people who faced the shock in elementary and middle school leads to proportionately lower earnings outcomes. Or put differently, because the war caused people of all grades to study fewer years on average, higher private returns to schooling translate into a stronger percentage decrease in income. The results for women display an almost perfect monotonic pattern in this regard, and men show a similar pattern from grade five onwards. We do not have an explanation for the fifth-grade spike and can only speculate about the reasons.[24] The finding, however, opens opportunities for further research on the matter.

There are also noticeable spikes at the end of the two graphs, corresponding to women's grade 15 (third year of college) and men's grade 20 (second year of Ph.D. studies). Both spikes are by-products of slicing the data to remove the age groups that may have partly retired. The cutoff

[24] For example, it is possible that the war somehow dissuaded particularly productive fifth grader males from studying as many years as they would have otherwise.

points for both genders exclude some of the observations of women's grade 15 and men's grade 20. When we added the observations back in, the spikes disappeared, indicating they are just epiphenomena.

Figure 6: Estimated private returns to a year of schooling by grade in which exposed to the schooling shock.



Notes: All estimates are 2SLS estimates of returns to schooling. Using the models from section 5.1, we estimate model (1) for women and model (2) for men, instrumenting for "Years of schooling."
The estimates represent the income decrease per one year of schooling lost due to the war.
All estimates significant at 1% level.

5.5 Using Gulf War exposure as the instrumental variable: Robustness checks

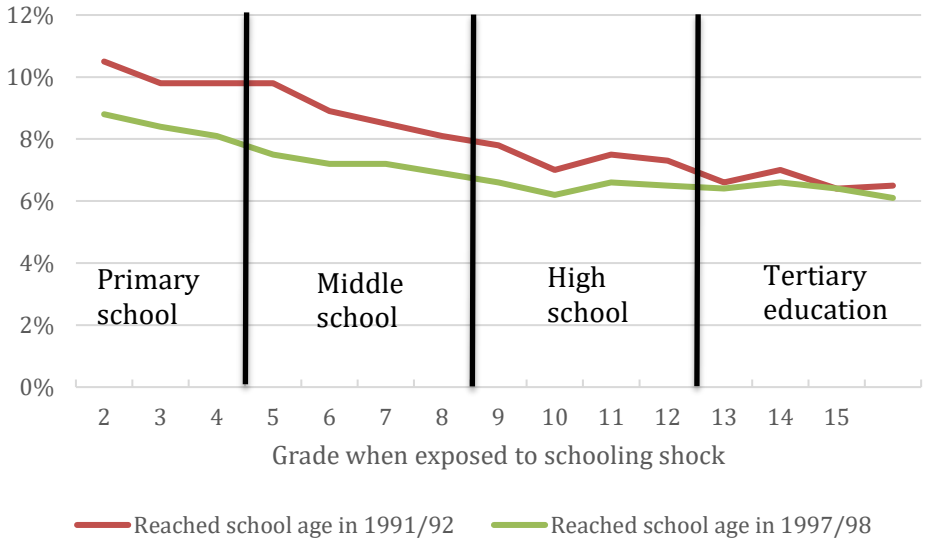
The previous two subsections suggest a pattern between private returns to schooling and the grade in which students experienced the Gulf War. Now we explore the robustness of the

pattern depending on the choice of the control group. The exploration builds on the previous subsection, which reports 2SLS estimates on the subset of students born between March 16, 1985 and March 15, 1992, the control group, combined with each of the war-affected grades individually. In the next step, we disaggregate the control group into seven control sub-groups by corresponding school grades. The oldest cohort represents students who were likely to enter first grade in 1991/92 and the youngest entering the first grade in 1997/98. We then conduct estimates analogously to the previous subsection. The disaggregation allows us to assess the importance of the age difference between war-affected schooling groups and the control group.

Given the numerous grade-by-grade estimates of private returns to schooling, we plot selected results and then report them all in Appendix 4. Figure 7 and Figure 8 present the estimates of two control group subsets for women and men. The two control group subsets, representing the oldest and the youngest, illustrate that choice of the control group matters. Namely, estimates using the older control group tend to have higher private returns to schooling: the line representing students who reached school age in 1991/92 tends to be positioned higher. The pattern is consistent with at least two plausible explanations. First, a war-induced disruption might have impacted the members of the control group, even though they were not at school at the time. A difference of the impact on the older and the younger members might then explain the pattern in Figure 7 and Figure 8. And second, it is also possible that the younger members of the control group are affected by a secular trend in average years of schooling that we cannot measure. This would, again, bias our results, increasingly so with a higher age difference between a chosen war-affected schooling sub-group and control sub-group.

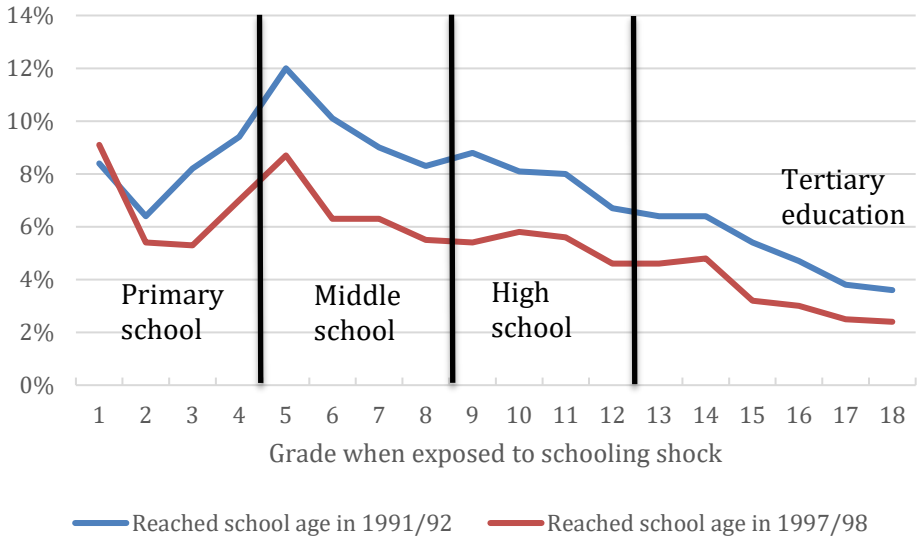
The results in this section lead to two conclusions. First, the validity of the estimated private returns to schooling for older war-affected students depends on the secular trend in average years of schooling. Second, we can establish intervals of point-estimates of private returns to schooling for students affected by the war in a lower grade. Even if present, the secular trend in schooling is less important because they are closer in age to the control sub-groups. The interval of point estimates of private returns to schooling of women exposed to the Gulf War shock in first grade is between 8.1 percent and 10.5 percent. The corresponding interval for men is between 8.4 percent and 12.4 percent. Both intervals are consistent with our earlier estimates of the returns to schooling for those affected by the war in elementary school.

Figure 7: Estimated private returns to a year of schooling of women. By grade in which exposed to the schooling shock and by control group.



Notes: All estimates are 2SLS estimates of returns to schooling. Using the models from section 5.1, we estimate model (1), instrumenting for "Years of schooling."
The estimates represent the income decrease per one year of schooling lost due to the war.
All estimates are significant at 1% level.

Figure 8: Estimated private returns to a year of schooling of men. By grade in which exposed to the schooling shock and by control group.



Notes: All estimates are 2SLS estimates of returns to schooling. Using the models from section 5.1, we estimate model (2), instrumenting for "Years of schooling."
The estimates represent the income decrease per one year of schooling lost due to the war.
All estimates are significant at least at 10% level.

6. Conclusion: The long-term effects of schooling disruptions and the current COVID-19 pandemic

We estimate in this paper the long-term impacts of schooling disruptions using high-quality civil service payroll data. The sample size of the data allows for almost a population-level analysis of Kuwaiti nationals' returns to schooling. Our methodology facilitated the study of the long-term effects of schooling disruptions at different stages of the education cycle. Most notably, we find that students who were in lower grades during the invasion tend to suffer a higher percentage wage loss for each lost year of schooling. This holds for women and from grade five onwards for men.

While the results are of interest on their own, they can also prove useful in the context of

recent efforts to assess the costs of disrupted schooling during the COVID-19 pandemic (e.g., Azevedo et al. 2020). When assessing a society-wide disruption like a pandemic, it seems appropriate to base one's estimates on a similar type of disruption. Although the natural experiment generated by the Gulf War is not identical to a pandemic, both involve significant society-wide political and economic disruptions. Assuming that the similarities between the two shocks are strong enough, one can use our LATE estimates to generate—at the very least—a qualitative assessment of students whose private returns to schooling are at highest risk. In the case of female students who lost schooling because of the shock, the greatest losses are generally felt by those who were in lower grades during the war. We observe the same pattern for male students from grade five onwards. Quantitative assessment, however, could also be useful, particularly when it comes to estimates pertaining to elementary school students during the war, which are likely more reliable as the students are closer in age to their control group. For example, male elementary school students lost an average of half a year of schooling, equivalent to an average annual loss almost 4.4 percent of their annual compensation as adults. The corresponding amount for female students was almost 3.4 percent.[25]

[25] Lost years of schooling are based on the estimates from section 4.1 (-0.393 years for females, -0.496 for males), private returns to schooling are retrieved from the estimate in section 5.3 (8.6% for females, 8.8% for males). We compute the loss by multiplying the lost years of schooling and the private returns to schooling.

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Appendix 1: How we mapped years of education to the achieved education level variable in the data set

Education achievement (Original)	Education achievement (English translation—computer translated)	Years of schooling (2004-05 reform)
دكتوراة	PhD	22
ماجستير	Master	18
دبلوم دراسات عليا سنتان بعد الجامعى	Postgraduate diploma two years after the university	18
دبلوم دراسات عليا سنة بعد الجامعى	Postgraduate diploma 1 year after university	17
جامعى	University	16
دبلوم	diploma	14
ثانوية بدورة سنتان فاكثر	High school + (2+) years of private sector training course	14+, counted as 14
ثانوية بدورة سنة	High school + 1 year of training course	13
ثانوية	High School	12
ثانوية بدورة قطاع خاص سنتان	High School + 2 years of private sector training course	14
ثانوية بدورة قطاع خاص سنة	High School + 1 year of private sector training course	13
متوسطة بدورة سنتان فأكثر	Middle School + (2+) years of training course	10+, counted as 10 (11+, counted as 11)
متوسطة بدورة سنة	Middle School + 1 year of training course	9 (10)
متوسطة بدورة قطاع خاص سنتان	Middle School + 2 years of private sector training course	10 (11)
متوسط	Middle School	8 (9)
متوسطة بدورة قطاع خاص سنة	Middle School + 1 year of private sector training course	9 (10)
ابتدائي بدورة سنة	Elementary + 1 year of training course	5 (6)
ابتدائي بدورة سنتان	Elementary + two years training course	6 (7)
ابتدائي بدورة قطاع خاص سنة	Elementary + 1 year private sector training course	5 (6)
ابتدائي	Elementary	4 (5)
بدون مؤهل بدورة قطاع خاص سنة	Without a qualification in a one-year private sector course	1
بدون مؤهل	Without qualification	0
تعليم موازي	Parallel education	NA
تأهيل مهني	Vocational rehabilitation	NA
مستوي تعليمي مطلوب تعريفة	Educational level undefined	NA

Notes: The mapping incorporates the school reform that was effective starting school year 2004-05 onwards, changing the distribution of years of education between primary, middle, and secondary school from 4-4-4 to 5-4-3 respectively. If there was a resulting change, it is reflected in the last column in bracket.
We cannot distinguish between programs awarding the same type of degree, and we, for example, have to treat one-year and two-year master's degrees as equivalent.
We do not adjust for the time of schooling lost during the war as the information is not available on an individual level.

Appendix 2: Minimum retirement age for Kuwaiti civil servants (conditional on fulfilling the minimum years of service for retirement)

Table: Minimum full-pension retirement age of Kuwaiti women, by date of birth

Minimum retirement age (women)	Applicable dates or full years	Have to be born on or before
No fixed age	Up to June/06/2004	
41	July/01/2004–Dec/31/2006	Dec/31/1965
42	2007–2009	Dec/31/1967
43	2010–2012	Dec/31/1969
44	2013–2014	Dec/31/1970
45	2015	Dec/31/1970
46	2016	Dec/31/1970
47	2017	Dec/31/1970
48	2018	Dec/31/1970
49	2019	Dec/31/1970
50	2020	Dec/31/1970

Source: PIFSS (2017: 75–76)

Note: The table should be used in combination with a minimum of required years of service, does not apply to women who never married (further on the exceptions, see the source)

Table: Minimum full-pension retirement age of Kuwaiti men, by date of birth

Minimum retirement age (men)	Applicable dates or full years	Have to be born on or before
46	Up to Dec/31/2005	
47	2006–2009	Dec/31/1962
48	2010–2012	Dec/31/1964
49	2013–2014	Dec/31/1965
50	2015	Dec/31/1965
51	2016	Dec/31/1965
52	2017	Dec/31/1965
53	2018	Dec/31/1965
54	2019	Dec/31/1965
55	2020	Dec/31/1965

Source: PIFSS (2017: 75–76)

Note: The table should be used in combination with a minimum of required years of service (for the exceptions, see the source).

Appendix 3: Age ranges that are allowed for registration at the corresponding school grade level

The Ministry of Education allows students to be enrolled in a given grade at various ages. According to decision number (31639) taken on the 17/5/2004, the following table shows the age ranges that are allowed for registration at the corresponding grade level (Registration in Public Schools n.d.).

Educational Level	Grade levels	Age Range
Primary	First	From 6-9 years
	Second	From 7-10 years
	Third	From 8- 11 years
	Fourth	From 9-12 years
	Fifth	From 10-13 years
Intermediate	Sixth	From 11-14 years
	Seventh	From 12-15 years
	Eighth	From 13-16 years
	Ninth	From 14-17 years
High school	Tenth	From 15-18 years
	Eleventh	From 16- 19 years
	Twelfth	From 17-20 years

Appendix 4: 2SLS estimates of private returns to schooling by Gulf War grade and post-war control group

Table: 2SLS estimates of private returns to schooling of women, by Gulf War grade and post-war control group

Grade when likely exposed to the Gulf War shock	Control group						
	Reached school age in 1991/92	Reached school age in 1992/93	Reached school age in 1993/94	Reached school age in 1994/95	Reached school age in 1995/96	Reached school age in 1996/97	Reached school age in 1997/98
1	0.105***	0.0856***	0.0902***	0.0925***	0.0816***	0.0813***	0.0880***
2	0.0983***	0.0855***	0.0880***	0.0889***	0.0792***	0.0784***	0.0838***
3	0.0980***	0.0866***	0.0877***	0.0878***	0.0783***	0.0766***	0.0807***
4	0.0982***	0.0863***	0.0854***	0.0832***	0.0737***	0.0712***	0.0748***
5	0.0890***	0.0799***	0.0798***	0.0785***	0.0705***	0.0686***	0.0718***
6	0.0849***	0.0760***	0.0765***	0.0756***	0.0683***	0.0673***	0.0723***
7	0.0815***	0.0736***	0.0740***	0.0731***	0.0664***	0.0653***	0.0690***
8	0.0778***	0.0696***	0.0694***	0.0678***	0.0625***	0.0619***	0.0663***
9	0.0698***	0.0621***	0.0624***	0.0611***	0.0566***	0.0568***	0.0623***
10	0.0747***	0.0682***	0.0682***	0.0672***	0.0629***	0.0626***	0.0663***
11	0.0727***	0.0670***	0.0671***	0.0662***	0.0622***	0.0620***	0.0654***
12	0.0664***	0.0604***	0.0613***	0.0609***	0.0574***	0.0583***	0.0640***
13	0.0703***	0.0653***	0.0657***	0.0653***	0.0617***	0.0618***	0.0659***
14	0.0644***	0.0598***	0.0607***	0.0606***	0.0578***	0.0587***	0.0639***
15	0.0647***	0.0598***	0.0601***	0.0596***	0.0567***	0.0570***	0.0613***

Notes: Robust standard errors are in parentheses.

Each cell represents the coefficient for "years of schooling" of a separate 2SLS estimation

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table: 2SLS estimates of private returns to schooling of men, by Gulf War grade and post-war control group

Grade when likely exposed to the Gulf War shock	Control group						
	Reached school age in 1991/92	Reached school age in 1992/93	Reached school age in 1993/94	Reached school age in 1994/95	Reached school age in 1995/96	Reached school age in 1996/97	Reached school age in 1997/98
1	0.0838***	0.0883***	0.124***	0.0946***	0.0885***	0.0938***	0.0915***
2	0.0644***	0.0717***	0.0923***	0.0647***	0.0566***	0.0607***	0.0536**
3	0.0820***	0.0827***	0.0994***	0.0743***	0.0650***	0.0657***	0.0526**
4	0.0941***	0.0930***	0.107***	0.0884***	0.0802***	0.0786***	0.0704***
5	0.120***	0.110***	0.131***	0.105***	0.0953***	0.0932***	0.0866***
6	0.101***	0.0947***	0.101***	0.0818***	0.0734***	0.0716***	0.0633***
7	0.0902***	0.0877***	0.0927***	0.0756***	0.0702***	0.0699***	0.0631***
8	0.0829***	0.0799***	0.0795***	0.0641***	0.0589***	0.0596***	0.0546***
9	0.0880***	0.0840***	0.0819***	0.0680***	0.0619***	0.0607***	0.0539***
10	0.0806***	0.0787***	0.0751***	0.0642***	0.0609***	0.0617***	0.0584***
11	0.0804***	0.0782***	0.0740***	0.0650***	0.0614***	0.0607***	0.0562***
12	0.0668***	0.0656***	0.0594***	0.0510***	0.0481***	0.0486***	0.0460***
13	0.0641***	0.0637***	0.0577***	0.0492***	0.0471***	0.0485***	0.0457***
14	0.0638***	0.0637***	0.0580***	0.0503***	0.0482***	0.0497***	0.0481***
15	0.0543***	0.0547***	0.0466***	0.0372***	0.0346***	0.0357***	0.0321***
16	0.0472***	0.0480***	0.0369***	0.0271**	0.0249*	0.0293***	0.0295***
17	0.0384***	0.0401***	0.0305***	0.0220**	0.0207*	0.0239**	0.0248**
18	0.0362***	0.0388***	0.0264**	0.0166	0.0157	0.0207*	0.0241*
19	0.0262*	0.0326**	0.0171	0.00392	0.00411	0.0126	0.0163
20	-0.0192	-0.00378	-0.0723	-0.139	-0.181	-0.131	-0.148

Notes: Robust standard errors are in parentheses.

Each cell represents the coefficient for "years of schooling" of a separate 2SLS estimation

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$